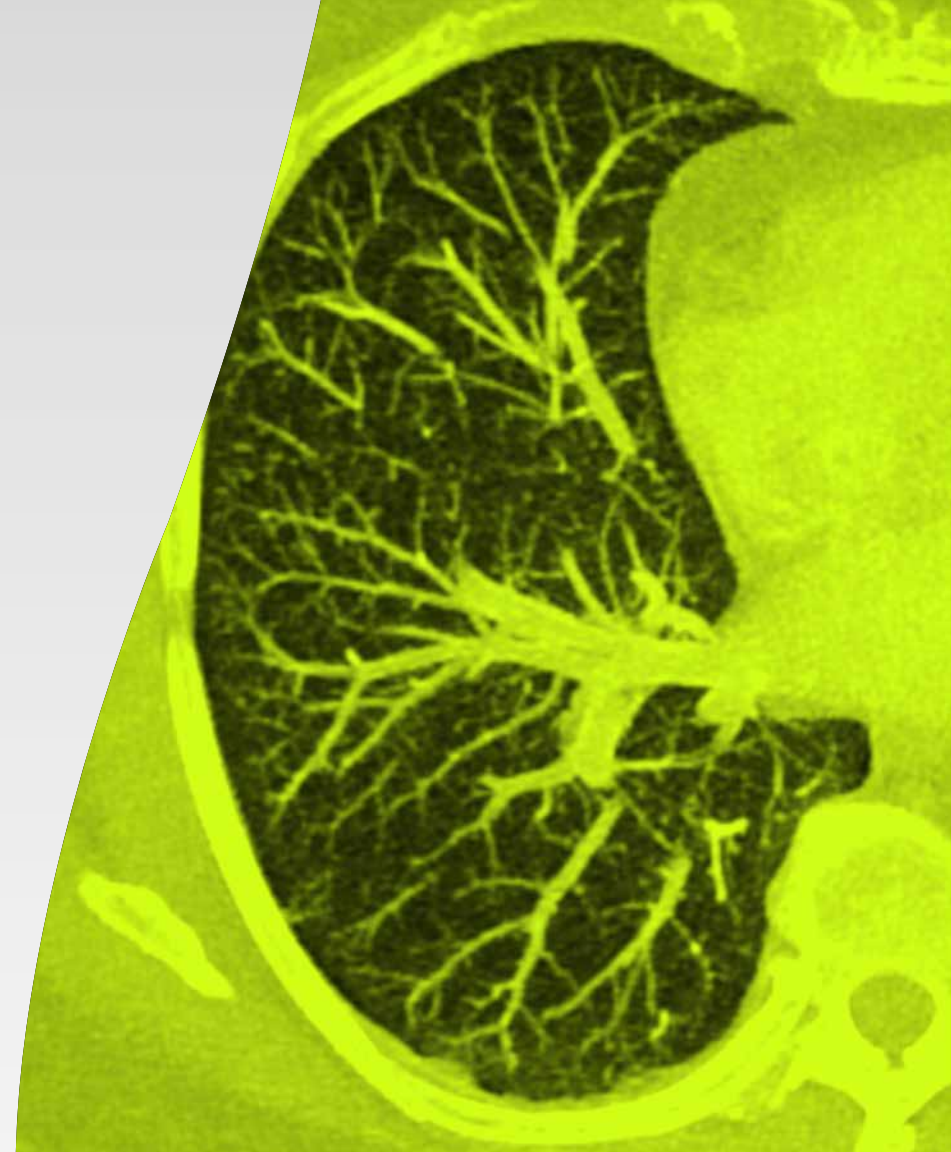


MODERN
RADIOLOGY
eBook

Chest Imaging

ESR EUROPEAN SOCIETY
OF RADIOLOGY

胸部
影像学



/ Preface

Modern Radiology is a free educational resource for radiology published online by the European Society of Radiology (ESR). The title of this second, rebranded version reflects the novel didactic concept of the *ESR eBook* with its unique blend of text, images, and schematics in the form of succinct pages, supplemented by clinical imaging cases, Q&A sections and hyperlinks allowing to switch quickly between the different sections of organ-based and more technical chapters, summaries and references.

Its chapters are based on the contributions of over 100 recognised European experts, referring to both general technical and organ-based clinical imaging topics. The new graphical look showing Asklepios with fashionable glasses, symbolises the combination of classical medical teaching with contemporary style education.

Although the initial version of the *ESR eBook* was created to provide basic knowledge for medical students and teachers of undergraduate courses, it has gradually expanded its scope to include more advanced knowledge for readers who wish to ‘dig deeper’. As a result, *Modern*

Radiology covers also topics of the postgraduate levels of the *European Training Curriculum for Radiology*, thus addressing postgraduate educational needs of residents. In addition, it reflects feedback from medical professionals worldwide who wish to update their knowledge in specific areas of medical imaging and who have already appreciated the depth and clarity of the *ESR eBook* across the basic and more advanced educational levels.

I would like to express my heartfelt thanks to all authors who contributed their time and expertise to this voluntary, non-profit endeavour as well as Carlo Catalano, Andrea Laghi and András Palkó, who had the initial idea to create an *ESR eBook*, and - finally - to the ESR Office for their technical and administrative support.

Modern Radiology embodies a collaborative spirit and unwavering commitment to this fascinating medical discipline which is indispensable for modern patient care. I hope that this *educational* tool may encourage curiosity and critical thinking, contributing to the appreciation of the art and science of radiology across Europe and beyond.

Minerva Becker, Editor
Professor of Radiology, University of Geneva, Switzerland

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CHAPTER OUTLINE:

- Introduction
- Diagnostic Imaging Techniques
- How to Read a Chest X-Ray (CXR)
- The Normal CXR
- The Silhouette Sign
- Soft Tissue Asymmetry on CXRs
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- Pathology of the Hilum
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- Pulmonary Oedema
- Pulmonary Hypertension
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- References
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- 影像诊断技术
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- 剪影征
- CXR 见软组织不对称
- CXR 见医疗装置和其他异物
- CXR 上骨病变
- 胸膜和胸膜腔病变
- 纵隔异常
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- 核心要点
- 参考文献
- 知识测试

/ 前言

《现代放射学》是由欧洲放射学协会 (European Society of Radiology, ESR) 在线发布的免费放射学教育资源。第二版 (更名版) 标题反映了 *ESR 电子书* 新颖的教学概念, 它以简洁页面的形式巧妙地融合文本、图像和示意图, 并辅以临床影像学案例、问答部分和内容超链接, 使读者能够在各基于器官的部分、更具技术性的章节、摘要以及参考文献之间快速切换浏览。

其章节以 100 多名公认欧洲专家的优秀稿件为根基, 涉及各类一般技术和基于器官的临床影像学主题。同时采用了全新的图形外观, 展示了佩戴时尚眼镜的 Asklepios, 象征着传统医学教学与现代风格教育的结合。

虽然初版 *ESR 电子书* 旨在为医学生和本科生教师提供医学基础知识, 但现已逐渐扩充其知识领域, 为希望“深入挖掘”的读者提供了更多高阶技术知识。因此, 《现代放射学》还涵盖了 *欧洲放射学培训* 课程研究生水平的各类主题, 旨在解决住院医师的研究生教育需求。此外, 书中还囊括了全球医疗专业人士的反馈, 他们希望更新自己在医学影像特定领域的知识, 并对 *ESR 电子书* 在基础和高等教育水平上的深度和清晰度表示高度赞赏。

我要衷心感谢所有为这项非营利活动自愿贡献时间和专业知识的作者, 以及最初提出创作 *ESR 电子书* 的 Carlo Catalano、Andrea Laghi 和 András Palkó, 最后还要感谢 ESR 办公室所提供的技术和行政支持。

《现代放射学》充分体现了医者的协作精神和对这门热门医学学科坚定不移的承诺, 这是现代患者护理必须具备的优秀精神品质。我希望这款教育工具能够激励各位始终保持好奇心和批判性思维, 从而促进整个欧洲乃至欧洲以外地区对放射学艺术和科学的认识。

Minerva Becker, 编辑
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/ Chest Imaging.
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/ Chest Imaging.
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/ Translation Credits

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Chest Imaging

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ENDORSED BY:

Chinese Society of Radiology

NOTE FROM THE COORDINATORS:

Thank you to Chinese radiology experts for bridging languages and open the world-class English resource by ESR to every Mandarin-speaking student, fueling global radiology talent with a single click

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/ 翻译致谢

本章节为《现代放射学电子书》的部分译文。

原文标题:

胸部影像学

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审定:

中华医学会放射学分会

译者寄语:

感谢中国放射学专家们的倾力奉献! 你们跨越了语言的鸿沟, 将欧洲放射学会 (ESR) 的世界级学术宝库呈献给广大中文学子。如今, 前沿智慧一键即达, 为全球放射学人才的蓬勃发展注入了强劲动力。

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<=> CORE KNOWLEDGE

<!=> ATTENTION

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<?> QUESTIONS

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<=> 核心知识

<!=> 注意

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>=< 进阶知识

>|< 比较

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<?> 问题

Chest Imaging

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Chest Imaging

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基于 ESR 课程的放射学教育

胸部 影像学

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Chapter Outline

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 - Lateral Projections (Erect and Sitting)
 - AP Projections (Supine and Sitting)
 - Digital Radiography
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- Magnetic Resonance Imaging (MRI)
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章节大纲:	简介	CXR 上骨病变	肺实质异常
简介	影像诊断技术	胸膜和胸膜腔病变	肺腺泡及肺小叶
影像诊断技术	胸部 X 线	胸腔积液	肺部高密度影
如何判读胸部 X 线 (CXR)	站立后前位	气胸	肺泡性高密度影 (实变)
检查结果	侧位 (站立和坐立)	胸膜增厚和斑块	肺炎
正常 CXR	前后位 (仰卧和坐立)	纵隔异常	多灶性及多叶分布
剪影征	数字 X 线摄影	纵隔气肿	影征
CXR 见软组织不对称	前后位和后前位之间的差异	纵隔增宽	蝙蝠翼与反向蝙蝠翼影征
CXR 见医疗装置和其他异物	计算机断层扫描 (CT)	纵隔肿块 (MM)	与磨玻璃影 (GGO)
CXR 上骨病变	超声 (US)	间质性高密度影	表现类型和鉴别诊断
胸膜和胸膜腔病变	磁共振成像 (MRI)	肿块	CXR 见微结节性影征
纵隔异常	正电子发射计算机断层扫描 (PET-CT)	肺门重叠征	CXR 上的网状结节性影
肺门病变	如何判读胸部 X 线 (CXR)	用于 MM 定性检查的 CT	CT 扫描影征
肺实质异常	检查结果	前纵隔肿块 (AMM)	结节性高密度影
肺水肿	组织间的差异: 基本概念	鉴别诊断与影像学征象	孤立性肺结节 (SPN)
肺动脉高压	系统化方法必不可少!	胸膜上皮肿瘤	偶发
核心要点	正常胸部 X 线 (CXR)	生殖细胞肿瘤	肺结节的随访
参考文献	软组织	淋巴瘤	肺癌
知识测试	骨	中纵隔肿块 (MMM)	肺癌 TNM 分期与
	胸膜及胸膜腔	鉴别诊断与影像学征象	多学科肿瘤团队 (MDTB)
	纵隔	小细胞肺癌	肺癌筛查
	心胸比 (CTR)	非小细胞肺癌	多发性肺结节 (MPN)
	分区	裂孔疝	肺不张性高密度影 (萎陷)
	纵隔线条、条纹	后纵隔肿块 (PMM)	影像学征象
	及界面	鉴别诊断与影像学征象	透亮度增强 (过度透亮)
	肺门	降主动脉瘤	肺气肿的定义和类型
	双肺门增大	肺门病变	CT 上的肺气肿
	肺叶及肺段	鉴别诊断与影像学征象	肺水肿
	肺区及肺管系统	结节病	左心衰竭
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/ Introduction

Welcome to the basics of chest imaging!

Understanding the fundamentals of chest imaging is essential for accurately diagnosing a wide range of pulmonary and thoracic conditions. Chest imaging techniques include conventional chest X-rays (CXR), computed tomography (CT), Positron Emission Tomography CT (PET CT), Magnetic Resonance Imaging (MRI) and ultrasonography (US).

CXRs serve as the cornerstone of thoracic imaging, providing a quick and cost-effective assessment of a variety of diseases. When interpreting CXRs, it's crucial to understand the standard radiographic views and to familiarise yourself with the normal chest anatomy. Developing a systematic approach to CXR interpretation will help you identify abnormalities efficiently and communicate findings effectively.

In addition to CXR, CT has become indispensable for evaluating complex thoracic pathology with greater detail and sensitivity. Understanding the basic CT

anatomy and the key CT features of common chest diseases is essential not only for interpreting thoracic CT scans accurately but also for requesting the appropriate imaging investigation as a referring doctor.

The aims of this chapter are

- / to briefly discuss relevant advantages and disadvantages of each imaging technique used to investigate chest pathologies
- / to understand which is the most appropriate imaging investigation in a specific clinical scenario
- / to outline a systematic approach to the interpretation of CXRs
- / to introduce the reader to key CT features of common chest diseases

For didactic reasons, correlation of CXR findings with CT and PET CT findings is provided, whenever appropriate.

As chest pathologies are also discussed in other chapters of the ESR e-book, such as cardiac imaging, emergency radiology, vascular imaging or interventional radiology, you will be referred to the respective chapters, whenever necessary.

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欢迎学习胸部影像学检查基础知识!

了解胸部影像学检查的基本原理对于准确诊断多种肺部和胸部疾病至关重要。胸部影像学检查技术包括常规胸部 X 线检查 (CXR)、计算机断层扫描 (CT)、正电子发射计算机断层扫描 (PET-CT)、磁共振成像 (MRI) 和超声检查 (US)。

CXR 是胸部影像学检查的基石, 可快速、经济地评估多种疾病。判读 CXR 时, 掌握标准投照体位并熟悉正常胸部解剖结构至关重要。建立一套系统的 CXR 判读方法, 有助于高效识别异常表现并有效传递检查结果。

除 CXR 外, CT 也已成为评估复杂胸部病变的重要工具, 其能以更细致、更敏感的方式呈现病变细节。掌握基础胸部

CT 解剖结构及常见胸部疾病的关键 CT 特征, 不仅对准确判读胸部 CT 扫描结果至关重要, 也有助于作为转诊医生开具恰当的影像学检查申请。

本章的目的是

- / 简要探讨用于检查胸部病变的各项影像学技术的相关优缺点
- / 了解在特定临床场景下最适宜的影像学检查方法
- / 概述 CXR 判读的系统化方法
- / 介绍常见胸部疾病的关键 CT 特征

出于教学目的, 在适当情况下会介绍 CXR 检查结果与 CT、PET-CT 检查结果的关联性。

由于胸部病变的相关内容亦在 ESR 电子书的其他章节展开讨论, 例如心脏影像学检查、急诊放射学、血管成像或介入放射学, 必要时将指引读者参考相关章节。

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/ Chest X-Ray (CXR)

Chest X-ray (CXR), a fundamental imaging modality in medical diagnostics, plays a pivotal role in evaluating various thoracic conditions. Its versatility, accessibility and cost-effectiveness contribute to its widespread use in clinical practice.

>|< COMPARE

ADVANTAGES:

One of the primary advantages of CXRs is their ability to provide quick and non-invasive visualisation of the thoracic cavity, including the lungs, heart, ribs and surrounding structures. This imaging technique is invaluable for diagnosing a wide range of respiratory conditions such as pneumonia, tuberculosis, chronic obstructive pulmonary disease (COPD) and lung cancer.

Additionally, CXRs are routinely used in the assessment of cardiac abnormalities, rib fractures and pleural effusions.

CXRs also offer the advantage of being readily available in most healthcare settings. The simplicity and speed of obtaining CXRs allow for rapid evaluation of patients presenting with respiratory symptoms or chest trauma, aiding in timely diagnosis and treatment decisions.

The standard radiographic views of CXRs include the erect posterior-anterior (PA) projection, the erect and sitting lateral projections, the supine and erect anterior-posterior (AP) projections.

The technical aspects of conventional X-ray imaging are described in the respective eBook chapter

DISADVANTAGES:

Despite its numerous advantages, CXRs have limitations. One notable drawback is its lower sensitivity compared to computed tomography (CT) or magnetic resonance imaging (MRI). CXRs may not always detect subtle abnormalities or provide detailed anatomical information, necessitating further evaluation with complementary imaging studies.

Nevertheless, the widespread use of CXRs persists due to their cost-effectiveness, portability and familiarity among healthcare providers. In many clinical scenarios, CXRs serve as the initial imaging modality, guiding further diagnostic workup or treatment plans. Their role as a rapid and accessible tool for assessing thoracic pathology continues to make CXRs a cornerstone of modern medical imaging practice.

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/ 胸部 X 线 (CXR)

胸部 X 线 (CXR) 作为医学诊断中的基础影像学检查手段，在评估各类胸部疾病中发挥着重要作用。其多功能性、可及性和成本效益使其在临床实践中得以广泛应用。

>|< 比较

优点:

CXR 的主要优势之一在于其能够快速、无创地显示胸腔（包括肺、心脏、肋骨及周围结构）的影像。这一影像学技术在诊断肺炎、肺结核、慢性阻塞性肺病（chronic obstructive pulmonary disease, COPD）和肺癌等各种呼吸系统疾病方面具有不可估量的价值。

此外，CXR 还常规用于评估心脏异常、肋骨骨折及胸腔积液。

CXR 还具备一项优势：在大多数医疗机构中的普及度高。其操作简单，出片快，可快速评估出现呼吸系统症状或胸部创伤的患者，有助于及时做出诊断和治疗决策。

缺点:

尽管 CXR 具有诸多优势，但亦存在局限性。其中一项显著局限是其敏感性低于计算机断层扫描 (CT) 或磁共振成像 (MRI)。CXR 不一定能发现细微异常或提供详细的解剖学信息，需通过补充影像学检查进一步评估。

尽管如此，由于成本效益高、便携性强以及在医务人员中的高认知度，CXR 仍将持续广泛应用。在许多临床场景中，CXR 作为初始影像学检查手段，可指导后续诊断性检查或治疗方案的制作。作为评估胸部病变的快速、易获取工具，CXR 已成为现代医学影像学实践的基石。

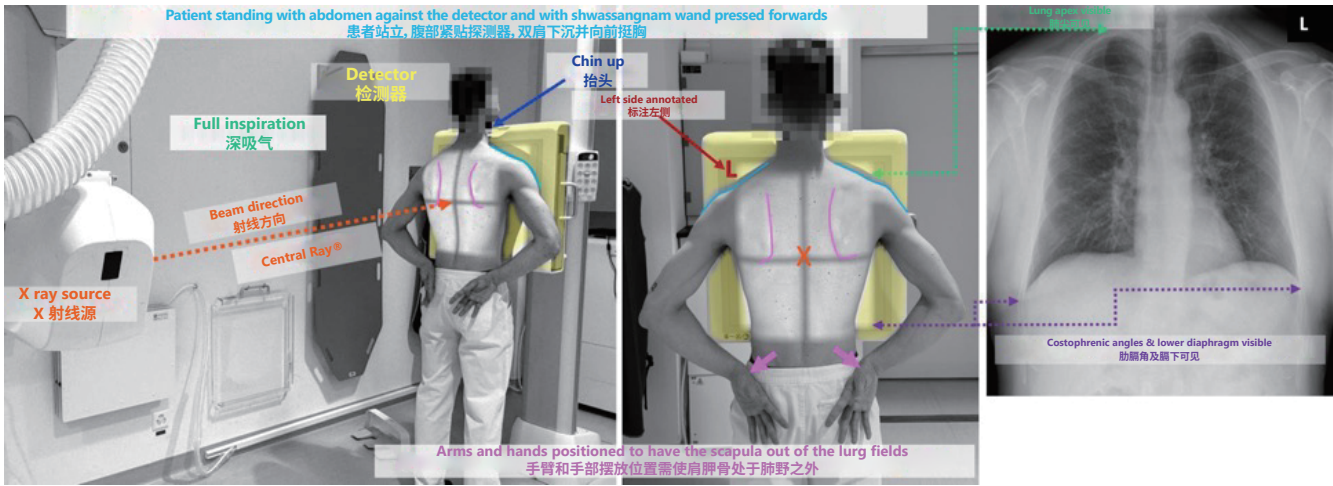
CXR 的标准投照体位包括站立后前位 (PA)、直立和坐立侧位、仰卧位和站立前后位 (AP)。

有关常规 X 线成像技术方面的介绍，请参阅相应电子书章节

/ Erect Posterior-Anterior (PA) Projection

<!=> ATTENTION

- / The PA projection is the standard frontal radiograph acquired with the patient standing.
- / The image is viewed as if looking at the patient face-to-face



*The Central X-ray is perpendicular to the detector and centred on the midline at the level of the inferior scapula borders

** Digital detector or conventional film cassette.

The distance between the X-ray tube and the detector = 1.80m

Many thanks to Davide Cabral, Damien Locarnoni and Adrien Grobet from the Division of Radiology, Geneva University Hospitals for their contributions to creating this figure.

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/ 站立后前位 (PA)

<!=> 注意

- / 后前位投照是患者站立位采集的标准正位摄影。
- / 阅片时视角模拟与患者面对面直视

*中心 X 线垂直于探测器，且中心对准中线，位置与肩胛骨下角水平齐平

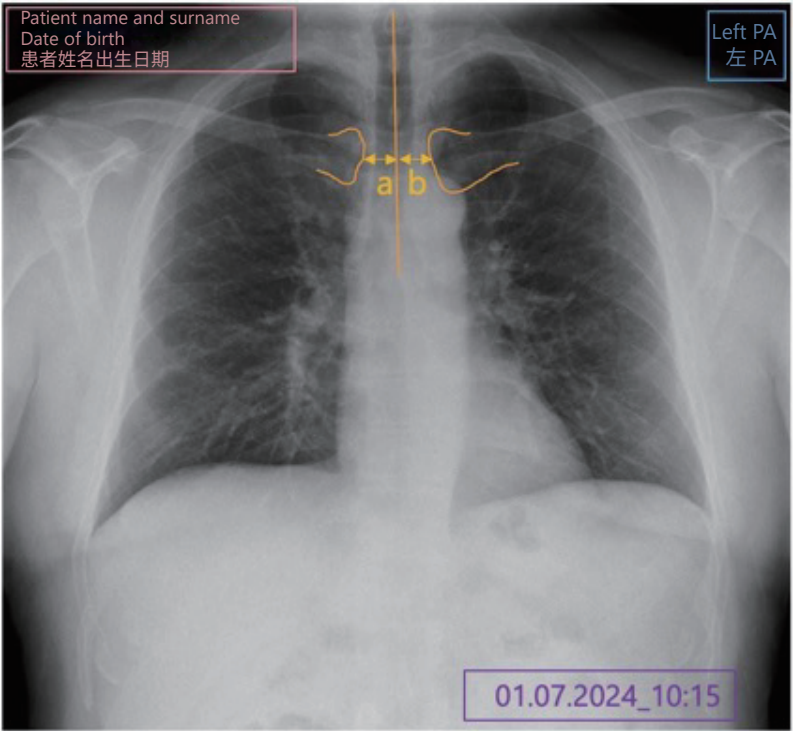
** 数字探测器或传统胶片暗盒。

X 线管与探测器之间的距离 = 1.80 m

非常感谢日内瓦大学医院放射科的 Davide Cabral、Damien Locarnoni 和 Adrien Grobet 对绘制本图的支持。

Technical quality criteria of a CXR PA projection include:

- / The **patient identity (name and date of birth)** are indicated on the image
- / The **date and hour** when the CXR was obtained are indicated
- / The **left side** of the film is indicated and whether this is a **PA projection**
- / The CXR should be in a **strict anterior view (no rotation)** > i.e., the distance between the right medial clavicle and the vertical line through the spinous processes of the dorsal spine (a) should be equal to the distance between the left clavicle border and the vertical line through the spinous processes of the dorsal spine (b).



<!=> ATTENTION

This is important as rotation may cause anatomical distortion and may result in erroneous image interpretation.

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后前位 CXR 的技术质量标准包括:

- / 图像上注明患者身份信息 (姓名和出生日期)
- / 注明该 CXR 的拍摄日期和具体时间
- / 标注出胶片的左侧以及拍摄体位是否为后前位
- / CXR 应呈严格前位 (无旋转) >, 即右侧锁骨内侧缘与通过胸椎棘突的垂直参考线之间的距离 (a) 应等于左侧锁骨边缘至同一垂直参考线的距离 (b)。

<!=> 注意

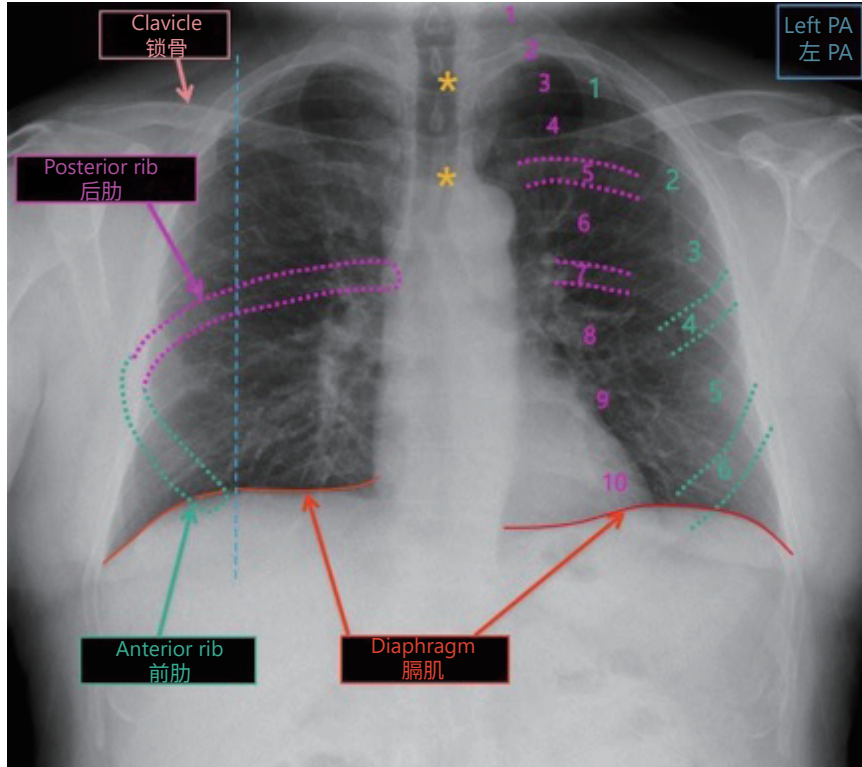
这一点很重要, 因为旋转可能导致解剖结构变形, 并可能引起图像判读错误。

Further technical quality criteria include:

- / The trachea (yellow) is centred
- / Maximum inspiration, i.e., at least 10 posterior ribs (pink) should be visible above the diaphragm (orange) or 5-7 anterior ribs (green) at the mid-clavicular line (blue).

<!=> ATTENTION

- / To correctly count the ribs, note that the posterior rib portions are more horizontally oriented than the anterior ribs!
- / < 5 anterior ribs: insufficient inspiration
- / > 7 anterior ribs: lung hyperinflation



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其他技术质量标准包括:

- / 气管 (黄色) 居中
- / 最大吸气状态, 即膈肌 (橙色) 上方至少可见 10 根后肋 (粉红色), 或锁骨中线 (蓝色) 可见 5-7 根前肋 (绿色)。

<!=> 注意

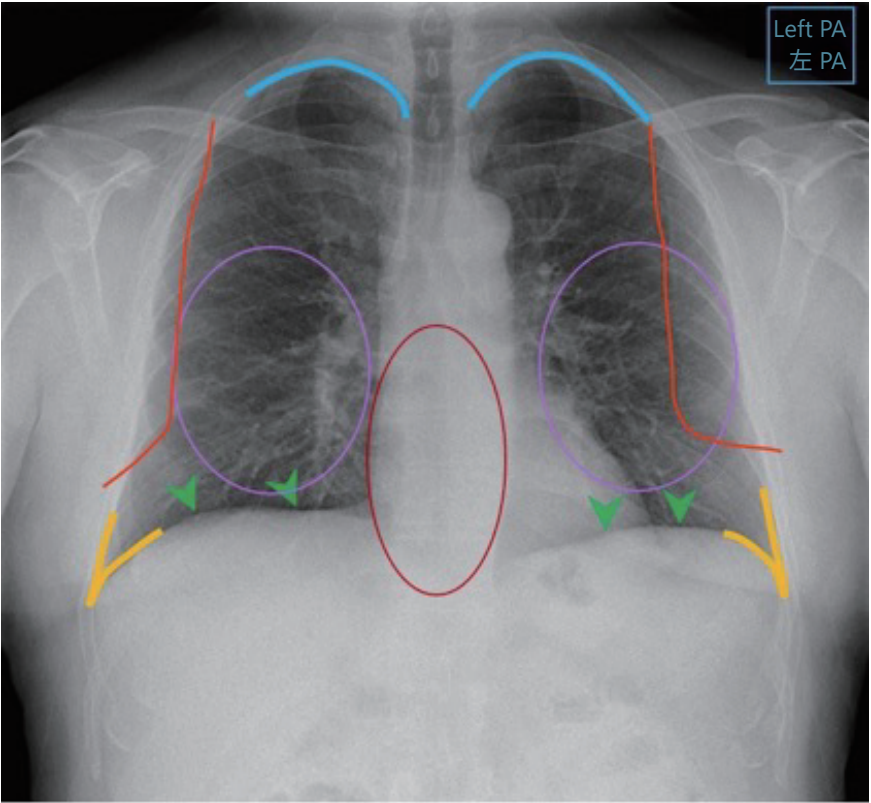
- / 要正确计数肋骨数量, 需注意后肋部分的走行相较于前肋更为水平!
- / 前肋数量 < 5: 吸气不足
- / 前肋数量 > 7: 肺过度充气

Finally, technical quality criteria of a CXR include:

- / The lung domes (blue), the costophrenic angles (yellow) and the diaphragms (green) should be clearly visible
- / Exposure should be such that the thoracic vertebrae (red ellipse) should be slightly visible behind the heart and the lung vessels (purple ellipse) should be clearly seen
- / The scapulae (orange) should be mostly outside the lung fields

<!=> ATTENTION

Before making a diagnostic assessment, the technical quality of a CXR should be evaluated to avoid overdiagnosis.



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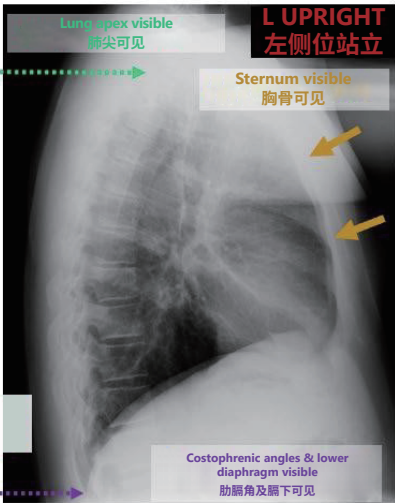
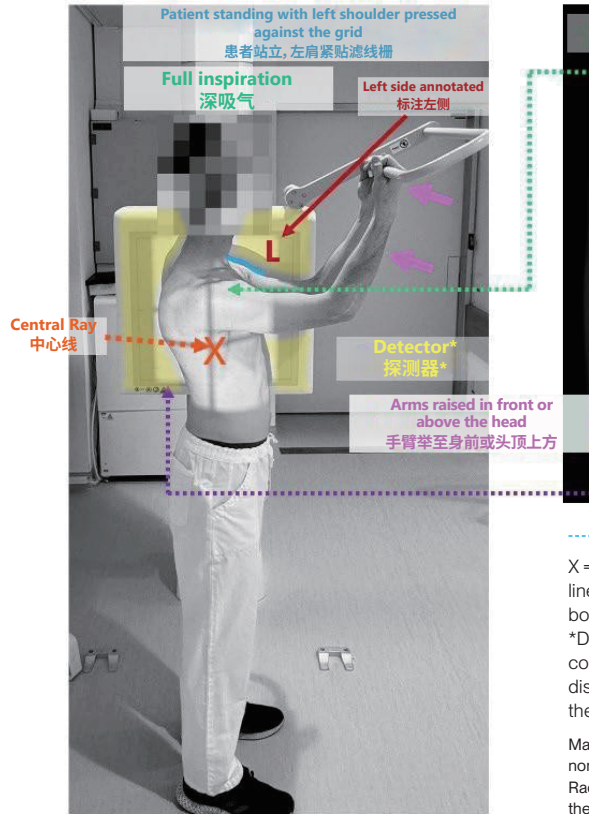
最后, CXR 的技术质量标准还包括:

- / 肺顶 (蓝色)、肋膈角 (黄色) 和膈肌 (绿色) 应清晰可见
- / 曝光条件下胸椎 (红色椭圆形) 在心脏后方轻度可见, 同时肺血管 (紫色椭圆形) 应清晰可见
- / 肩胛骨 (橙色) 应大部分位于肺野外

<!=> 注意

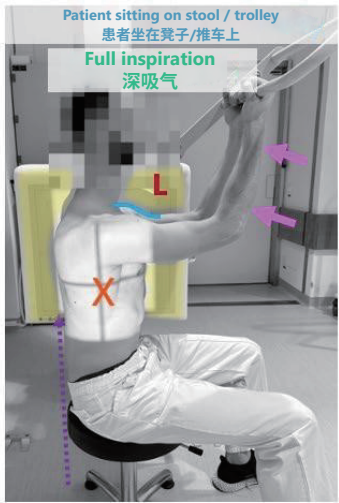
在进行诊断评估之前, 应先评估 CXR 的技术质量以避免过度诊断。

/ Lateral Projections (Erect and Sitting)



X = central ray targeting the midaxillary line at the level of the lower scapula border
*Digital detector technology or conventional X-ray cassette. The distance between the X-ray tube and the detector = 1.80m

Many thanks to Davide Cabral, Damien Locarnoni and Adrien Grobet from the Division of Radiology, Geneva University Hospitals for their contributions to creating this figure.



<!=> ATTENTION

The left lateral projection (annotated with “L”) is the standard lateral chest projection. The image is viewed as if looking at the patient in profile.

If a right lateral projection is used, it is annotated with “R” for the right side (labelling with the side closest to the detector)

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X = 在肩胛骨下缘水平对准腋中线的中心线

*数字检测器技术或传统 X 线暗盒。X 线管与探测器之间的距离 = 1.80 m

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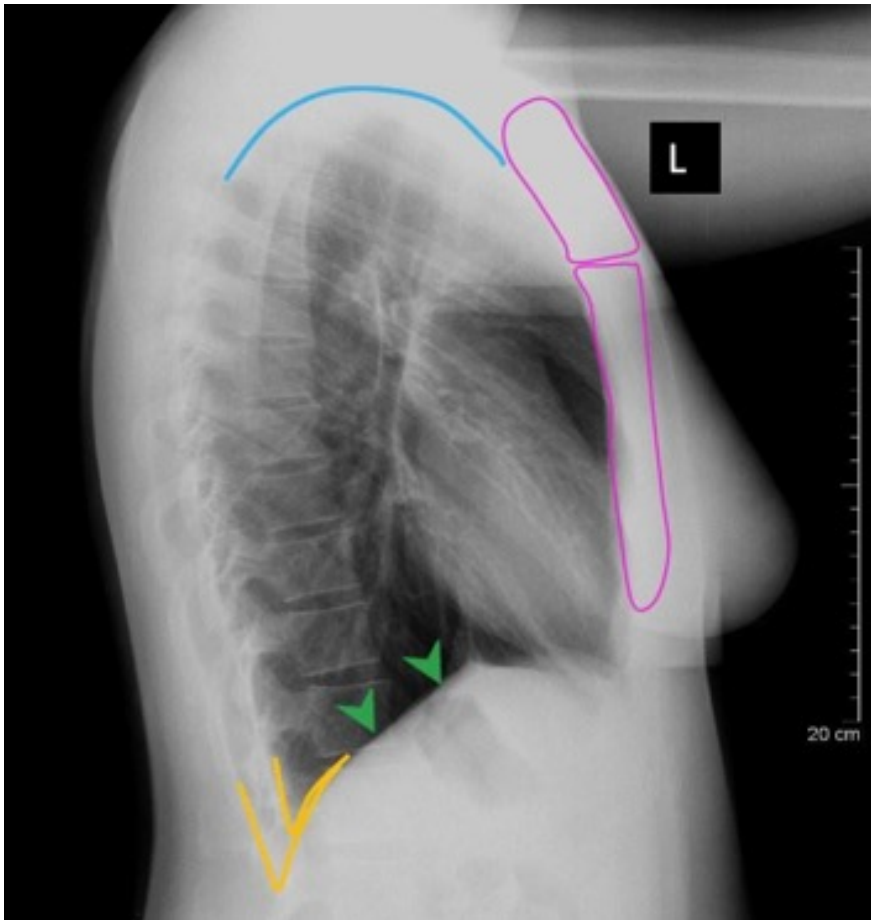
<!=> 注意

左侧位 (标为 “L”) 是标准的胸部侧位投照体位。阅片时视角模拟从患者侧面直视

若采用右侧位, 则以 “R” 标注右侧 (标注原则为靠近探测器的一侧)。

The technical quality criteria of a lateral CXR include:

- / The lung apices (blue), the costophrenic angles (yellow) and the diaphragms (green) should be clearly visible
- / The sternum (pink) should be seen



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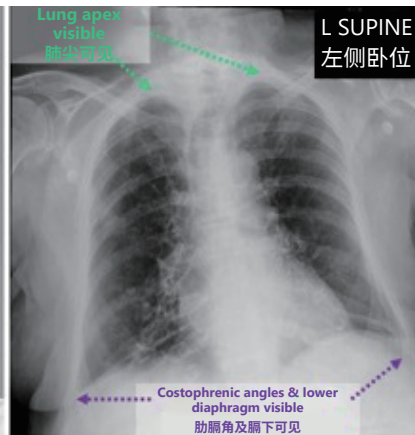
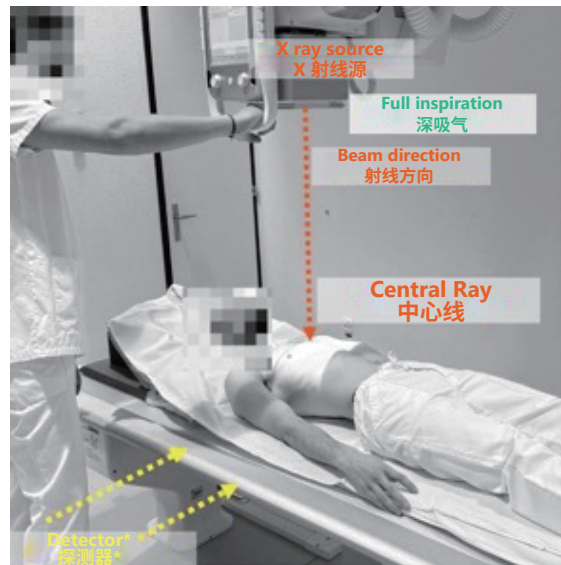
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侧位 CXR 的技术质量标准包括:

- / 肺顶 (蓝色)、肋膈角 (黄色) 和膈肌 (绿色) 应清晰可见
- / 胸骨 (粉红色) 应可见

/ Anterior-Posterior (AP) Projections (Supine and Sitting)



<!=> ATTENTION

The AP supine and the AP erect (in bed or on a stool) projections are used when the patient is too unwell to stand or to sit or when the patient cannot leave the hospital room (isolation). The image is viewed as if looking at the patient face-to-face.

*Digital detector technology or conventional X-ray cassette. The distance between the X-ray tube and the detector should be ideally 1.80m. However, this is not always possible due to ceiling height. Therefore, 1.50m is sometimes used.

Many thanks to Davide Cabral, Damien Locarnoni and Adrien Grobet from the Division of Radiology, Geneva University Hospitals for their contributions to creating this figure.

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/ 前后位 (AP) (仰卧和坐立)

当患者病情过重无法站立或坐立，或因隔离等原因无法离开病房时，需采用仰卧前后位和直立前后位（患者可卧床或坐于凳上）。阅片时视角模拟与患者面对面直视。

<!=> 注意

*数字探测器技术或传统 X 线暗盒。理想情况下，X 线管与探测器之间的距离应为 1.80 m。但受限于天花板高度，不一定能达到这一距离。因此，有时会使用 1.50 m 的距离。

非常感谢日内瓦大学医院放射科的 Davide Cabral、Damien Locarnoni 和 Adrien Grobet 对绘制本图的支持。

/ Digital Radiography

ADVANTAGES:

- Digital CXR offers numerous advantages over traditional film-based CXR. In this technique, X-ray images are captured electronically and viewed on computer screens, eliminating the need for physical film processing.
- This digital approach presents several key benefits:
- + enhanced image quality and clarity compared to conventional CXR

+ the digital format allows for manipulation of image contrast, brightness and zoom levels, enabling better visualisation and interpretation of subtle abnormalities

+ lower radiation doses than film-based counterparts, reducing patients' exposure to ionising radiation - this is particularly advantageous for paediatric and pregnant patients, as well as those requiring frequent X-ray examinations

+ ease of storage and transmission. Digital images are stored electronically in picture archiving

and communication systems (PACS), facilitating quick retrieval and comparison with previous studies.

+ dgital CXRs can be easily shared with referring physicians or specialists for consultation or further evaluation

+ digital CXRs streamline workflow and increase efficiency in radiology departments

+ no need for film processing or darkroom facilities, saving time and resources

+ images can be acquired, processed and interpreted rapidly, leading to faster diagnosis and treatment decisions

In terms of clinical use, digital CXRs are invaluable for diagnosing a wide range of thoracic conditions, as described in this eBook chapter. They are also commonly employed in preoperative evaluations, postoperative monitoring and routine health screenings.

While initial costs and maintenance requirements may present challenges, the numerous advantages (superior image quality, reduced radiation exposure, enhanced workflow efficiency and seamless data management compared to traditional film radiography) make digital CXRs indispensable in modern medical practice.

>|< COMPARE

DISADVANTAGES:

- Despite these advantages, digital radiography has certain limitations:
- initial cost of implementing digital radiography systems can be substantial compared to traditional film-based equipment

- digital systems require regular maintenance and upgrades to ensure optimal performance, adding to overall operational expenses

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/ 数字 X 线摄影

优点:

- 数字 CXR 相较于传统胶片 CXR 具有诸多优势。该技术通过电子方式采集 X 线图像并在计算机屏幕上显示，彻底摒弃了物理胶片的冲洗流程。
- 这种数字化手段带来了几项关键优势：
- + 图像质量和清晰度优于传统 CXR

+ 数字格式支持对图像对比度、亮度及缩放级别进行调节，有助于更精准地观察和判读细微异常

+ 与胶片成像技术相比，辐射剂量更低，减少了患者的电离辐射暴露 - 这对于儿童、孕妇以及需要频繁进行 X 线检查的患者尤为有利

+ 易于存储和传输。数字图像以电子形式存储于影像归档
- 和通信系统 (PACS) 中，便于快速调阅并与既往检查进行对比。

+ 数字 CXR 可轻松实现与转诊医生或专科医师共享，便于会诊或进一步评估使用

+ 数字化 CXR 简化了放射科的工作流程并提高了效率

+ 无需胶片冲洗或暗室设施，可节省时间和资源

+ 可快速完成图像的采集、处理和判读，从而加速诊断与治疗决策的制定

缺点:

- 尽管有诸多优势，数字 X 线摄影仍存在一定局限性：
- 相较于传统胶片设备，数字 X 线摄影系统的初始投入成本较高

- 数字系统需定期维护与升级以确保理想性能，这会增加整体运营成本

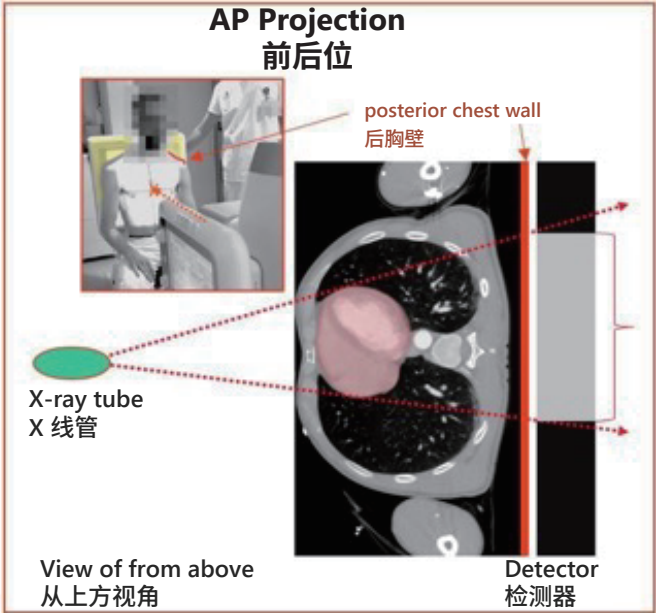
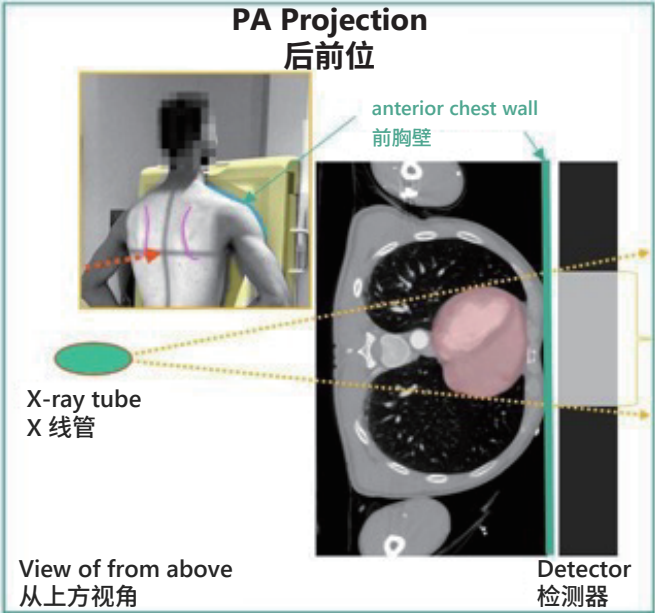
在临床应用层面，数字 CXR 对多种胸部疾病的诊断具有重要价值（详见本电子书章节阐述），同时也广泛应用于术前评估、术后监测及常规健康筛查。

尽管初始成本与维护需求可能构成挑战，但数字 CXR 的诸多优势（与传统的胶片摄影相比，图像质量优异、辐射暴露减少、工作流程效率提高和数据管理无缝），使其在现代医疗实践中不可或缺。

>|< 比较

/ Difference between PA and AP Projections

>|< COMPARE



<|> ATTENTION

For the **chest PA** projection, the detector is close to the **anterior (green)** chest wall, therefore, closer to the heart.

For the **chest AP** projection, the detector is close to the **posterior (red)** chest wall, therefore, farther away from the heart.

Due to X-ray beam divergence, the heart appears **larger** on the AP CXR projection compared to the PA projection. The larger heart size on the AP CXR should not be misinterpreted as pathology.

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<|> 注意

在胸部后前位 (PA) 投照中, 探测器贴近前 (绿色) 胸壁, 因此更靠近心脏。

在胸部前后位 (AP) 投照中, 探测器贴近后 (红色) 胸壁, 因此距离心脏更远。

由于 X 线束发散, 与后前位投照相比, 前后位 CXR 上心脏看起来更大。前后位 CXR 上显示的心脏较大不应误认为病变。

/ Computed Tomography (CT)

Standard CT chest protocols involve intravenous contrast injection and the CT acquisition is started after approximately 20 seconds to visualise arterial structures. Images with **soft tissue (mediastinal, A), bone (B) and lung window (C)** settings, as well as 2D reconstructions in the **coronal (D) and sagittal (E)** planes are obtained routinely.

Variations include CT angiography (CTA), CT pulmonary angiogram (CTPA), high-resolution CT (HRCT) with thin sections (continuous 1 - 1.5 mm slices) for detailed lung parenchyma evaluation and low dose CT (LD CT) with thin sections.

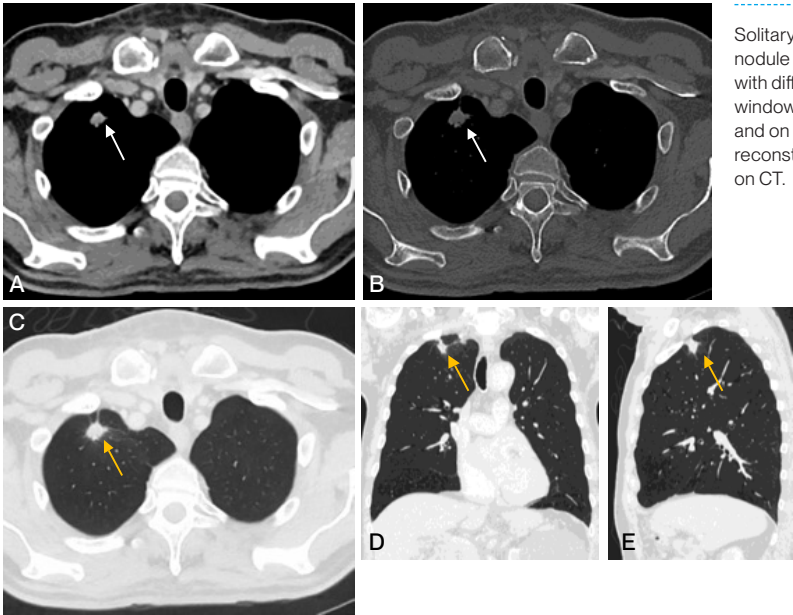
Indications range from assessing masses, nodules and lung cancer staging to diagnosing vascular and pleural diseases and emergencies like chest trauma or pulmonary embolism.

While chest CT offers quick access and detailed anatomical information, it comes with radiation exposure and some limitations in vascular assessment.

The technical aspects, advantages and disadvantages of CT are described in detail in the eBook chapter on CT. For CTA and CPA > see eBook chapter on Vascular Imaging

<!=> ATTENTION

When performing a CT of the chest, it is of utmost importance to tailor the examination to the specific questions asked by the referring physician. Therefore, the appropriate clinical information is a must, especially regarding the timing of intravenous contrast delivery, e.g., the CT imaging protocol will be different in suspected lung embolism versus staging of lung cancer.



Solitary lung nodule as seen with different window settings and on 2D reconstructions on CT.

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/ 计算机断层扫描 (CT)

标准胸部 CT 方案需静脉注射对比剂, 并在约 20 s 后开始采集 CT 图像, 以显示动脉结构。常规获取软组织窗 (纵隔窗, A)、骨窗 (B) 和肺窗 (C) 的图像, 以及冠状位 (D) 和矢状位 (E) 的 2D 重建图像。

其变体包括 CT 血管成像 (CTA)、肺动脉 CT 血管成像 (CTPA)、采用薄层扫描 (连续 1-1.5 mm 层厚) 的高分辨率 CT (HRCT) (用于详细评估肺实质), 以及薄层低剂量 CT (LD CT)。

适应证范围涵盖肿块、结节的评估, 肺癌分期, 以及血管及胸膜疾病的诊断, 还可用于胸部创伤、肺栓塞等急症的诊治。

虽然胸部 CT 能快速提供详细解剖信息, 但其存在辐射暴露风险, 且在血管评估方面具有一定局限性。

CT 的技术细节、优缺点在有关 CT 的电子章节中有详细描述。有关 CTA 和 CPA 的内容>, 请参阅《血管成像》电子章节

<!=> 注意

进行胸部 CT 检查时, 根据转诊医生提出的具体问题制定检查方案至关重要。因此, 必须获取充分的临床信息, 尤其是静脉对比剂注射的时机 (例如, 疑似肺栓塞与肺癌分期的 CT 成像方案会有所不同)。

通过不同窗口设置及 CT 2D 重建观察到的孤立性肺结节。

/ Ultrasonography (US)

The technical aspects of US are described in the eBook chapter on US.

Ultrasound (US) imaging has emerged as an additional, valuable, non- irradiating tool to evaluate chest pathology.

The main indications for chest ultrasound include:

- / detection and quantification of pleural effusions, guidance of thoracentesis and evaluation of loculated collections
- / diagnosing pneumothorax, particularly in critically ill patients
- / detecting pneumonia and providing monitoring
- / aiding in biopsy guidance of peripherally located chest masses

Contraindications of US are related to patient comfort and cooperation.

US may be limited in obese individuals or those with massive subcutaneous emphysema.

<!=> ATTENTION

US is particularly beneficial when immediate assessment is needed, such as in emergency settings or when radiation exposure is a concern (pregnant women or children). Its portability allows bedside evaluation, making it invaluable in critical care settings.

Diagnostic US performance varies depending on the pathology being evaluated. For pleural effusions and pneumonia, US has high sensitivity and specificity. In diagnosing pneumothorax, the reported sensitivity is variable as it depends on pneumothorax size, however, the specificity is high.



Right pleural effusion detected on US imaging.

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Abid I, Qureshi N, Lategan N, Williams S, Shahid S. Point-of-care lung ultrasound in detecting pneumonia: A systematic review. Can J Respir Ther. 2024 Jan 29;60:37-48. doi: 10.29390/001c.92182. PMID: 38299193; PMC10830142.

Jahanshir, A., Moghari, S.M., Ahmadi, A. et al. Value of point-of-care ultrasonography compared with computed tomography scan in detecting potential life-threatening conditions in blunt chest trauma patients. Ultrasound J 12, 36 (2020). <https://doi.org/10.1186/s13089-020-00183-6>

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/ 超声 (US)

US 的技术细节参见《超声检查》电子书章节。

超声 (US) 成像已成为评价胸部病变的另一种有价值的非辐照工具。

胸部超声的主要适应证包括:

- / 检测和量化胸腔积液、引导胸腔穿刺术以及评估包裹性积液
- / 诊断气胸，尤其是危重症患者
- / 检测肺炎并提供病情监测
- / 辅助胸部外周肿块的活检引导

US 的禁忌证主要与患者舒适度及配合度相关。

对于肥胖患者或存在大面积皮下气肿者，US 的效果可能受限。

US 诊断的效能因所评估的病变类型而异。针对胸腔积液和肺炎，US 具有较高的敏感性和特异性。在气胸诊断中的敏感性因气胸量而异，但其特异性较高。

<!=> 注意

当需要即时评估（如急诊场景）或需关注辐射暴露风险（如孕妇或儿童）时，US 尤为适用。其便携性支持床旁评估，在重症监护场景中具有不可替代的价值。

US 成像检测到右侧胸腔积液。

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/ Magnetic Resonance Imaging (MRI)

The MRI technique, its advantages and disadvantages are described in the eBook chapter on MRI.

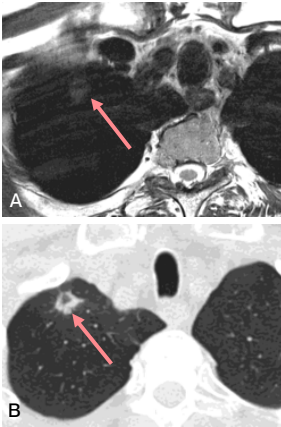
For the indications and utility of MRI in the assessment of cardiac pathology > see eBook chapter on Cardiac Imaging.

While CT scans are pivotal in noncardiac chest imaging, MRI is an equivalent or even superior alternative to CT in the following situations:

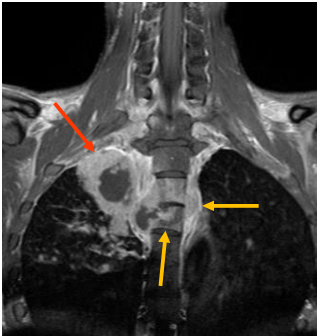
- / assessing the lung apices, diaphragm, spinal column and pleural pathology
- / characterising masses, which cannot be adequately characterised with CT, e.g., some cystic masses
- / determining neoplastic chest wall invasion and identifying blood vessel or mediastinal invasion
- / detecting metastatic invasion of bone marrow
- / providing functional data to improve treatment response evaluation in cancer

>|< COMPARE

- + MRI offers notable advantages > excellent tissue contrast, multiplanar imaging capability, sensitivity to blood flow and the absence of ionising radiation. Its radiation-free nature makes it particularly suitable for paediatric and pregnant patients, as well as those requiring ongoing monitoring.
- However, MRI is limited by signal loss from lung motion and lack of protons in the lung and magnetic field inhomogeneity due to air-tissue interfaces.



Follow-up MRI obtained in a patient with head and neck squamous cell carcinoma (HN SCC). A right upper lobe nodule was seen on the T2W sequence (A). CT (B) confirmed the presence of a solitary lung nodule. Biopsy revealed lung metastasis from HN SCC.



Spinal tuberculosis with a large apical empyema in a different patient. Contrast-enhanced T1W MR image reveals a large spinal and paraspinal mass with osseous destruction (yellow) extending into the right lung apex (red).

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/ 磁共振成像 (MRI)

MRI 的技术细节及其优缺点参见有关 MRI 的电子书章节。

关于 MRI 在心脏病理评估中的适应证与应用价值, > 请参阅《心脏影像学检查》电子书章节。

尽管 CT 扫描在非心脏胸部影像学检查中占据关键地位, 但在以下场景中, MRI 可作为 CT 的等效甚至更优替代方案:

- / 评估肺尖、膈肌、脊柱及胸膜病变
- / 对 CT 难以充分定性的肿块进行鉴别 (如部分囊性肿块)
- / 判断肿瘤性胸壁浸润, 并识别血管或纵隔浸润
- / 检测骨髓转移性浸润
- / 提供功能数据以优化肿瘤疗效评估

>|< 比较

- + MRI 优势显著 > 出色的组织对比度、多平面成像能力、对流动血液的敏感性及无电离辐射。由于没有电离辐射, 这项技术尤其适用于儿童、孕妇及需要长期随访监测的患者。
- 然而, MRI 的应用受到肺运动引起的信号丢失, 肺组织质子缺乏以及肺内空气/组织界面导致的磁场不均匀性的限制。

某头颈部鳞状细胞癌 (HN SCC) 患者的随访 MRI。T2W 序列 (A) 见右肺上叶结节。CT (B) 确认孤立性肺结节存在。活检证实 HN SCC 肺转移。

某脊柱结核伴肺炎巨大脓肿患者。对比增强 T1W MR 影像显示脊柱及椎旁巨大肿块伴骨破坏 (黄色), 病变向右侧肺尖延伸 (红色)。

<=> 参考文献

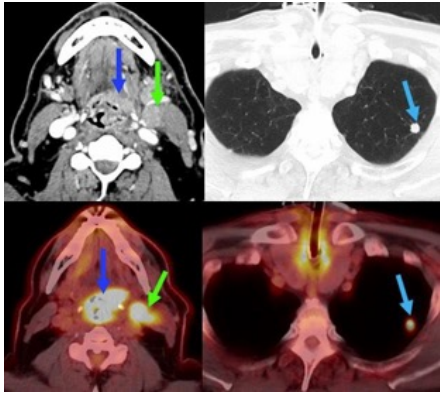
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/ Positron Emission Tomography CT (PET CT)

The PET CT technique, its advantages and disadvantages are described in the eBook chapter on nuclear imaging.

PET CT plays an important role in the diagnosis, staging and monitoring of tumours in the chest, including lung cancer, oesophageal cancer and lymphomas.



FDG PET CT images of a patient with a histologically proven **primary adenocarcinoma of the lung (light blue)** and a synchronous **primary squamous cell carcinoma of the oropharynx (dark blue)** with **ipsilateral lymph node metastasis (green)**. There were no other metastatic lymph nodes nor distant metastases.

>|< COMPARE

- + One significant advantage of PET CT is its ability to detect metabolic changes associated with malignancy at an early stage, sometimes before structural changes are evident on CT scans. In selected cases, PET CT may be superior to contrast enhanced CT for the delineation of tumours associated with post- obstructive extensive atelectasis. Although PET CT is of limited value for the T classification of lung cancer, it increases the diagnostic accuracy for the N and M classification. Compared to standalone CT, PET CT offers superior sensitivity and specificity for detecting extra-thoracic metastatic disease, especially osseous and adrenal lesions. Additionally, PET CT can help differentiate between benign and malignant lesions, reducing the incidence of false positives and unnecessary invasive procedures. PET CT also allows detection of occult primary tumours and second primary cancers, guiding treatment decisions and facilitating therapeutic approaches. Moreover, PET CT is valuable for monitoring treatment response and detecting disease recurrence, allowing clinicians to adapt treatment strategies accordingly. Its ability to assess both the extent of disease and its metabolic activity provides valuable prognostic information, aiding in patient management and improving outcomes.
- However, PET CT has some limitations, such as its relatively high cost compared to other imaging modalities, which may limit its accessibility in some healthcare settings. Additionally, PET CT involves exposure to ionising radiation, although advances in technology have reduced radiation doses while maintaining image quality.

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/ 正电子发射计算机断层扫描 (PET-CT)

PET-CT 的技术细节及其优缺点参见有关核成像的电子书章节。

PET-CT 在胸部肿瘤（包括肺癌、食管癌和淋巴瘤）的诊断、分期和监测中发挥着重要作用。

>|< 比较

- + PET-CT 的一项显著优势在于它能够早期检测与恶性肿瘤相关的代谢改变，有时甚至早于 CT 扫描显示结构改变。在特定病例中，对于阻塞性广泛肺不张相关肿瘤的勾勒，PET-CT 的准确性可能优于对比增强 CT。尽管 PET-CT 对肺癌 T 分期的判断价值有限，但其可提高 N 分期及 M 分期的诊断准确性。相较于单独 CT 检查，PET-CT 在检测胸外转移性疾病（尤其是骨及肾上腺病变）时具有更高的敏感性 & 特异性。此外，PET-CT 有助于鉴别良性 & 恶性病变，降低假阳性率及不必要的侵入性操作。PET-CT 还可检出隐匿性原发肿瘤及第二原发癌，指导治疗决策并优化治疗方案。此外，PET-CT 对监测治疗反应及检测疾病复发具有重要价值，有助于临床医生及时调整治疗策略。其评估疾病程度及代谢活性的能力可提供重要预后信息，辅助患者管理并改善结局。
- 然而，PET-CT 也存在一定局限性，例如相较于其他影像学检查手段，其费用相对较高，可能限制其在部分医疗机构的可及性。此外，PET-CT 涉及电离辐射暴露，尽管技术进步已在维持图像质量的同时降低了辐射剂量。

一名经组织学证实为原发性肺腺癌（浅蓝色）合并同期发生的原发性口咽鳞状细胞癌（深蓝色）伴同侧淋巴结转移（绿色）患者的 FDG PET-CT 图像。显示无其他转移淋巴结及远处转移灶。

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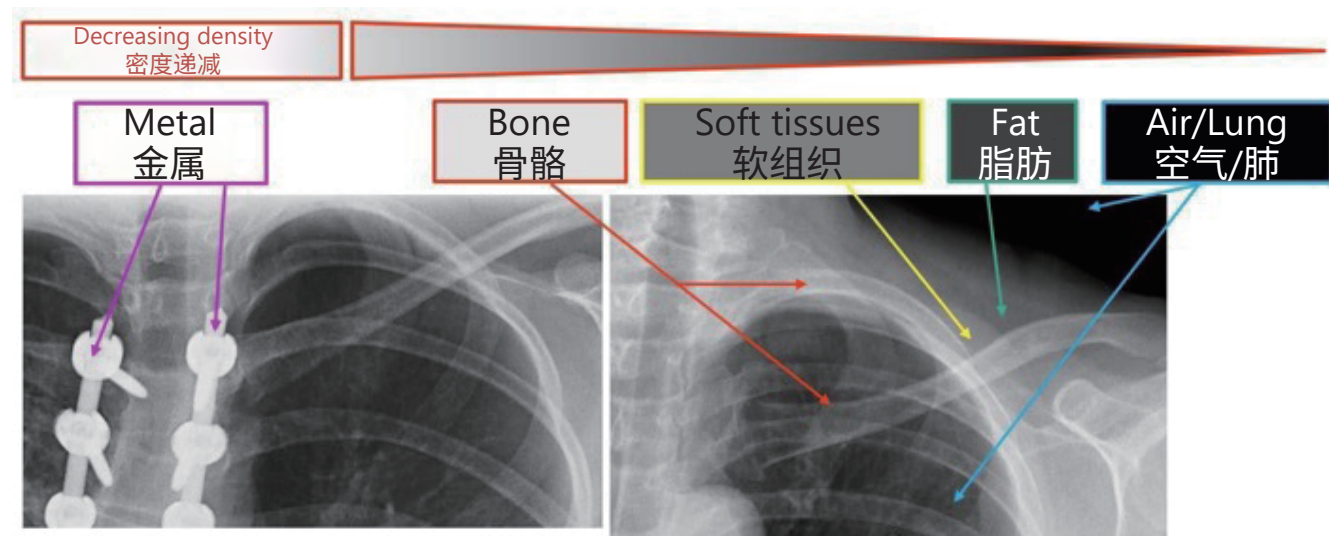
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/ Difference between Tissues: Basic Concepts

The amount of X-ray absorption by tissues depends on their atomic number (Z). It rises with the 3rd power of Z. The absorbed amount defines the density of tissues on an X-ray images

> see eBook chapter on Conventional X-Ray Imaging!

The denser the tissue, the more X-rays are attenuated. Because calcium has a high atomic number, it absorbs X-rays most; therefore, bone appears "whitish" while air appears as "black" areas. Soft tissues, water and fat appear in different shades of grey. As metals have even higher Z, they appear as "white" areas on conventional X-rays.



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组织对 X 线的吸收量取决于其原子序数 (Z)。吸收量与 Z 的 3 次方成正比, 决定了 X 线影像中的组织密度

> 请参阅《常规 X 线成像》电子书章节!

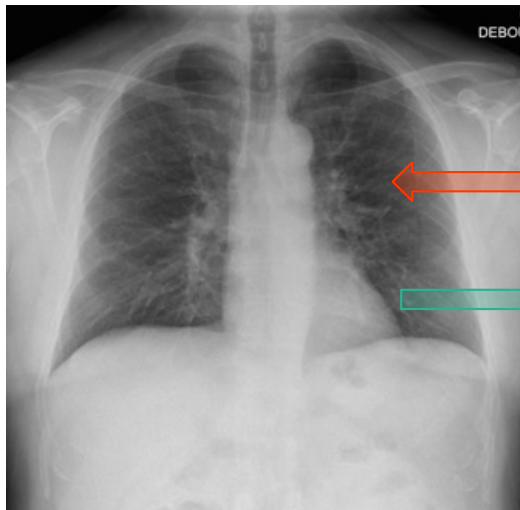
组织密度越高, X 线衰减越多。由于钙元素的原子序数较高, 吸收 X 线最多; 因此图像中骨骼呈现“白色”, 而空气则表现为“黑色”区域。软组织、水和脂肪呈现深浅不一的灰色。由于金属元素的 Z 更高, 在常规 X 线图像中会呈现更为鲜明的“白色”区域。

/ A Systematic Approach Is a Must!

There are many different ways to read a CXR, e.g., following the ABCDEFGHI approach (mnemonic chest radiograph assessment mainly used in the English literature):

- / Airway
- / Bone & soft tissue
- / Cardiac
- / Diaphragm
- / Effusion
- / Fields, fissures, foreign bodies
- / Great vessels
- / Hila & lung
- / Impression

Alternatively, a CXR can be read from the **periphery of the CXR image to the centre (red)** (i.e., starting with the soft tissues of the chest wall and bones and then continuing with the pleural spaces, lung contours (mediastinal margins, diaphragm), lungs and pulmonary blood vessels, hila, mediastinum and ending with the heart). Vice-versa a CXR can be read from the **centre of the image to its periphery (green)**.



<!=> ATTENTION

Independently on how a CXR image is read, one should follow a logical or easy to remember approach. All anatomic structures should be evaluated and the same reading sequence should be followed to avoid missing out lesions! A checklist approach is very useful for the detection of relevant findings. It is advisable to begin with the technical image quality.

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CXR 的阅片方法多种多样,例如遵循 ABCDEFGHI 法(一种英文文献中主要采用的胸片阅片记忆法):

- / 气道
- / 骨骼和软组织
- / 心脏
- / 膈肌
- / 积液
- / 肺野、叶间裂与异物
- / 大血管
- / 肺门与肺
- / 印象总结

或者,可从 **CXR 图像的周边向中心(红色)**展开阅片,即首先观察胸壁软组织与骨骼,继而评估胸膜腔、肺轮廓(包括纵隔边缘、膈肌)、肺及肺内血管、肺门、纵隔,最终观察心脏。反之,亦可从 CXR 图像的中心向周边(绿色)展开阅片。

<!=> 注意

无论对 CXR 图像采用何种阅片方式,均需遵循逻辑清晰或易于记忆的流程。需系统评估所有解剖结构,并保持固定的阅片顺序,以避免漏诊病变!清单式检查法对发现关键异常具有重要价值。建议首先评估检查技术的图像质量。

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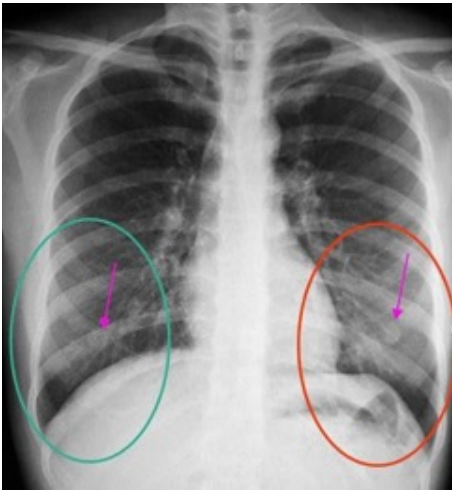
/ Soft Tissues

In general, the soft tissues of the chest wall, breasts and neck tend to be symmetric. However, some degree of breast asymmetry is very common. As breast tissue can obscure parts of the lungs, asymmetry of lung zones should not be mistaken for underlying lung pathology.

The nipples can sometimes be seen on the PA CXR and they should not be confounded with lung



PA CXR with symmetric soft tissues.



PA CXR with asymmetric soft tissues. The left lower lung zone (red circle) appears denser than the right lower lung (green circle) zone because of asymmetric breast tissue. Nipple projections (pink arrows).

nodules. Metallic nipple markers can be used to indicate the nipple position. This allows to distinguish a nipple shadow from a lung nodule on a CXR.

The normal fat planes between the muscles of the chest wall and the neck are smooth.



Close-up of a PA CXR shows the normal fat planes (arrows), which are less dense than muscles.

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/ 软组织

一般而言, 胸壁、乳房及颈部的软组织倾向于对称分布。然而, 一定程度的乳房不对称极为常见。由于乳腺组织可能遮挡部分肺组织, 因此肺区的不对称不应被误认为潜在的肺部病变。

后前位 CXR 有时可见乳头, 其不应与肺结节相混淆。金属乳头标记物可用于标记乳头位置。这有助于在 CXR 上区分乳头阴影与肺结节。

胸壁与颈部肌肉间的正常脂肪间隙表现为光滑。

软组织对称的后前位 CXR。

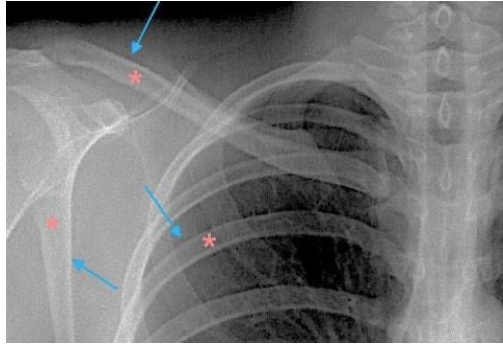
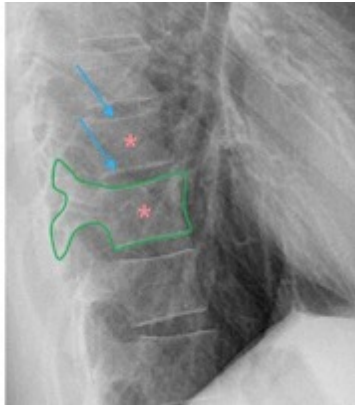
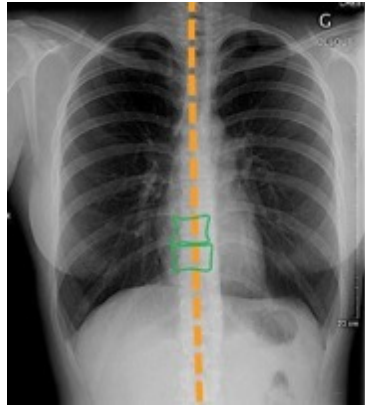
软组织不对称的后前位 CXR。由于乳腺组织不对称, 左下肺区 (红色圆圈) 的密度可能高于右下肺区 (绿色圆圈)。乳头影 (粉色箭头)。

后前位 CXR 的特写图可清晰显示正常脂肪间隙 (箭头), 其密度低于周围肌肉组织。

/ Bones

The clavicles, scapulae, humeri, ribs, the vertebral column and the sternum are seen on CXRs.

Normal bones have a **dense cortex (blue arrows)** and a **marrow cavity (pink asterisks)** composed of spongy bone, which appears less dense. The **vertebral bodies (green line)** have a regular almost rectangular shape. The spinal processes of the dorsal spine form a **straight line (yellow dashed line)** on the PA CXR. On a lateral CXR, there is **some minor degree of kyphosis curvature** (however, there are large differences in the normal population - **pink dashed line**).



Detail from a PA CXR showing the normal anatomy of the clavicles, scapula, ribs and vertebral bodies.

<!=> ATTENTION

CXRs are not very sensitive to bone pathology, which can be easily overlooked as findings can be very subtle.

Detail from a lateral CXR showing the normal anatomy of the vertebral bodies.

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在 CXR 上可观察到锁骨、肩胛骨、肱骨、肋骨、脊柱和胸骨。

正常骨骼具有致密皮质（蓝色箭头）和由松质骨构成的骨髓腔（粉色星号），松质骨密度相对较低。椎体（绿线）形态规则，近似矩形。后前位 CXR 可见胸椎后方的棘突排列形成一条直线（黄色虚线）。侧位 CXR 可见轻度脊柱后凸（但正常人群存在显著个体差异 - 粉色虚线）。

后前位 CXR 细节图，显示锁骨、肩胛骨、肋骨和椎骨体的正常解剖结构。

<!=> 注意

CXR 对骨骼病变的敏感性有限，其异常表现往往较为细微，容易漏诊。

侧位 CXR 细节图，显示椎体的正常解剖结构。

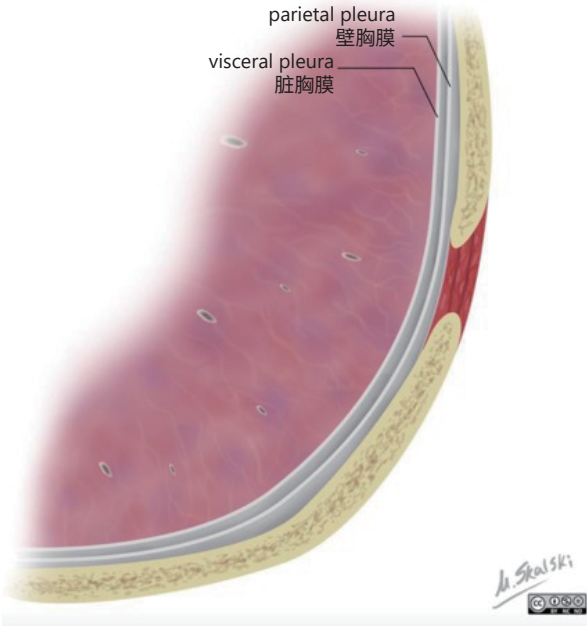
/ Pleura and Pleural Cavity

The pleura is a serous membrane that encloses the lungs and lines the thoracic cavity. It folds back on itself forming the pleural space or pleural cavity. There is no connection between the right and left pleural space.

The pleural cavity is located between the visceral pleura (attached to the lungs) and the parietal pleura (attached to the opposing chest wall, the exposed thoracic diaphragm surface and the lateral aspect of the mediastinum).

The pleural cavity contains a very small amount of serous fluid which acts as a lubricant and allows for easy lung movement and inflation/deflation during breathing. Under normal circumstances, the visceral and the parietal pleura are in contact with each other. Therefore, the pleural cavity is regarded as a potential space.

The pleural fissures are formed by the visceral pleura surrounding the different lung lobes.



Case courtesy of Matt Skalski, <https://radiopaedia.org/?lang=us>, Radiopaedia.org. From the case <https://radiopaedia.org/cases/53333?lang=us> rID: 53333

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/ 胸膜及胸膜腔

胸膜是包裹肺部并衬覆在胸腔内壁的一层浆膜。其自身反折形成胸膜间隙（即胸膜腔）。左右两侧胸膜腔互不相通。

胸膜腔位于脏胸膜（衬覆于肺部）和壁胸膜（衬覆于胸壁内面、暴露的胸膈表面和纵隔侧面）之间。

胸膜腔内含极少量浆液，具有润滑作用，可确保呼吸时肺部顺畅移动及扩张/回缩。正常情况下，脏胸膜与壁胸膜紧密相贴。因此胸膜腔被视为潜在间隙。

肺裂由包绕各肺叶的脏胸膜折叠形成。

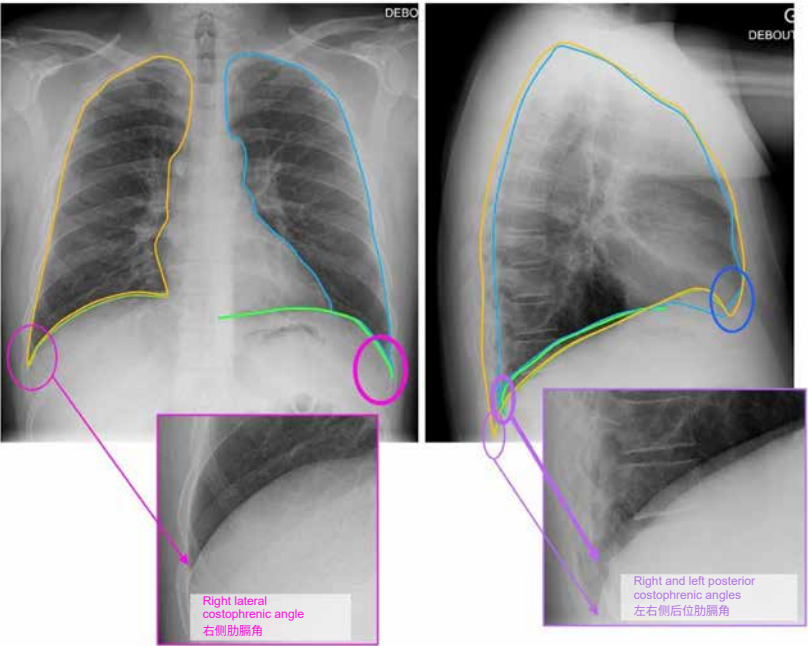
病例由 Matt Skalski 提供, <https://radiopaedia.org/?lang=us>, Radiopaedia.org. 摘自病例 <https://radiopaedia.org/cases/53333?lang=us> rID: 53333

The pleural cavity is clearly seen on CXRs only if it is abnormal.

On a normal CXR, the lung markings should be seen up to the chest wall. The contours of the **left (blue line)** and **right (yellow line)** pleural cavity around the lung edges form a thin line.

The **left (green line)** and **right (light green line)** hemidiaphragm dome cannot be distinguished from the pleural cavity located along the domes. The right hemidiaphragm is either higher or at the same level as the left hemidiaphragm.

The normal **right and left lateral (pink circles)**, **right and left posterior (purple circles)** and the **anterior (blue circle)** costophrenic recesses are seen as the lateral, anterior and posterior costophrenic angles.



<!=> ATTENTION

The costophrenic angles should always be acute and sharply delineated.
On a left lateral CXR, the **right posterior** costophrenic recess appears larger than the **left posterior** recess because it is farther away from the detector/film.

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CXR 上仅当胸膜腔异常时，方可清晰显示其形态。

正常 CXR 上，肺纹理应清晰显示并延伸至胸壁边缘。左侧（蓝线）与右侧（黄线）胸膜腔沿肺边缘走行的轮廓表现为细线样结构。

左侧（绿线）与右侧（浅绿线）膈穹窿与其表面覆盖的胸膜腔在影像上难以明确区分。右侧膈穹窿位置多高于或与左侧膈穹窿平齐。

正常双侧肋膈隐窝（左、右侧，粉色圆圈）、双侧后肋膈隐窝（紫色圆圈）及前肋膈隐窝（蓝色圆圈）在影像上分别表现为侧位、前位及后位肋膈角。

<!=> 注意

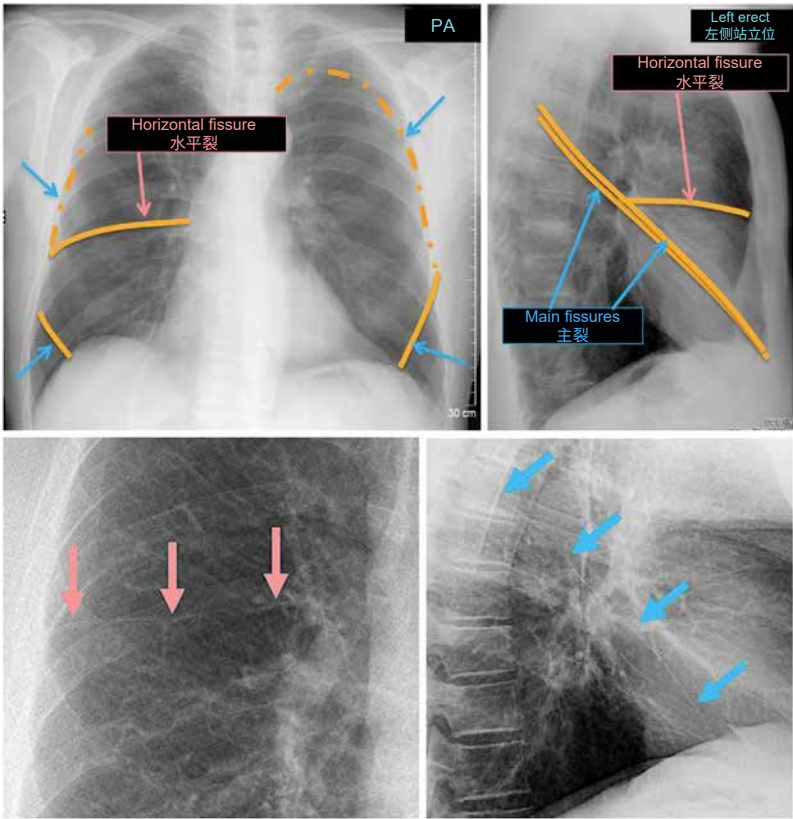
正常肋膈角应为锐利的清晰锐角。
在左侧位 CXR 上，右后肋膈隐窝因远离探测器/胶片，其显影范围常大于左后肋膈隐窝。

The normal fissures are often not seen on CXRs. However, when visible, they appear as subtle, thin lines in typical locations as described below.

The **horizontal fissure (pink arrows)**, which can be occasionally seen on a PA /AP and lateral CXR, appears as a horizontal line located at the level of the right hilum. It divides the upper right lobe from the middle lobe.

The **main or oblique fissures (blue arrows)** cannot be seen on a PA/ AP CXRs because they have an oblique orientation. However, they can be occasionally identified as very thin lines with an oblique posterior-superior towards anterior-inferior orientation on lateral CXRs.

The right oblique fissure divides the right upper and middle lobe from the inferior lobe. The left oblique fissure divides the left upper lobe from the inferior lobe.



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正常肺裂在 CXR 上多不显影。但若显影，多表现为以下典型部位的细线状影。

水平裂（粉色箭头）偶可见于后前位/前后位和侧位 CXR，表现为右肺门水平的一条水平线，分隔右肺上叶与中叶。

主裂或斜裂（蓝色箭头）因走行倾斜，在后前位/前后位 CXR 上无法显影。但在侧位 CXR 上偶可见其呈自后上向前下倾斜的细线状影。

右侧斜裂分隔右肺上叶、中叶与下叶。左侧斜裂分隔左肺上叶与下叶。

/ Mediastinum

The mediastinum is a space in the midline of the chest located between the left and right lung, the sternum and the vertebral column and between the upper chest aperture and the diaphragm. It contains the heart and

great vessels, the internal mammary vessels, part of the azygos system, the thoracic duct, the trachea, the right and left main bronchi, nerves (phrenic, vagus branches), the thymus and many lymph nodes.

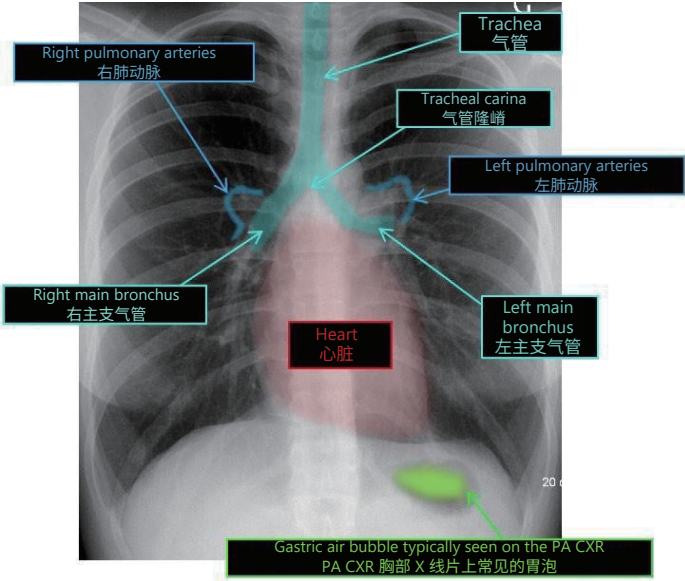
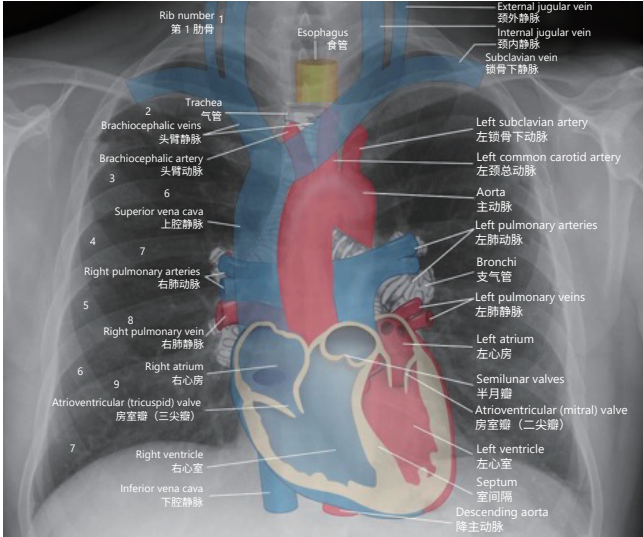


Image from: https://commons.wikimedia.org/wiki/File:Mediastinal_structures_on_chest_X-ray_annotated.jpg

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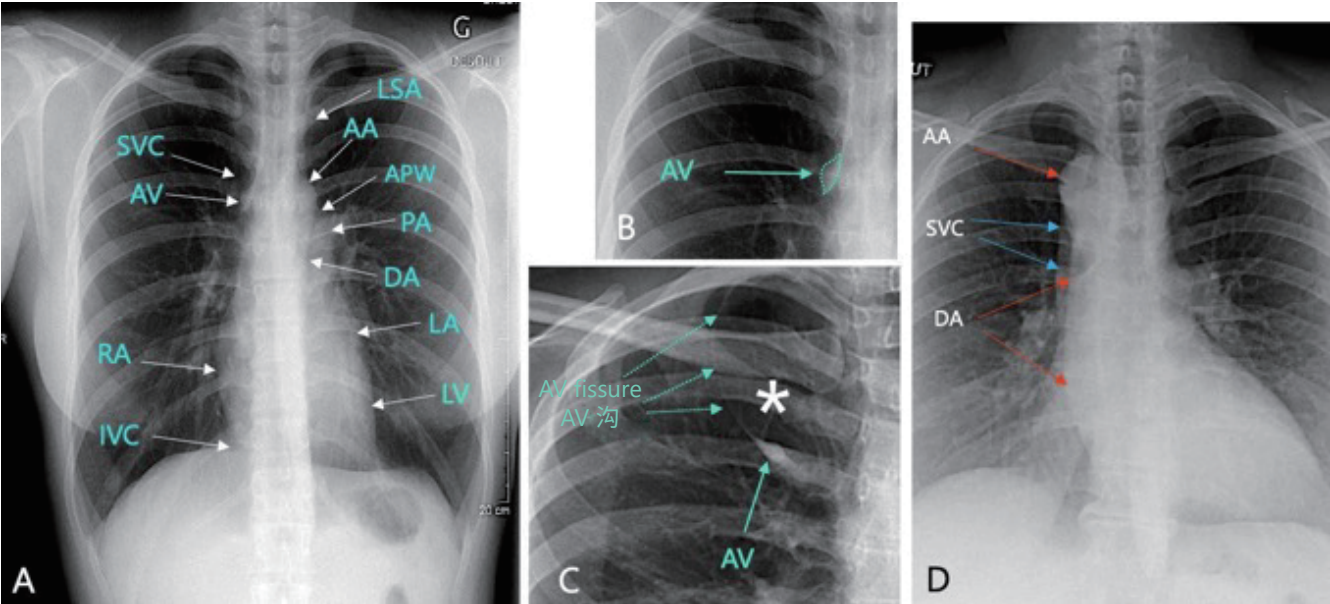
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/ 纵隔

纵隔是位于胸部正中线的间隙，介于左右肺之间、胸骨与脊柱之间，以及胸廓上口与膈肌之间。其内包含心脏与大血管、内乳血管、部分奇静脉系统、胸导管、气管、左右主支气管、神经（膈神经、迷走神经分支）、胸腺及众多淋巴结。

图片来源: https://commons.wikimedia.org/wiki/File:Mediastinal_structures_on_chest_X-ray_annotated.jpg



A. Normal mediastinal contours as seen on a CXR. Superior vena cava (SVC); Azygos vein (AV); Right atrium (RA); Inferior vena cava (IVC); Aortic arch (AA) also called aortic knuckle; Main pulmonary artery (PA); Aorto-pulmonary window (APW); Descending aorta (DA); Left atrial appendage (LA); Left ventricle (LV); Left subclavian artery (LSA). B. The AV is usually seen as a lenticular structure along the right mediastinal border. C. In about 1-2% of chest X-rays, the AV lies outside the mediastinum at the base of the azygos fissure, which is an accessory fissure. The azygos fissure separates the azygos lobe (*) from the upper lobe. D. A right-sided aortic arch (AA) can be an incidental finding or it can be associated with congenital heart disease or other vascular anomalies of the great vessels. The patient shown in D had no associated anomalies (right AA as a variant).

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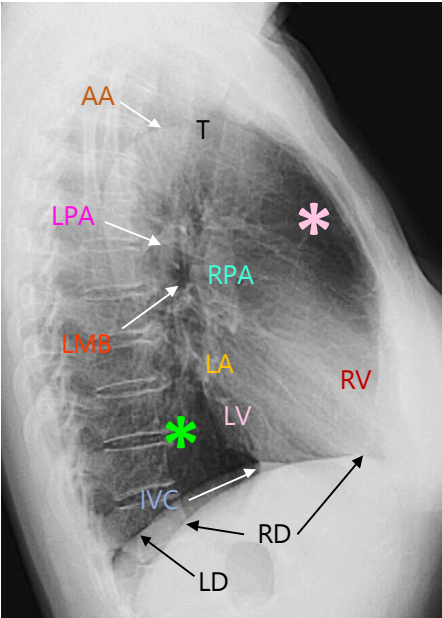
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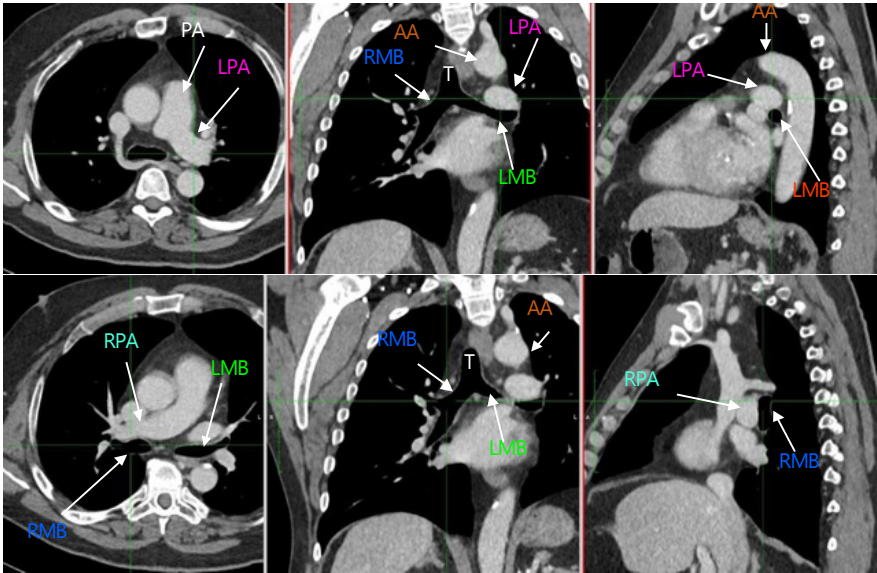
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A. CXR 上的正常纵隔轮廓。上腔静脉 (SVC); 奇静脉 (AV); 右心房 (RA); 下腔静脉 (IVC); 主动脉弓 (AA, 又称主动脉结); 主肺动脉 (PA); 主动脉-肺动脉窗 (APW); 降主动脉 (DA); 左心耳 (LA); 左心室 (LV); 左锁骨下动脉 (LSA)。B. 奇静脉通常表现为沿右侧纵隔边缘走行的透镜状结构。C. 在大约 1%-2% 的胸部 X 线中, 奇静脉位于奇静脉裂 (一种副裂) 底部, 超出纵隔范围。奇静脉裂分隔奇叶 (*) 与上叶。D. 右位主动脉弓 (AA) 既可为偶然发现, 也可能与先天性心脏病或其他大血管畸形相关。D 中所示患者无相关异常 (右位 AA 为变异表现)。



Normal anatomy on a lateral CXR and corresponding axial, coronal and sagittal contrast enhanced CT reformatted images. Trachea (T); Aortic arch (AA); Left pulmonary artery (LPA); Right pulmonary artery (RPA); Left atrium (LA); Left ventricle (LV); Right ventricle (RV); Inferior vena cava (IVC). The LPA is higher than the RPA as it passes over the left main bronchus (LMB), whereas the RPA passes in front of the right main bronchus (RMB). Right hemidiaphragm (RD); Left hemidiaphragm (LD). Note that the retrosternal area(pink asterisk) and the retrocardiac area (green asterisk) should not be obliterated, i.e., they have a low density as the lungs project over these areas.



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侧位 CXR 及相应的轴位、冠状位和矢状位对比增强 CT 重建图像上的正常解剖结构。气管 (T); 主动脉弓 (AA); 左肺动脉 (LPA); 右肺动脉 (RPA); 左心房 (LA); 左心室 (LV); 右心室 (RV); 下腔静脉 (IVC)。LPA 因跨越左主支气管 (LMB) 而位置高于 RPA, RPA 走行于右主支气管 (RMB) 前方。右膈肌 (RD); 左膈肌 (LD)。需注意: 胸骨后区 (粉色星号) 与心后区 (绿色星号) 不应被遮蔽 (即因肺组织投影覆盖这些区域, 其密度较低)。

/ Cardiothoracic Ratio (CTR)

The cardiothoracic ratio (CTR) is a simple method which helps to detect cardiac silhouette enlargement due to cardiomegaly. Nevertheless, pericardial effusion also results in cardiac silhouette enlargement on a CXR.

The CTR should always be measured on a PA CXR. It should not be measured on an AP CXR as the heart appears artificially enlarged on the AP projection (see explanation on page 18).

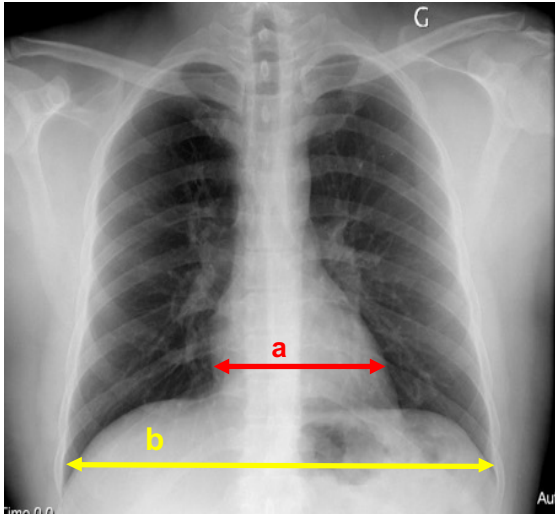
The CTR is a very approximative measurement for the estimation of cardiac pathology. For the evaluation of cardiac pathology in symptomatic patients, other imaging techniques are necessary

> see eBook chapter on Cardiac Imaging

<!=> ATTENTION

Expiration and a prominent epicardial fat pad can result in a CTR > 0.50 – 0.55 despite absent cardiomegaly or absent pericardial effusion.

A CTR < 0.42 is often called small heart syndrome. It can be seen in cachectic states, adrenal insufficiency, heart transplant and other conditions.



Maximum horizontal right-left cardiac silhouette diameter (a).
Maximum horizontal right-left thoracic diameter measured between the pleural edges (b).
Cardiothoracic ratio (CTR) = $a/b < 0.50 - 0.55$ and > 0.42

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/ 心胸比 (CTR)

心胸比 (CTR) 是一种有助于检测因心脏肥大引起的心影增大的简单方法。然而，心包积液也可导致 CXR 显示心影增大。

CTR 应始终通过后前位 CXR 测量。不应通过前后位 CXR 测量，因为在前后位投照中，心脏会表现出人为增大（详见第 18 页解释）。

CTR 一项用于评估心脏病变的近似测量指标。对于有症状患者的心脏病变评估，需采用其他影像学检查技术

> 请参阅《心脏影像学检查》电子书章节

CTR < 0.42 通常称为小心脏综合征。可见于恶病质状态、肾上腺功能不全、心脏移植等情况。

<!=> 注意

呼气状态及心包脂肪垫突出可能导致 CTR > 0.50–0.55，即使不存在心脏肥大或心包积液。

右-左心脏轮廓最大水平直径 (a)。在胸膜缘之间测量的右-左胸廓最大水平直径 (b)。
心胸比 (CTR) = $a/b < 0.50 - 0.55$ 和 > 0.42

/ Compartments

<!=> ATTENTION

The benefits of dividing the mediastinum into different compartments and using a standardised classification scheme include:

- / providing a relevant differential diagnosis for mediastinal masses identified at imaging, CT and MRI being the main imaging modalities for the evaluation and diagnosis of mediastinal pathology
- / facilitating discussions in multidisciplinary settings (i.e., “speaking the same language”)
- / assistance in planning diagnostic interventional procedures and surgery

<∞> REFERENCES

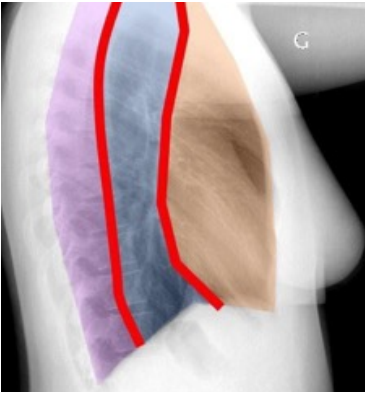
Felson B. Chest roentgenology. Philadelphia, Pa: Saunders, 1973.
Goodman LR. Felson's principles of chest roentgenology, a programmed text. 5th edition. Elsevier 2020. ISBN-13 978-0323625678

Radiologists, surgeons and anatomists have used different mediastinal compartment classifications. For example, Felson's classification based on lateral CXRs has long been the most popular classification among radiologists, whereas the Shield classification based on intraoperative anatomic landmarks has long been most popular among surgeons.

The Felson classification is based on arbitrary landmarks. According to the Felson classification, the **anterior mediastinum (orange)** comprises everything from the posterior sternum surface to a line drawn from the anterior tracheal wall to the posterior inferior vena cava. The **middle mediastinum (blue)** extends from the posterior boundary of the anterior mediastinum to a line drawn 1 cm posterior to the anterior edge

of the thoracic vertebrae. Finally, the **posterior mediastinum (purple)** lies behind the posterior boundary of the middle mediastinum.

A new classification was proposed by the International Thymic Malignancy Interest Group (ITMIG) based on anatomic landmarks seen at CT.



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<!=> 注意

将纵隔划分成不同分区并采用标准化分区体系的优势包括:

- / 为影像学检查发现的纵隔肿块提供相关鉴别诊断, CT 和 MRI 是评估和诊断纵隔病变的主要影像学检查方法
- / 促进多学科协作中的讨论 (即 “使用统一术语”)
- / 辅助诊断性介入操作及手术的规划

<∞> 参考文献

Felson B. Chest roentgenology. Philadelphia, Pa: Saunders, 1973.
Goodman LR. Felson's principles of chest roentgenology, a programmed text. 5th edition. Elsevier 2020. ISBN-13 978-0323625678

放射科医生、外科医生和解剖学家长期以来采用不同的纵隔分区方法。例如, 基于侧位 CXR 的 Felson 分区法是放射科医生最常用的方法, 而基于术中解剖标志的 Shield 分区法是外科医生最常用的方法。

Felson 分区法基于人为设定的解剖标志。根据 Felson 分区法, 前纵隔 (橙色) 涵盖从胸骨后表面至一条连线的区域——该连线起自气管前壁, 止于下腔静脉后缘。中纵隔 (蓝色) 从前纵隔的后边界延伸至胸椎前缘后方 1 cm 处的连线。最后, 后纵隔 (紫色) 位于中纵隔的后边界后面。

近期, 国际胸腺恶性肿瘤兴趣小组 (International Thymic Malignancy Interest Group, ITMIG) 基于 CT 可见的解剖标志提出了新的分区方法。

Felson 纵隔分区

The International Thymic Malignancy Interest Group (ITMIG) classification divides the mediastinum based on anatomic CT boundaries into the **prevascular (anterior) compartment (green)**, **visceral (middle) compartment (red)** and **paravertebral (posterior) compartment (blue)**.

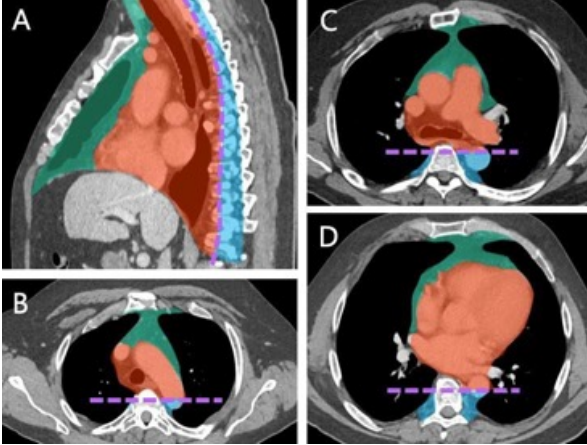
The **prevascular (anterior) compartment** extends from the posterior sternum surface to the anterior aspect of the pericardium and from the thoracic inlet to the diaphragm. It contains the left brachio-cephalic vein, the thymus, fat and lymph nodes. The prevascular compartment wraps around the pericardium/heart.

The **visceral (middle) compartment** extends from the posterior boundary of the anterior compartment to a vertical line connecting the points located 1 cm posterior to the anterior surface of the thoracic spine and – in the cranio- caudal direction – it extends from the thoracic inlet to the diaphragm. It contains vascular structures (heart, aorta, superior vena cava, intrapericardial pulmonary arteries and veins, thoracic duct), trachea, tracheal bifurcation, lymph nodes, vagal and phrenic nerves and the oesophagus.

The **paravertebral (posterior) compartment** extends from the posterior boundary of the middle mediastinum to a vertical line at the posterior margin of the chest wall at the lateral thoracic spine margin. It includes the thoracic spine and paravertebral soft tissues.

<!=> ATTENTION

The ITMIG classification is applicable only to cross-sectional imaging techniques. However, mediastinal masses are often detected on CXRs as CXRs are the most commonly performed examinations. On CXRs, mediastinal masses present as soft tissue densities on PA/AP and lateral projections leading to abnormal mediastinal contours, thickening of mediastinal stripes and lines and displacement of structures.



Mediastinal compartments according to the ITMIG classification. A. Sagittal reformatted CT image. Axial CT images at the level of the aortic arch (B), main pulmonary artery bifurcation (C) and left atrium (D). The dashed purple line is the boundary line between the visceral (middle) and paravertebral (posterior) mediastinal compartments.

<=> REFERENCE

Carter BW, Benveniste MF, Madan R, et al. ITMIG Classification of Mediastinal Compartments and Multidisciplinary Approach to Mediastinal Masses. Radiographics. 2017 Mar-Apr;37(2):413-436. doi: 10.1148/rg.2017160095. Epub 2017 Jan 27. PMID: 28129068.

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国际胸腺恶性肿瘤兴趣小组 (ITMIG) 分区法基于 CT 解剖标志, 将纵隔划分为血管前区 (前纵隔区, 绿色)、内脏区 (中纵隔区, 红色) 和椎体旁区 (后纵隔区, 蓝色)。

血管前区 (前纵隔区) 从胸骨后表面延伸到心包前面, 从胸廓入口延伸到膈肌。其内包含左头臂静脉、胸腺、脂肪及淋巴结, 且包绕心包/心脏。

内脏区 (中纵隔区) 从前纵隔区后界延伸至一条垂直线 (该线连接胸椎体前表面后方 1 cm 处的点), 头足方向从胸廓入口延伸至膈肌。其内包含血管结构 (心脏、主动脉、上腔静脉、心包内肺动脉和静脉、胸导管)、气管、气管分叉、淋巴结、迷走神经、膈神经和食管。

椎体旁区 (后纵隔区) 从中纵隔区后界延伸至胸壁后缘 (胸椎外侧缘) 的垂直线。其内包含胸椎及椎旁软组织。

<!=> 注意

ITMIG 分区法仅适用于横断面成像技术。然而, 由于 CXR 是最常进行的检查, 因此常在 CXR 上检测到纵隔肿块。在 CXR 上, 纵隔肿块表现为后前位/前后位和侧位投照上的软组织密度影, 导致纵隔轮廓异常、纵隔条纹和线条增厚及结构移位。

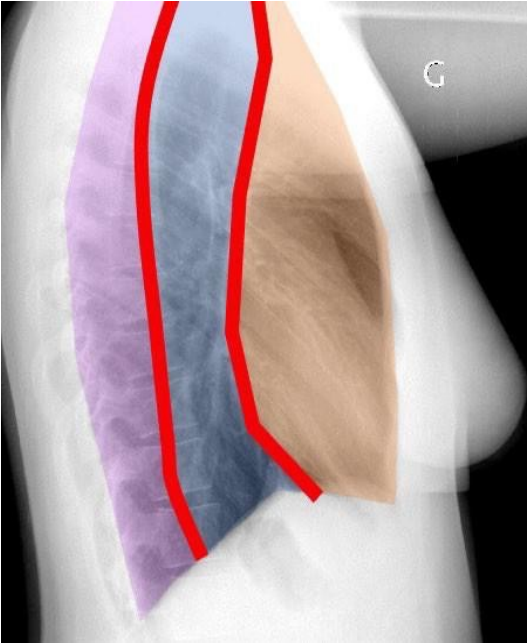
根据 ITMIG 分区法进行的纵隔分区。A. 矢状位重建 CT 影像。主动脉弓 (B)、主肺动脉分叉 (C) 和左心房 (D) 水平的轴位 CT 影像。紫色虚线是内脏区 (中纵隔区) 和椎体旁区 (后纵隔区) 之间的边界线。

<=> 参考文献

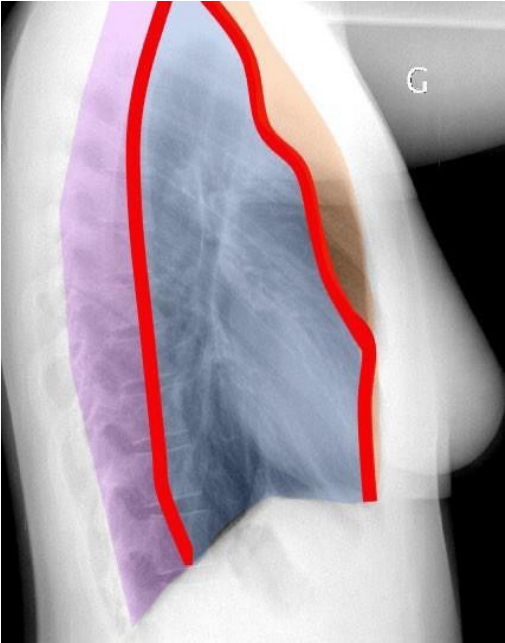
Carter BW, Benveniste MF, Madan R, et al. ITMIG Classification of Mediastinal Compartments and Multidisciplinary Approach to Mediastinal Masses. Radiographics. 2017 Mar-Apr;37(2):413-436. doi: 10.1148/rg.2017160095. Epub 2017 Jan 27. PMID: 28129068.

>|< COMPARE

Mediastinal compartments according to Felson



Mediastinal compartments according to the ITMIG classification



Although the ITMIG classification is applicable only to cross-sectional imaging techniques, the lateral CXR shown above illustrates the mediastinal compartments according to this classification.

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>|< 比较

Felson 纵隔分区

根据 ITMIG 分区法进行的纵隔分区

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虽然 ITMIG 分区法仅适用于横断面成像技术，但上图的侧位 CXR 仍可显示根据此分区法进行的纵隔分区。

/ Mediastinal Lines, Stripes and Interfaces

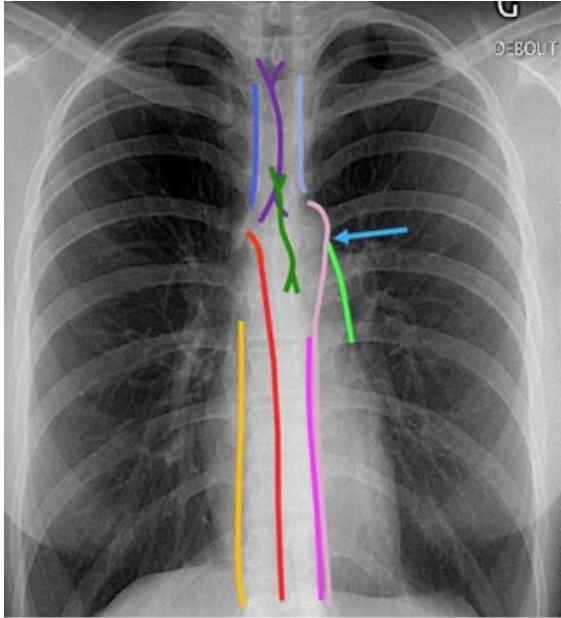
<!=> ATTENTION

Recognising normal and abnormal mediastinal lines and stripes on CXRs is very important to ensure that further CT examinations are judiciously prescribed.

Lines = thin tissue structures outlined on either side by air. Lines are mostly < 1 mm. They represent pleural-covered structures in the anterior and posterior mediastinum and include the **anterior junction line (green)** and the **posterior junction line (purple)**.

Stripes = thicker anatomic structures outlined by air. They include the **right paratracheal stripe (blue)** and the **left paratracheal stripe (light blue)**.

Interfaces = borders of solid structures with air. Some are often called “lines or stripes”. Interfaces include: the **right paraspinal line (yellow)**, the **left paraspinal line (pink)**, the **azygo-oesophageal recess (red)**, the **aorto-pulmonary window reflection (blue arrow)**, the **aortic pulmonary stripe (light green)** and the **paraortic line (light pink)**.



Mediastinal lines and stripes seen on CXRs

<=> REFERENCE

Felson B. Chest roentgenology. Philadelphia, Pa: Saunders, 1973. Jiao A, Nadim B, Hammer M, Jhala K. 3D Visual Guide to Lines and Stripes in Chest Radiography. Radiographics. 2023 Sep;43(9):e230017. doi: 10.1148/rg.230017. PMID: 37590159.

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/ 纵隔线条、条纹及界面

<!=> 注意

在 CXR 上识别正常与异常纵隔线条及条纹对于确保合理安排进一步的 CT 检查非常重要。

线条 = 由空气在两侧勾勒出的薄组织结构。大多数线条宽度 < 1 mm，代表前纵隔和后纵隔被胸膜覆盖的结构，包括前联合线（绿色）和后联合线（紫色）。

条纹 = 空气勾勒出的较厚解剖结构，包括右气管旁线（蓝色）和左气管旁线（浅蓝色）。

界面 = 实性结构与空气相邻的边界。有些通常称为“线条或条纹”。界面包括：右椎旁线（黄色）、左椎旁线（粉色）、奇静脉食管隐窝（红色）、主动脉-肺动脉窗反射（蓝色箭头）、主动脉肺动脉带（浅绿色）和主动脉旁线（浅粉色）。

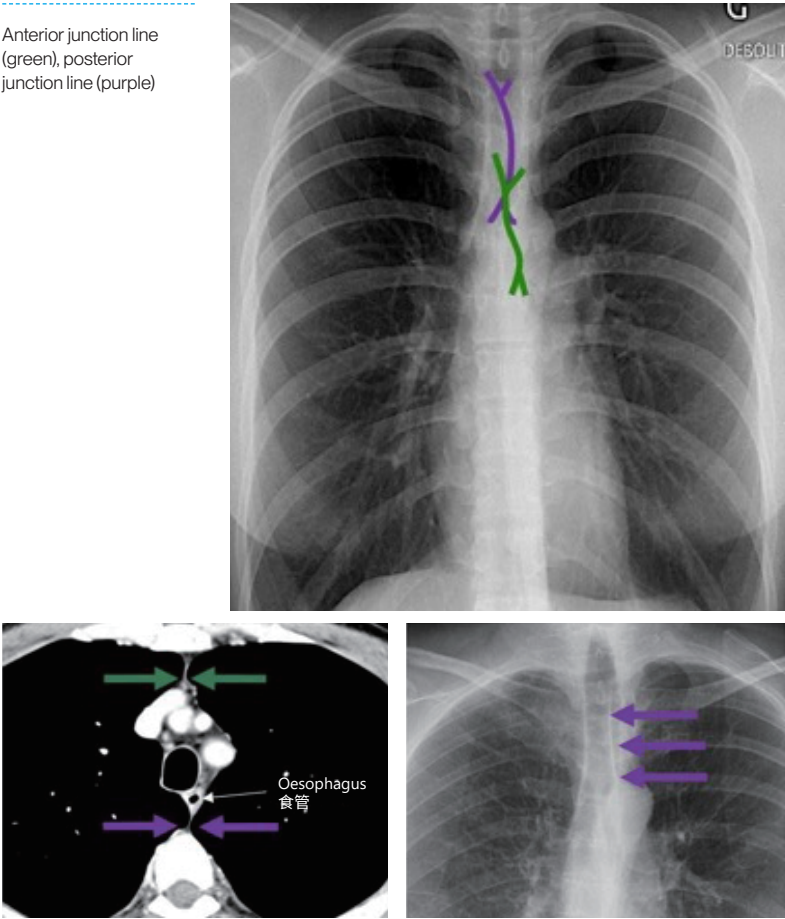
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<=> 参考文献

Felson B. Chest roentgenology. Philadelphia, Pa: Saunders, 1973. Jiao A, Nadim B, Hammer M, Jhala K. 3D Visual Guide to Lines and Stripes in Chest Radiography. Radiographics. 2023 Sep;43(9):e230017. doi: 10.1148/rg.230017. PMID: 37590159.

The **anterior junction line (green)** is a normal anatomic landmark on CXRs. It is the point of contact of the left and right visceral and parietal pleurae meeting anteriorly at the midline. It is seen in about 25% - 57% of all CXRs in older children and adults; however, it is not seen in healthy infants.

The **posterior junction line (purple)** is a normal anatomic landmark on CXRs. It is seen as a vertical line projected through the tracheal air column and extending from the aortic arch superiorly above the clavicles. It is seen in about 40% of all CXRs in adults. It is formed by the apposition of the pleural surfaces of the posteromedial surfaces of the upper lung lobes posteriorly to the oesophagus but anterior to the thoracic spine.



Anterior junction line (green), posterior junction line (purple)

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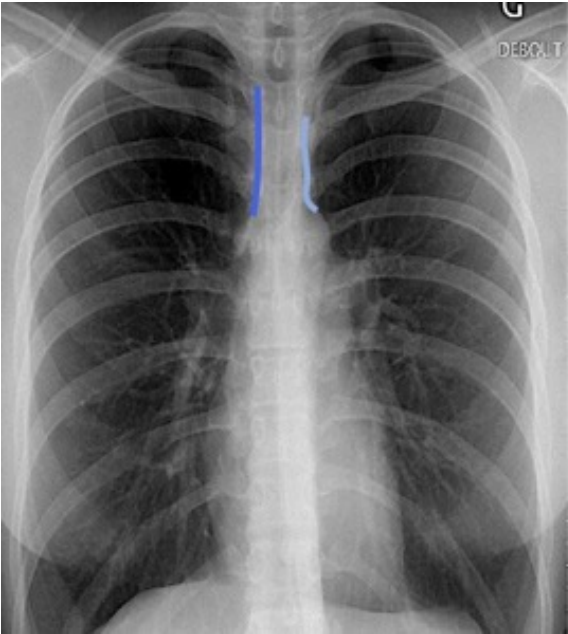
前联合线（绿色）是 CXR 上的正常解剖标志，为左右脏胸膜与壁胸膜在前正中线处相接的位置。约 25% - 57% 的儿童及成人 CXR 可见此线，但在健康婴儿中不可见。

后联合线（紫色）是 CXR 上的正常解剖标志，表现为穿过气管气柱的垂直线，向上延伸至锁骨上方主动脉弓水平。约 40% 的成人 CXR 可见此线。此线由食管后方、胸椎前方肺上叶后内侧面的胸膜表面并置形成。

前联合线（绿色）、后联合线（紫色）

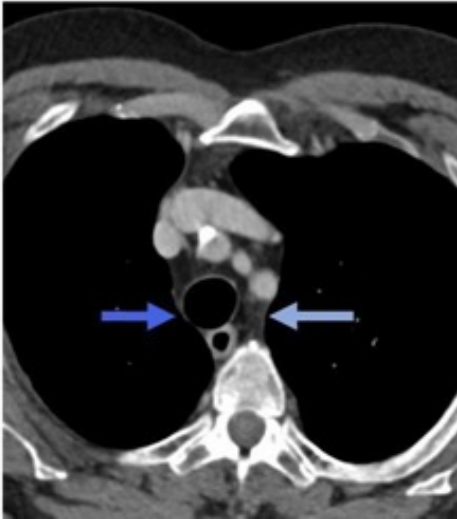
The **right paratracheal stripe (blue)** is a normal anatomic landmark on the PA/AP CXR. It is formed by the right tracheal wall, the adjacent pleural surfaces and the mediastinal fat between the pleural surfaces. It is visible because of the silhouette sign created by the tracheal air medially and air within the lung laterally. It is usually < 4 - 5 mm and it is seen in 65% - 97% of PA CXRs.

The **left paratracheal stripe (light blue)** is a normal anatomic landmark on the PA/AP CXR. It is formed by the left tracheal wall, the adjacent pleural surfaces of the left upper lobe and the mediastinal fat between the pleural surfaces.



It is seen in 21% - 31% of PA CXRs and it extends from the aortic arch to the subclavian artery. It has a variable thickness.

Right paratracheal stripe (< 4 - 5 mm, blue)
Left paratracheal stripe (variable thickness, light blue)



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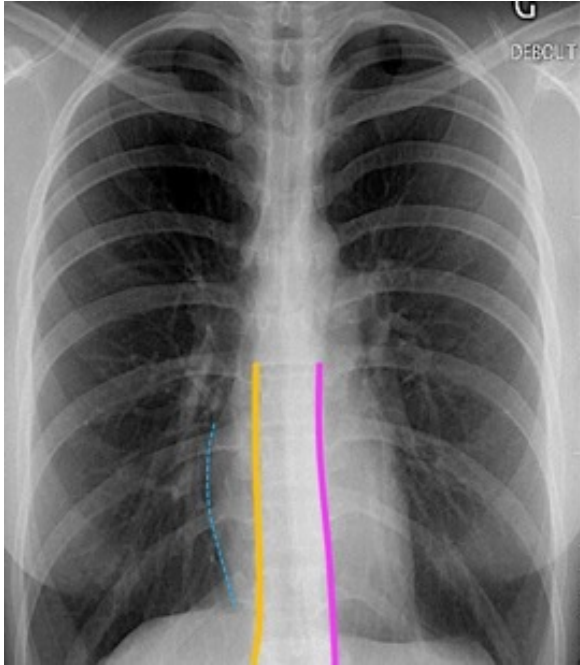
右气管旁线（蓝色）是后前位/前后位 CXR 的正常解剖标志，由右侧气管壁、邻近胸膜面及两者间的纵隔脂肪构成。因气管内侧气体与肺外侧气体的剪影征而显影，通常厚度 < 4 - 5 mm，在 65% - 97% 的后前位 CXR 中可见。

左气管旁线（浅蓝色）是后前位/前后位 CXR 的正常解剖标志，由左侧气管壁、左肺上叶邻近胸膜面及两者间的纵隔脂肪构成。

在 21% - 31% 的后前位 CXR 中可见，自主动脉弓延伸至锁骨下动脉，厚度变异较大。

右气管旁线 (< 4 - 5 mm, 蓝色) 左气管旁线 (厚度不等, 浅蓝色)

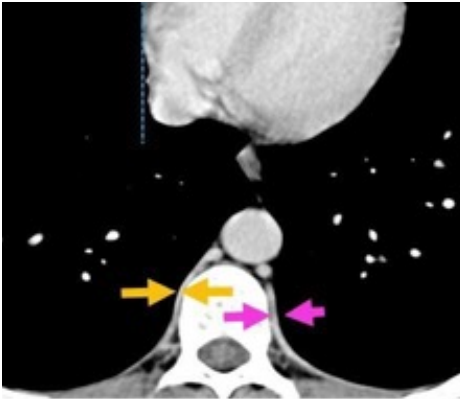
The **right paravertebral (paraspinal) line or stripe (yellow)** is an anatomic landmark seen on frontal CXRs. It is formed by the interface of the right lung pleura and the paraspinal soft tissues. The right paravertebral line is located medially from the **right heart border (blue)**.



The **left paravertebral (paraspinal) line or stripe (pink)** is formed by the interface of the left lung pleura and the paraspinal soft tissues.

The paraspinal lines extend below the diaphragm.

Visible on the right: 90%
Visible on the left: < 50%
Left paravertebral line (6 - 15 mm, yellow)
Right paravertebral line (2 - 4 mm, pink)
Right heart border (blue)



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右椎旁线或条纹（黄色）是正位 CXR 的解剖标志，由右肺胸膜与椎旁软组织的界面形成。右椎旁线位于右心缘（蓝色）内侧。

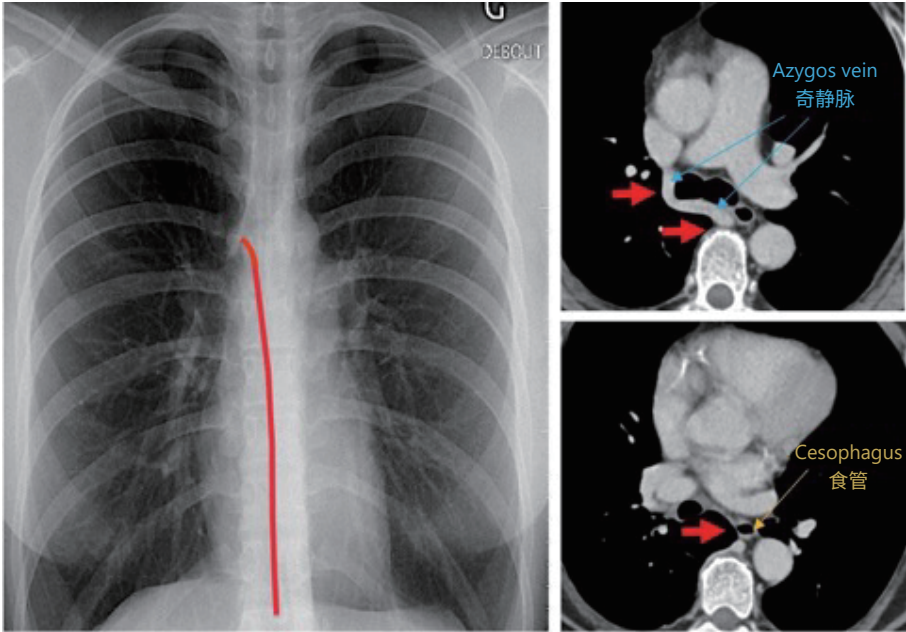
左椎旁线或条纹（粉色）由左肺胸膜与椎旁软组织的界面形成。

椎旁线向下延伸至膈肌以下。

右侧可见：90%
左侧可见：<50%
左椎旁线（6 - 15 mm，黄色）
右椎旁线（2 - 4 mm，粉色）
右心缘（蓝色）

The azygo-oesophageal recess or azygo-oesophageal line (red) is the region inferior to the level of the azygos vein arch formed by the interface between the right lower lobe pleura, the azygos vein and the oesophagus. The recess is bordered anteriorly by the heart and posteriorly by the vertebral column.

In its upper third, the azygo- oesophageal line may deviate slightly towards the right while it is usually straight in its lower part.



Azygo-oesophageal recess (red)

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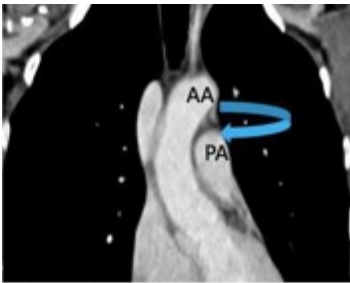
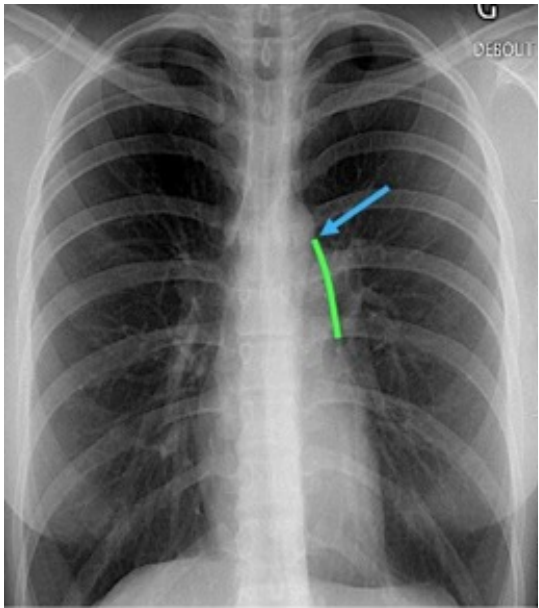
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奇静脉食管隐窝或奇静脉食管线（红色）位于奇静脉弓水平下方，由右肺下叶胸膜、奇静脉与食管间的界面形成。隐窝前缘为心脏，后缘为脊柱。

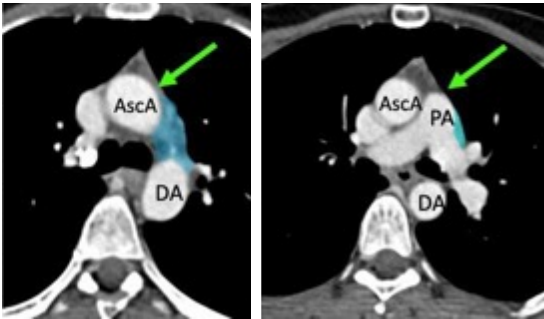
奇静脉食管线的上 1/3 段可能轻度向右偏移，下段通常平直。

奇静脉食管隐窝（红色）

The **aorto-pulmonary window (APW, blue)** is a mediastinal space bordered superiorly by the aortic arch (AA), inferiorly by the pulmonary artery (PA), posteriorly by the descending aorta (DA), anteriorly by the ascending aorta (AscA), laterally by the left lung and medially by the trachea. It contains fat, lymph nodes, nerves (left recurrent laryngeal, left phrenic and left vagus nerve) and the ligamentum arteriosum.



Aorto-pulmonary window (APW) = space (blue)
Aortic-pulmonary stripe (APS) = interface (green)



The **aortic-pulmonary stripe (APS, green)** is the interface between the left lung pleura and the mediastinal fat anterolateral to the aortic arch and pulmonary artery. It is rarely seen on CXRs.

<!=> ATTENTION

The APW has a concave or a straight lateral border on the PA CXR and the APS appears as a straight line. A convex lateral APW border should be regarded as abnormal.

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主动脉肺动脉窗 (APW, 蓝色) 是纵隔间隙, 上界为主动脉弓 (AA), 下界为肺动脉 (PA), 后界为降主动脉 (DA), 前界为升主动脉 (AscA), 外侧为左肺, 内侧为气管。其内包含脂肪、淋巴结、神经 (左喉返神经、左膈神经、左迷走神经) 及动脉韧带。

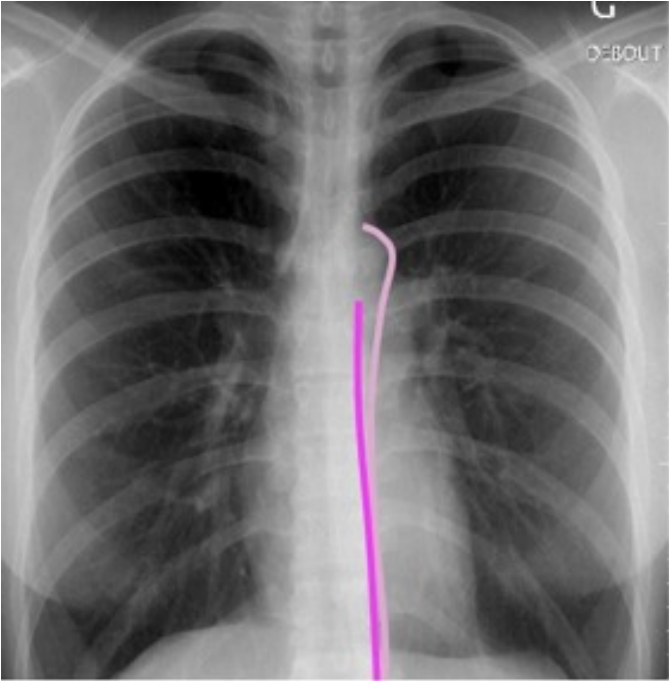
主动脉肺动脉带 (APS, 绿色) 为左肺胸膜与主动脉弓、肺动脉前外侧纵隔脂肪间的界面。在 CXR 上罕见显示。

主动脉肺动脉窗 (APW) = 间隙 (蓝色)
主动脉肺动脉带 (APS) = 界面 (绿色)

<!=> 注意

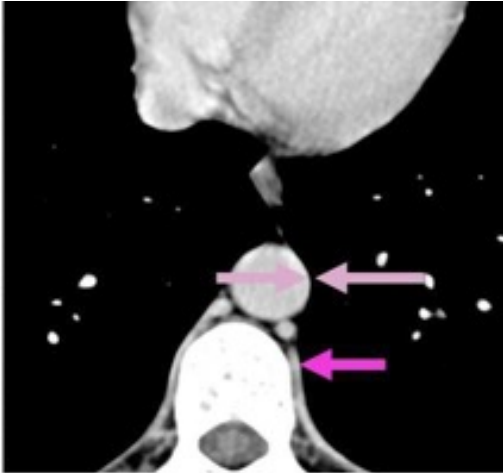
后前位 CXR 上主肺动脉窗外侧缘呈凹陷或平直, 主肺动脉带显示为一条直线。若主肺动脉窗外侧缘凸出, 应视为异常。

The **para-aortic line** (light pink) is the interface between the pleura of the left lung and the mediastinal pleura located along the descending aorta.



This usually straight line is also seen below the diaphragm. It is located lateral to the **left paravertebral line** (pink).

The para-aortic line is seen in at least 50% of CXRs.



Para-aortic line (light pink), left paravertebral line (pink)

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主动脉旁线（浅粉色）是左肺胸膜与沿降主动脉分布的纵隔胸膜间的界面。

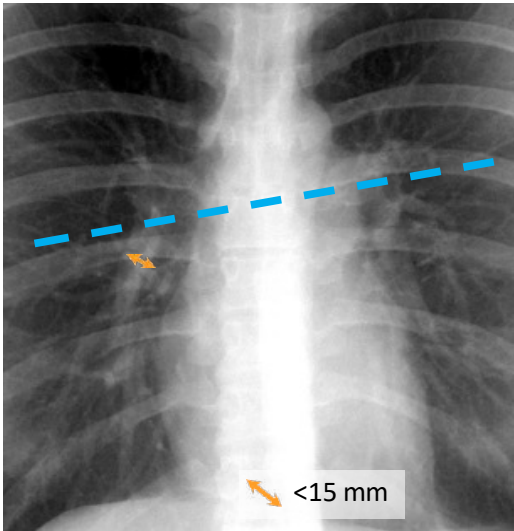
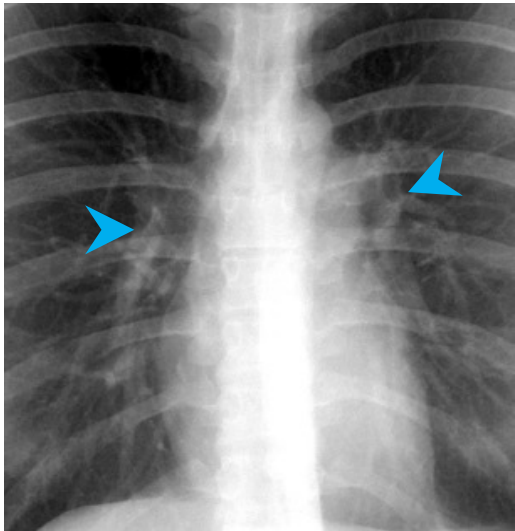
通常为直线，向下延伸至膈肌以下，位于左椎旁线（粉色）外侧。

至少 50% 的 CXR 可见主动脉旁线。

主动脉旁线（浅粉色）、左椎旁线（粉色）

/ Hila

- / The hila contain the major bronchi, the pulmonary vessels (99% of hilar volume) and lymph nodes.
- / On normal CXRs, hilar nodes are not visible.
- / The hila should have a similar size on CXR and a similar density.



- / The hilar point (blue arrows) is the intersection point/angle of the upper and lower lobe lung vessels. It is a useful point of reference to determine the position of the hila.
- / The left hilar point is 1 - 2 cm higher than the right hilar point on 96% of CXRs; in about 4% of CXRs, the hilar points are at the same level.

<!=> ATTENTION

Enlarged hilar nodes can cause hilar enlargement. Abnormally enlarged lymph nodes are the most common causes of pathological hilar enlargement!

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/ 肺门

- / 肺门内包含主支气管、肺血管（占肺门体积的 99%）和淋巴结。
- / 在正常 CXR 上，肺门淋巴结不可见。
- / 在 CXR 上，双侧肺门大小、密度应相似。
- / 肺门点（蓝色箭头）为上下叶肺血管的汇合点/角，是判断肺门位置的重要参考标志。
- / 96% 的 CXR 显示，左肺门点较右肺门点高 1 - 2 cm；约 4% 的 CXR 中，双侧肺门点处于同一水平。

<!=> 注意

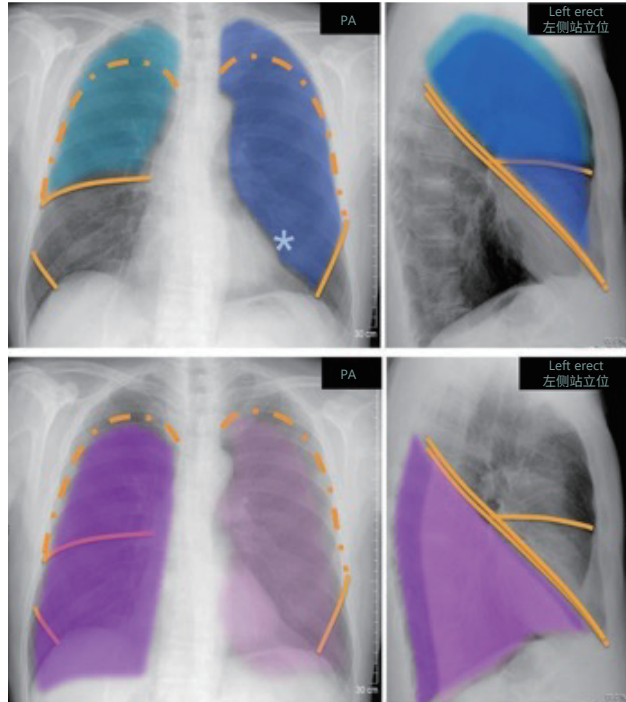
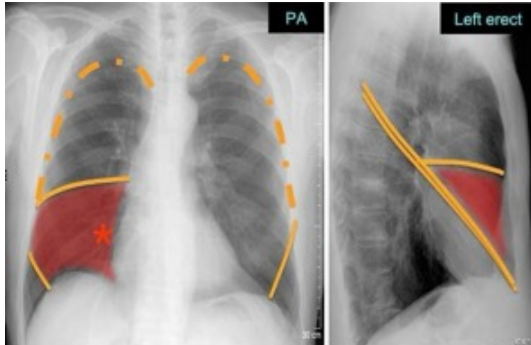
肺门淋巴结肿大可导致肺门增大。异常肿大的淋巴结是病理性肺门增大最常见的原因！

/ Lung Lobes and Lung Segments

The right lung has three lobes (**upper** [light blue], **middle** [red] and **lower** [pink]) while the left lung has two lobes (**upper** [blue] and **lower** [light pink]).

The **middle lobe** is separated from the **upper lobe** by the horizontal fissure and from the **lower lobe** by the oblique fissure. The middle lobe has 2 segments (medial and lateral). The medial segment of the middle lobe (**red asterisk**) is next to right heart border. The **right upper lobe** (above the horizontal fissure and anterior to the oblique fissure) has 3 segments (apical, posterior and anterior). The **right lower lobe** has 5 segments (superior, medial, anterior, lateral and posterior).

The **left upper lobe** is located anteriorly and superiorly to the left oblique fissure. It has 4 segments (apicoposterior, anterior, superior lingular and inferior lingular). The ligula (**blue asterisk**) abuts the left heart border. The **left lower lobe** has 4 segments (superior, antero-medial, lateral and posterior).



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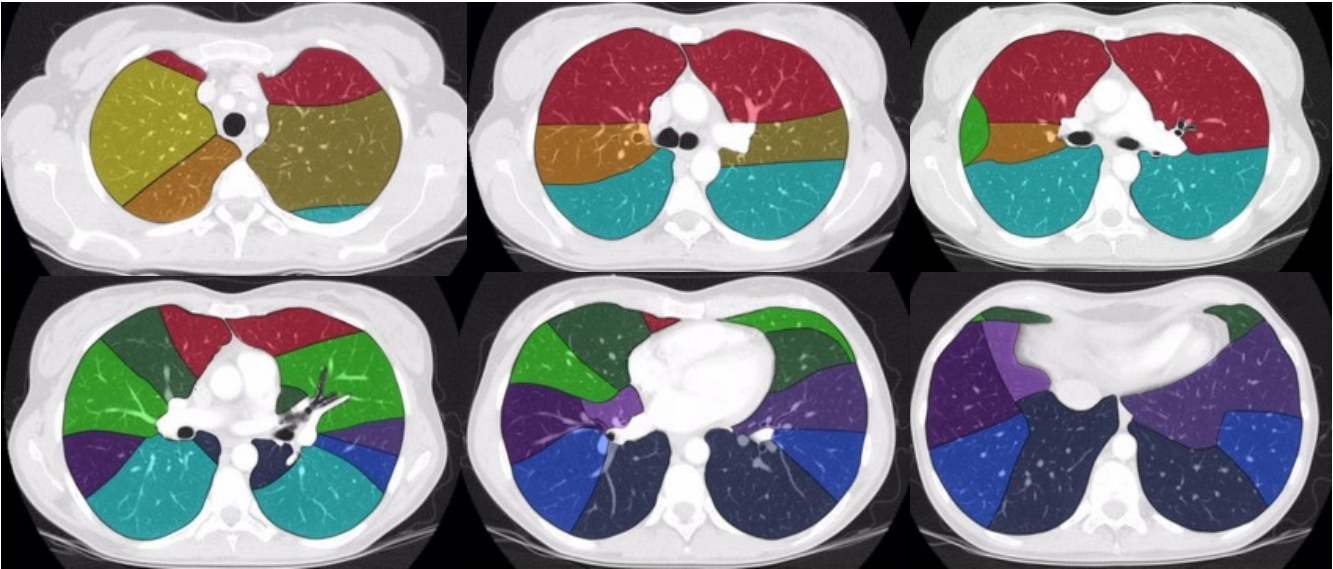
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/ 肺叶及肺段

右肺有 3 个肺叶 (上叶 [浅蓝色]、中叶 [红色] 和下叶 [粉色])，左肺有 2 个肺叶 (上叶 [蓝色] 和下叶 [浅粉色])。

中叶与上叶的分界为水平裂，中叶与下叶的分界为斜裂。中叶有 2 个肺段 (内侧段和外侧段)。中叶内侧段 (红色星号) 毗邻右心缘。右肺上叶 (位于水平裂上方、斜裂前方) 有 3 个肺段 (尖段、后段、前段)。右肺下叶有 5 个肺段 (上段、内侧底段、前底段、外侧底段和后底段)。

左肺上叶位于左斜裂的前上方，包含 4 个肺段 (尖后段、前段、上舌段和下舌段)。舌叶 (蓝色星号) 紧邻左心缘。左肺下叶有 4 个肺段 (上段、前内侧底段、外侧底段和后底段)。



Right Upper Lobe
右上叶

- Apical
尖段
- Posterior
后段
- Anterior
前段

Middle Lobe
中叶

- Lateral
外基底段
- Medial
内基底段

Right Lower Lobe
右下叶

- Superior
上段
- Medial
内侧段
- Anterior
前基底段
- Superior lingular
上舌段
- Inferior lingular
下舌段
- Lateral
外基底段
- Posterior
后基底段

Left Upper Lobe
左上叶

- Apicoposterior
尖后段
- Anterior
前段
- Superior lingular
上舌段
- Inferior lingular
下舌段

Left Lower Lobe
左下叶

- Superior
上段
- Anteromedial
前内基底段
- Lateral
外基底段
- Posterior
后基底段

Selected axial CT slices of the chest illustrating the anatomic position of the lung segments. Images reproduced from : <https://radiopaedia.org/play/59737/entry/1093616/case/54511/studies/60738?lang=us> (playlist contributed by Dirk Sehr)

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选定的胸部轴位 CT 切片，展示了各肺段的解剖位置。影像来源: <https://radiopaedia.org/play/59737/entry/1093616/case/54511/studies/60738?lang=us> (由 Dirk Sehr 提供的播放清单)

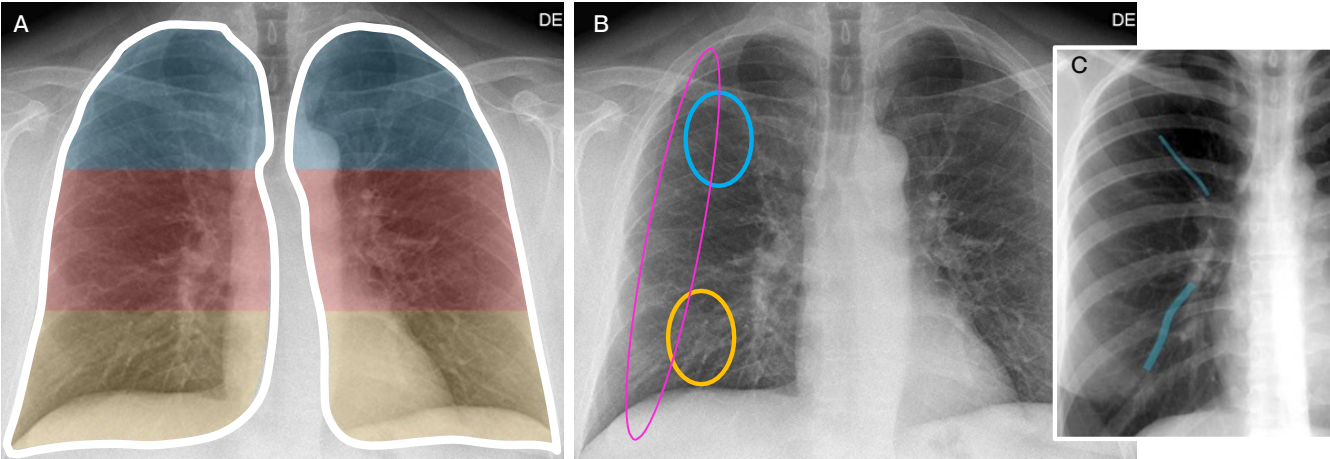
/ Lung Zones and Lung Vasculature

The lung zones serve only the purpose of radiologic description and assessment of parenchymal abnormality by comparing each zone with the opposite side. The **upper (blue), middle (red) and lower (yellow)** lung zones, which occupy each one third of the cranio-caudal lung size do not correspond to lung lobes. If the density of lungs in corresponding lung zones (e.g., left and right middle zones) is asymmetrical and if technical factors, e.g., rotation have

been excluded, lung pathology is very likely on a CXR.

The upper zone vessels are smaller than the lower zone vessels on a PA CXR because in an erect position there is an increasing gradient of perfusion per lung volume unit from apex to base (effects of gravity superimposed on the low pressure, low resistance vascular bed).

A. Lung zones: Upper lung zones (blue); Middle lung zones (red); Lower lung zones (yellow). B and C. In the erect position, the veins in the upper lung zones (i.e., the veins that branch superiorly from the hilum) are about 1/3 the size of those in the lower zones. Also, vessels in the upper lung zones are fewer than those in the lower zones. In the outer 1/3 of the lung zones (pink), lung vessels are fewer and smaller than in the inner third.



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/ 肺区及肺脉管系统

肺区仅用于影像学描述，以及通过比较两侧肺区来评估实质异常。上（蓝色）、中（红色）、下（黄色）肺区各占肺上下径的三分之一，与肺叶无对应关系。如果相应肺区（例如，左右中肺区）肺密度不对称，且已排除旋转等技术因素，则 CXR 很可能提示存在肺部病变。

在后前位 CXR 上，上肺区血管较下肺区血管细小，因直立位时，从肺尖至肺底的单位肺容积灌注量呈递增梯度（重力作用叠加于低压低阻的血管床所致）。

A. 肺区：上肺区（蓝色）；中肺区（红色）；下肺区（黄色）。B 和 C. 直立位时，上肺区静脉（即从肺门向上分支的静脉）管径约为下肺区的 1/3。此外，上肺区血管数量少于下肺区。在肺区的外 1/3 区域（粉色），肺血管数量及管径均少于内 1/3 区域。

/ The Silhouette Sign

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<!=> ATTENTION

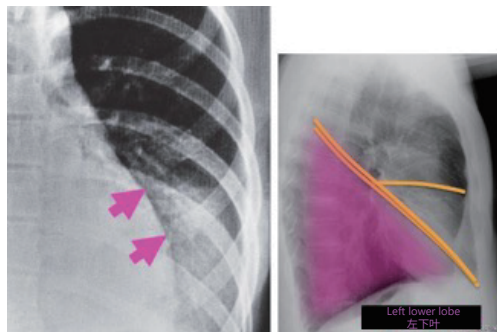
Definition: The loss of the normal silhouette of a structure on the CXR is called the silhouette sign.

Two opacities of similar density seen on a CXR

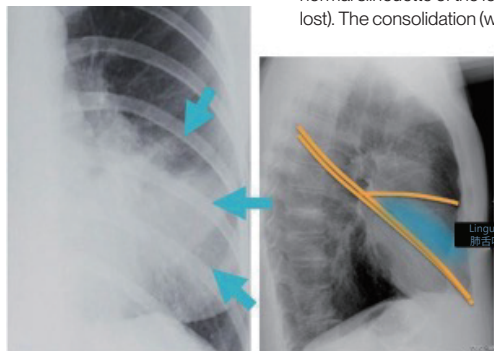
- / are next to each other if their borders (silhouettes) cannot be made out (silhouette sign is present)
- / are not next to each other if their borders (silhouettes) are well seen (silhouette sign is absent).

This sign is very useful in localising lung opacities as the borders of the cardiac silhouette are in contact with specific lung portions.

- / the right cardiac silhouette is next to the medial segment of the right middle lobe
- / the left cardiac silhouette is next to the lingula



Consolidation (in this case pneumonia) has a similar density as the heart. If the consolidation is in the left lower lobe, which is located more posteriorly in the chest than the heart, the silhouette sign is absent (i.e., the normal silhouette of the left ventricle is seen).



The silhouette sign is present (i.e., the normal silhouette of the left heart border is lost). The consolidation (which has a similar density as the heart) is in the lingula, which abuts the left ventricle.

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/ 剪影征

<!=> 注意

定义: CXR 上某一结构的正常轮廓消失, 称为剪影征。

CXR 提示两个密度相似的阴影

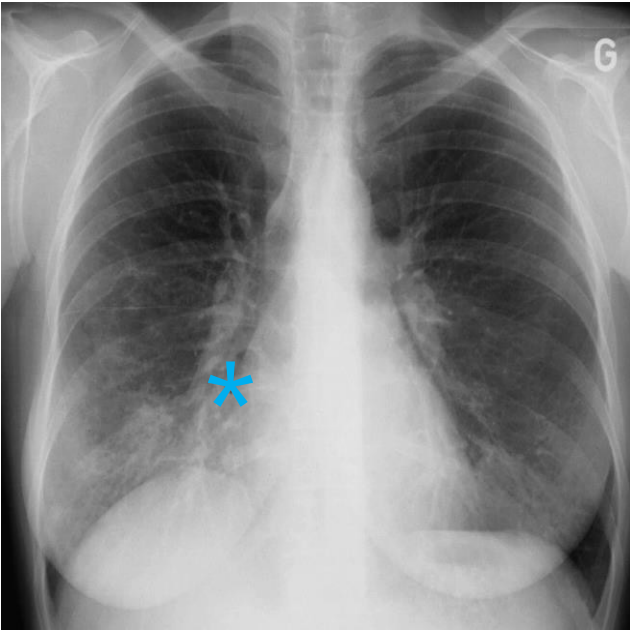
- / 若二者的边缘 (轮廓) 无法分辨, 则提示二者相邻 (存在剪影征)
- / 若二者的边缘 (轮廓) 清晰可见, 则提示二者不相邻 (无剪影征)。

该征象对定位肺部阴影具有重要价值, 其原理基于心影边界与肺特定部分毗邻。

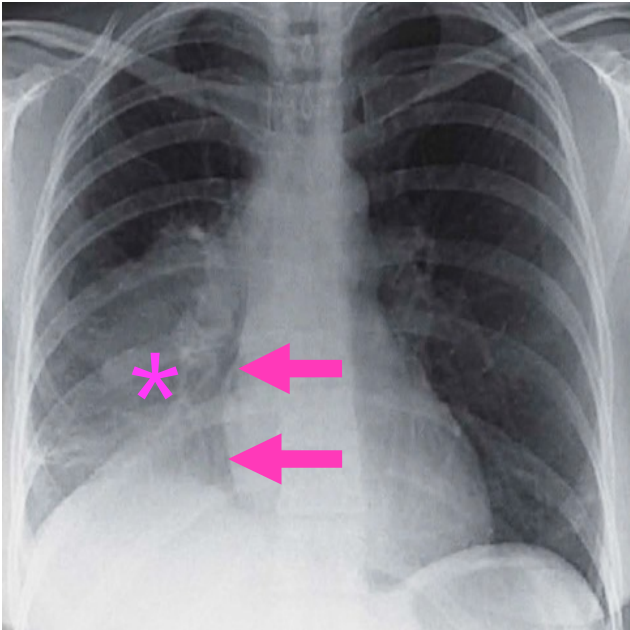
- / 右心影毗邻右肺中叶内侧段
- / 左心影毗邻舌叶

实变 (本例中为肺炎) 的密度与心脏相近。若实变位于左肺下叶, 位置较心脏更靠胸腔后方, 则不存在剪影征 (即, 可见左心室正常轮廓)。

存在剪影征 (即, 左心缘正常轮廓消失)。实变 (密度与心脏相近) 位于毗邻左心室的舌叶内。



Consolidation (in this case pneumonia, blue) is in the middle lobe. The silhouette sign is present (i.e., the normal silhouette of the right atrium is not clearly seen).



Consolidation (in this case pneumonia, pink) is in the right lower lobe, which is located more posteriorly in the chest than the heart, the silhouette sign is absent (i.e., the normal silhouette of the right atrium is seen).

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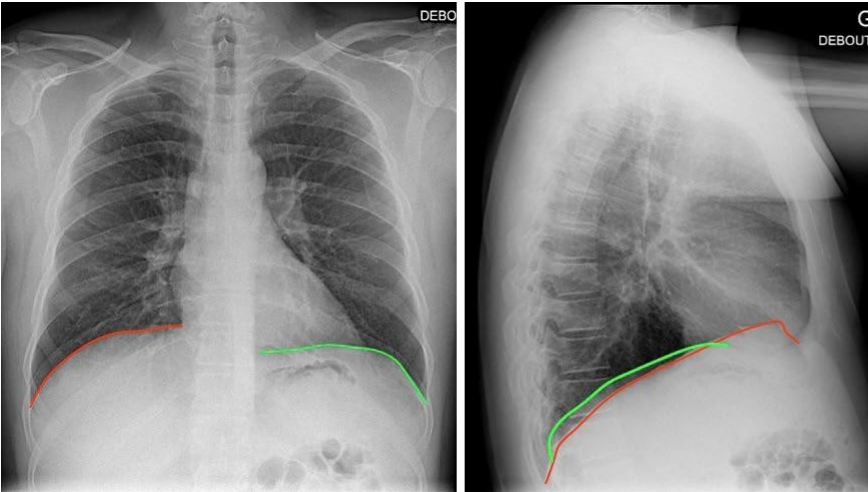
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实变（本例中为肺炎，蓝色）位于中叶。存在剪影征（即，右心房正常轮廓模糊不清）。

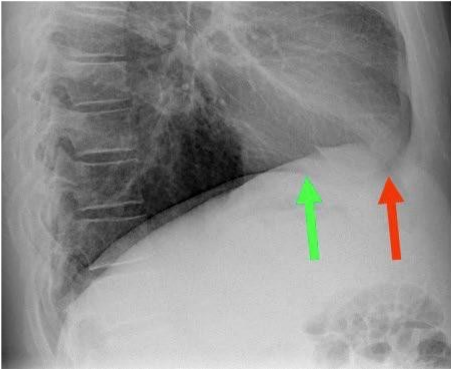
实变（本例中为肺炎，粉色）位于右肺下叶，位置较心脏更靠胸腔后方，则不存在剪影征（即，可见右心房正常轮廓）。

This silhouette sign can also be used for lesion localisation on lateral CXRs.

It also explains why the **left diaphragm (green line)** can be seen only to a point where it borders the heart (**green arrow**) while the **right diaphragm (red line)** is seen all the way to the anterior chest wall (**red arrow**).



The heart, the left diaphragm abutting the heart and the structures below the left diaphragm all have the same density and they are next to each other (the silhouette sign is present). The right diaphragm is seen as the interface between the air in the right lung and the abdominal soft tissues, which have a different density.



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剪影征同样适用于侧位 CXR 的病灶定位。

此外，该征象可解释以下现象：**左侧膈肌（绿线）** 仅在与心脏相邻区域（**绿色箭头**）显示边界，而**右侧膈肌（红线）** 则可完整显示至前胸壁（**红色箭头**）。这是因为心脏、与心脏相邻的左侧膈肌及左侧膈肌下方的结构密度相近且彼此相邻（存在剪影征）。右侧膈肌作为右肺内气体与腹腔软组织（密度不同）的界面，可清晰显示。

Soft Tissue Asymmetry on CXRs

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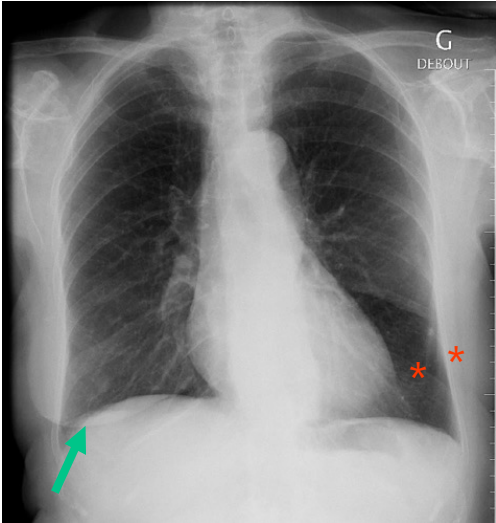
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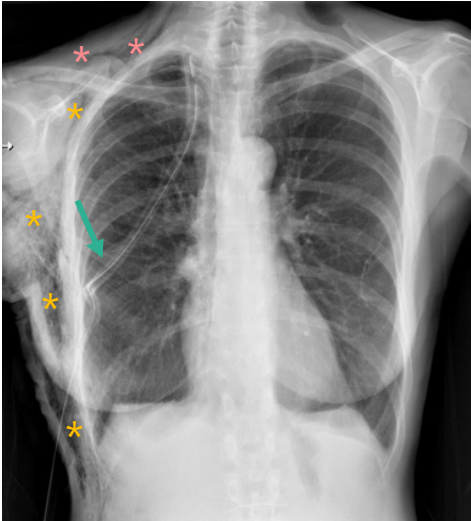
/ Soft Tissue Asymmetry on CXRs

An asymmetrically decreased soft tissue density can be seen in patients with mastectomy or sub-cutaneous emphysema (air in the soft tissues following trauma, pleural drain placement or infection with anaerobes).

An asymmetrically increased soft tissue density can be seen in the presence of a large soft tissue mass, hematoma or asymmetric breast tissue.



Decreased soft tissue density on the left (red asterisk) and breast asymmetry because of left mastectomy. Normal right breast contour (green arrow).



Irregular hyperlucent (very low-density) areas (yellow asterisks) along the right chest wall extending into the supraclavicular region (pink asterisks) because of soft tissue emphysema (air in the soft tissues) after thoracostomy tube (green arrow) placement to drain pneumothorax (see pages 60-63).

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/ CXR 见软组织不对称

乳腺切除术或皮下气肿（创伤、胸腔引流管置入或厌氧菌感染后导致的软组织内积气）的患者可见软组织密度不对称性降低。

在存在较大软组织肿块、血肿或不对称乳腺组织的情况下，可见软组织密度不对称性增加。

左侧软组织密度减低（红色星号），并因左侧乳腺切除术导致乳腺不对称。右侧乳腺轮廓正常（绿色箭头）。

沿右侧胸壁的不规则透亮区（极低密度，黄色星号），延伸至锁骨上区（粉色星号），此为胸腔引流管（绿色箭头）置入引流气胸后发生的软组织气肿（软组织内积气）表现（请参阅第 60-63 页）。

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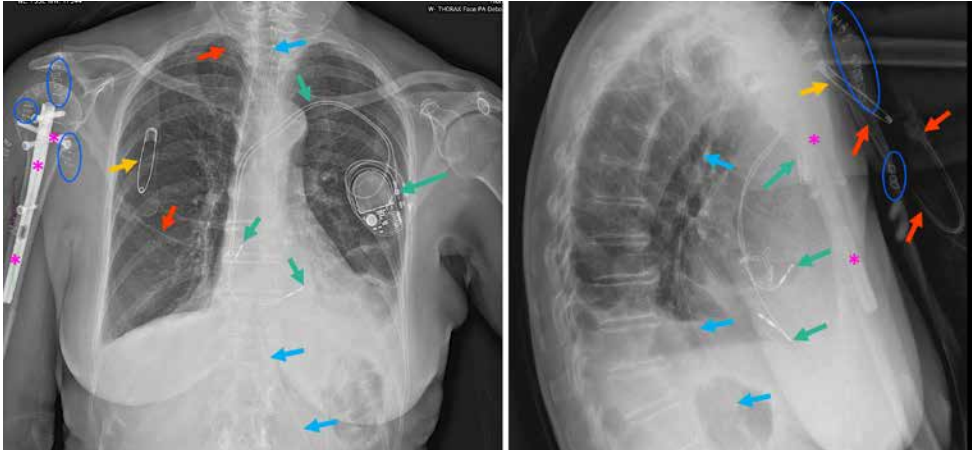
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/ Medical Devices and Other Foreign Bodies on CXRs

Medical devices are often seen on CXRs. They can be located inside the body (e.g., pacemakers, sternal wires, cardiac valve devices or replacements, nasogastric tubes, endotracheal tubes, pleural drainage tubes, dialysis catheters, osteosynthesis material) or outside the body but projecting on the CXR (e.g., oxygen tubes, electrodes for ECG, clamps).

Objects non-related to treatment can be also be seen on CXRs, e.g., buttons from hospital gowns, hair pins, hair braids, etc. These different types of medical devices and non-related foreign bodies are easily recognisable on CXRs.

To correctly locate a foreign body or a medical device, both a PA and a lateral CXR are necessary.



Patient with multiple medical devices seen on the CXR: Pacemaker with electrodes (green arrows), nasogastric tube (blue arrows), internal fixation hardware of the humerus (pink asterisks), Redon drain (red arrows), safety pin (yellow arrows), surgical staples (dark blue areas).

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/ CXR 见医疗装置和其他异物

CXR 上常见医疗装置。这些医疗装置既可能位于体内（如心脏起搏器、胸骨钢丝、心脏瓣膜装置或置换物、鼻胃管、气管内插管、胸腔引流管、透析导管、骨固定材料等），也可能位于体外但投射于 CXR 上（如氧气管、心电图电极、夹钳等）。

此外，CXR 上还可观察到与治疗无关的物体，如病号服纽扣、发夹、发辫等。上述各类医疗装置及无关的异物在 CXR 上均易于辨识。

在后前位和侧位 CXR 上准确定位异物或医疗装置是必要的。

在 CXR 上观察到多种医疗装置的患者：带电极的心脏起搏器（绿色箭头）、鼻胃管（蓝色箭头）、肱骨内固定硬件（粉色星号）、Redon 引流管（红色箭头）、安全别针（黄色箭头）、手术缝合钉（深蓝色区域）。

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Bone abnormalities include fractures, degenerative bone changes, metastatic bone disease or direct bone invasion by adjacent tumours.

Rib fractures are common in blunt chest trauma. They can be isolated or multiple and they can be associated with life-threatening complications including pneumothorax and haemothorax, lung contusion and laceration, brachial plexus and large vessel injury.

Isolated rib fractures are often hardly visible on CXRs, whereas multiple fractures are more easily recognised. Multiple rib fractures (yellow circles) typically involve ribs 4 – 10.

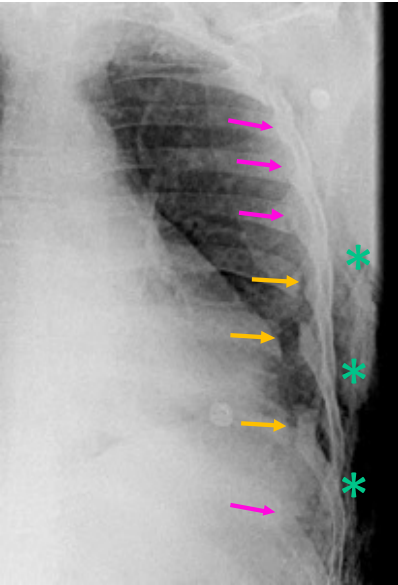
Fractures of ribs 1-3 indicate high velocity trauma.

Segmental fractures of > 3 ribs produce paradoxical chest wall movement with respiration. This is called flail thoracic segment or flail chest.

Older rib fractures are recognised on CXRs because of callus formation

> see eBook chapter on Musculoskeletal Imaging

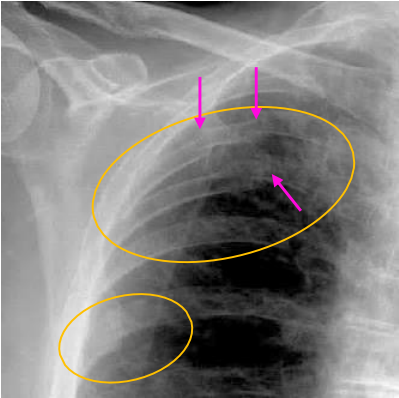
Rib fractures can also occur because of meta-static disease (pathologic fractures).



Patient with multiple rib fractures following a motor vehicle accident. Fractures are well seen whenever the rib ends are displaced (yellow arrows). Fractures are less conspicuous whenever the rib ends are not displaced (pink arrows). Associated soft tissue emphysema (green asterisks), see page 56.

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Bone abnormalities may be easily overlooked on CXRs and, therefore, must be looked for very carefully.



Detail of a PA CXR of a patient with multiple rib fractures (yellow ellipses) following a motor vehicle accident 8 weeks earlier. Fracture lines (pink arrows) are poorly seen and calcified callus is visible. The fractures are almost healed (complete healing usually occurs by 12 weeks).

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/ CXR 上骨病变

骨骼异常包括骨折、退行性骨改变、转移性骨疾病或邻近肿瘤的直接骨侵犯。

肋骨骨折在胸部钝伤中很常见。其可为孤立性或多发性，且可能伴随危及生命的并发症，包括气胸、血胸、肺挫伤与撕裂伤、臂丛神经及大血管损伤。

孤立性肋骨骨折在 CXR 上常难以显影，而多发性骨折则更易识别。多发性肋骨骨折（黄色圆圈）常发生在第 4 - 10 肋。

第 1-3 肋骨骨折提示高速创伤。

> 3 根肋骨的节段性骨折会导致呼吸时出现矛盾性胸壁运动，此现象称为连枷胸段或连枷胸。

陈旧性肋骨骨折因骨痂形成，在 CXR 上可被识别

> 请参阅《骨骼肌肉影像学检查》电子书章节

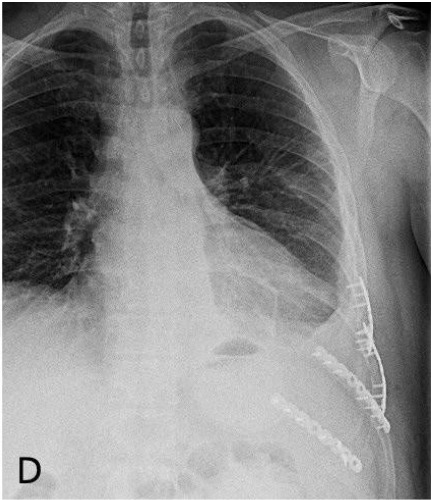
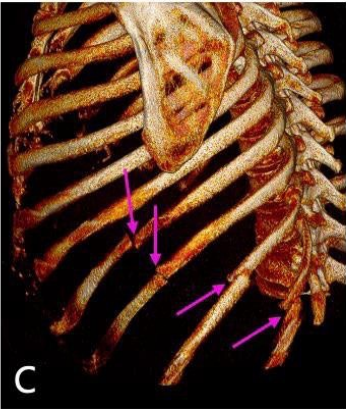
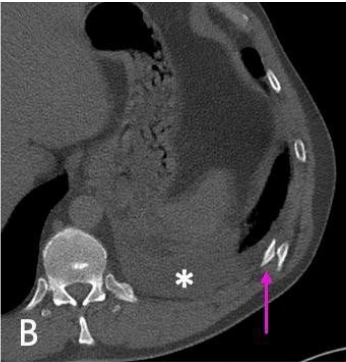
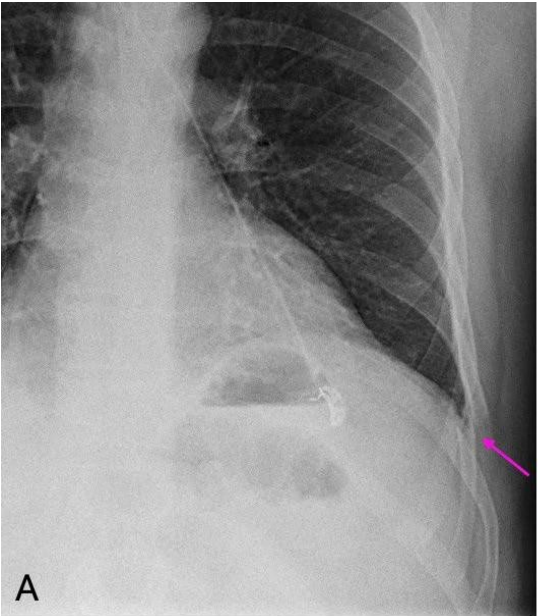
转移性疾病亦可发生肋骨骨折（病理性骨折）。

<=> 注意

骨骼异常在 CXR 上易被漏诊，因此需仔细观察。

机动车事故后患者伴发多发肋骨骨折。当肋骨断端移位时（黄色箭头），骨折清晰可见。当肋骨断端未移位时（粉色箭头），骨折不太明显。伴发的软组织气肿（绿色星号），请参阅第 56 页。

8 周前机动车事故后的多发性肋骨骨折（黄色椭圆形）患者的后前位 CXR 细节。骨折线（粉色箭头）不明显，可见钙化骨痂。骨折近乎愈合（通常在 12 周完全愈合）。



Detail of a PA CXR showing a displaced fracture of rib 10 (pink arrows) in a patient with a motor vehicle accident (A). As abdominal injuries were suspected clinically, a CT was obtained. The CT examination (B-C) shows fractures of ribs 9 – 12 (pink arrows) and a haemorrhagic pleural effusion (*) → see previous page Rib plating was carried out for flail chest. D. PA CXR obtained after rib plating.

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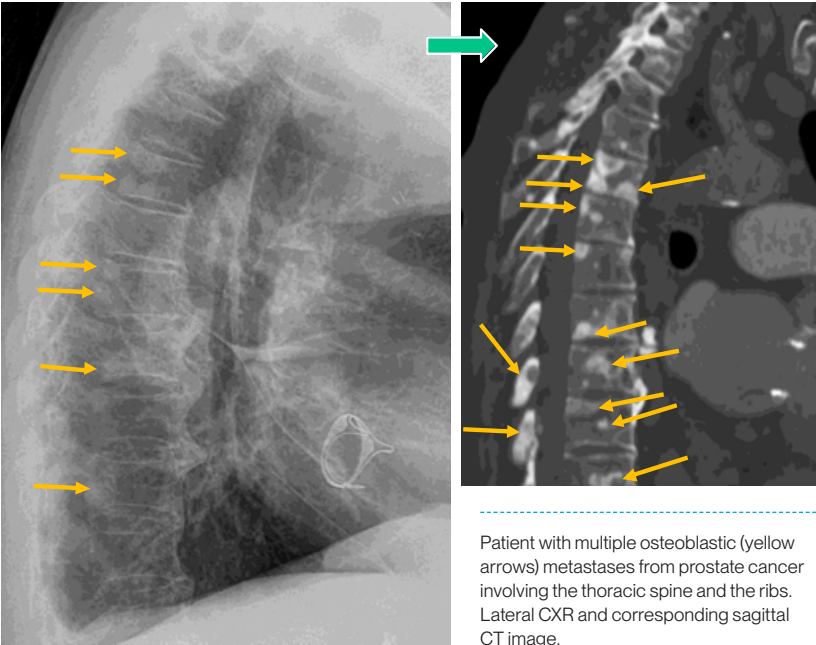
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机动车事故的患者第 10 肋错位骨折（粉色箭头）的后前位 CXR 细节 (A)。由于临床怀疑腹部损伤，进行了 CT 检查。CT 检查 (B-C) 显示第 9 – 12 肋骨骨折（粉色箭头）和血性胸腔积液 (*) → 见上页对连枷胸进行肋骨内固定术。D. 肋骨内固定术后获得的后前位 CXR。

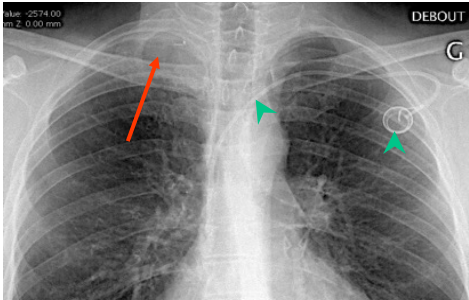
Bone is the third most common site of metastasis behind lung and liver. Bone metastases are classified as osteolytic, osteoblastic or mixed. Osteolytic metastases are characterised by destruction of bone; they are most often seen in multiple myeloma, lung cancer and non-Hodgkin lymphoma.



Patient with multiple osteoblastic (yellow arrows) metastases from prostate cancer involving the thoracic spine and the ribs. Lateral CXR and corresponding sagittal CT image.

Osteoblastic (osteosclerotic) metastases are characterised by new bone deposition. This deposition pattern is typically seen in prostate cancer, small cell lung cancer and Hodgkin lymphoma. The mixed pattern corresponds to both osteolytic and osteoblastic bone lesions or to lesions with both components.

Osteolysis of ribs and vertebral bodies can also occur by direct bone invasion from lung or pleural tumours.



Patient with a Pancoast tumour (= apical lung tumour, most often a primary squamous cell carcinoma of the lung at histology). Note absent visualisation of the 3rd right rib due to osteolysis (red arrow) by the tumour. On this PA CXR, the tumour appears as a soft tissue opacity at the lung apex. Compare with the normal left lung apex. Port-a-cath (green arrowheads) for chemotherapy.

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骨是继肺、肝之后第三最常见的转移部位。骨转移分为溶骨性、成骨性或混合性。溶骨性转移以骨质破坏为特征；最常见于多发性骨髓瘤、肺癌和非霍奇金淋巴瘤。

成骨性（骨硬化性）转移以新骨沉积为特征。这种沉积模式典型地见于前列腺癌、小细胞肺癌和霍奇金淋巴瘤。混合性模式同时包含溶骨性与成骨性病变，或两种成分并存。

肺或胸膜肿瘤直接骨侵犯也可导致肋骨和椎体骨质溶解。

前列腺癌患者出现多发性成骨性转移（黄色箭头），累及胸椎及肋骨。侧位 CXR 上，肿瘤表现为肺尖的软组织阴影。与正常左肺尖对比。用于化疗的静脉导管 (Port-a-cath)（绿色箭头）。

肺上沟瘤（= 肺尖肿瘤，组织学多为原发性肺鳞状细胞癌）患者。注意，由于肿瘤引起的骨质溶解（红色箭头），右侧第 3 肋未显影。在前后位 CXR 上，肿瘤表现为肺尖的软组织阴影。与正常左肺尖对比。用于化疗的静脉导管 (Port-a-cath)（绿色箭头）。

/ Pathology of the Pleura and Pleural Cavity

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/ Pleural Effusion

Pleural disorders include effusion, pneumothorax, pleural soft tissue thickening and plaque formation.

Pleural effusion = abnormal fluid accumulation in the pleural cavity.

Normally, the pleural cavities contain about 15 ml of serous fluid. A

physiologic imbalance between fluid production and absorption results in a pleural effusion.

Pleural effusions can be divided into transudates and exudates, which differ in terms of protein and lactate dehydrogenase concentration and specific gravity (all three are lower in transudates).

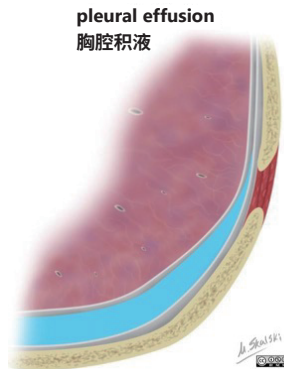
Transudates are mainly seen in cardiac failure, nephrotic syndrome and cirrhosis. They are caused by

increasing hydrostatic pressure or by decreasing oncotic capillary pressure.

Exudates are a consequence of changes in microcirculation or lymphatic pleural drainage. Exudates occur in chest neoplasms including metastases, infection and autoimmune diseases.

Pleural effusions result in passive atelectasis of the adjacent lung portions > see page 127.

Illustration courtesy of Matt Skalski, <https://radiopaedia.org/?lang=us> Radiopaedia.org. From the case <https://radiopaedia.org/cases/53333?lang=us> rID: 53333



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/ 胸腔积液

胸膜病变包括积液、气胸、胸膜软组织增厚和斑块形成。

胸腔积液 = 胸膜腔内有异常液体聚集。

正常情况下, 胸膜腔内含有约 15 ml 浆液。当液体生成与吸收之间的生理平衡被打破时, 即可引发胸腔积液。

胸腔积液可分为漏出液与渗出液, 二者在蛋白质含量、乳酸脱氢酶水平及比重上存在差异 (漏出液的这三项指标均较低)。

漏出液主要见于心力衰竭、肾病综合征及肝硬化, 其发生机制为毛细血管静水压升高或毛细血管胶体渗透压降低。

渗出液则是由于微循环或胸膜淋巴引流改变的结果。渗出液发生于胸部肿瘤 (包括转移瘤)、感染及自身免疫性疾病。

胸腔积液可导致邻近肺组织被动性肺不张 > 参见第 127 页。

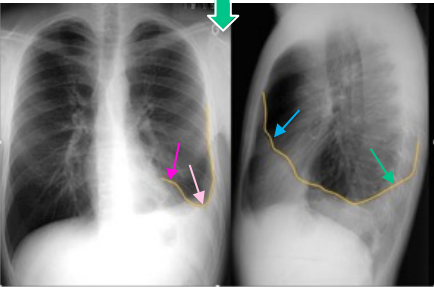
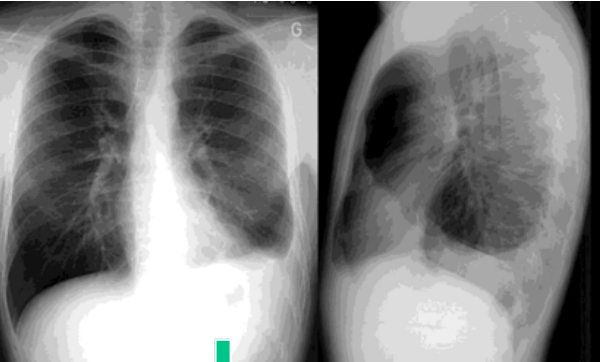
<!=> 注意

- / 直立后位和前位 CXR 对少量胸腔积液敏感性较低。
- / 胸腔积液 < 300 ml 时, 直立 CXR 无法检出。
- / 侧位 CXR 可较直立后位和前位投照更早检出胸腔积液。积液量 >100 ml 时, 侧位 CXR 可检出。积液可在后肋膈角处看到。
- / 仰卧位 CXR 可能漏诊大量胸腔积液, 因积液积聚于后部, 导致密度改变不易显现。
- / 超声检查 (US) 可检出极少量积液。
- / 仅通过影像学表现, CXR 和超声无法区分漏出液、渗出液、脓液、血液或乳糜液。

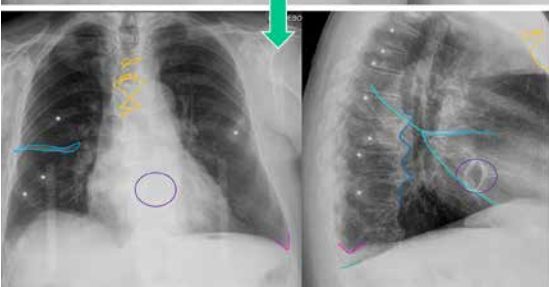
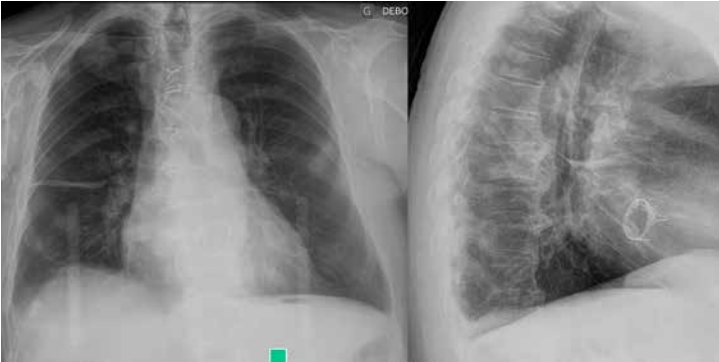
图示由 Matt Skalski 提供, <https://radiopaedia.org/?lang=us> Radiopaedia.org。摘自病例 <https://radiopaedia.org/cases/53333?lang=us> rID: 53333

<!=> ATTENTION

Radiologic features of pleural effusions include blunting of the costophrenic angles, meniscus sign (in large effusions), fluid accumulation in the lung fissures and mediastinal shift away from the effusion (in very large effusions).



Massive pleural effusion with meniscus sign (yellow line) in the lateral, (light pink) posterior (green arrow) and anterior (blue arrow) costophrenic angles, as well as in the cardiophrenic (pink arrow) angle.



Pleural effusion with meniscus sign (pink lines) on the left, blunting of the posterior right (green line) costophrenic angle and fluid in the horizontal fissure (light blue line) and in the rightoblique fissure (turquoise line). Mitral valve replacement (purple circle). Cerclage wires (yellow lines) after median sternotomy. Note that the patient has multiple osteoblastic metastases light pink asterisks). Osteophytes (dark line).

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<!=> 注意

胸腔积液的影像学特征包括肋膈角变钝、半月板征 (大量积液时)、肺裂积液和纵隔向积液对侧移位 (极大量积液时)。

左侧胸腔积液伴半月板征 (粉色线), 右后肋膈角变钝 (绿线), 水平裂 (浅蓝色线) 及右斜裂 (蓝绿色线) 内可见积液。二尖瓣置换术 (紫色圆环)。胸骨正中切开后环扎钢丝 (黄色线)。需注意, 该患者存在多发性成骨性转移 (浅粉色星号)。骨赘 (深色线)。

大量胸腔积液伴半月板征 (黄色线), 见于侧肋膈角 (浅粉色箭头)、后肋膈角 (绿色箭头)、前肋膈角 (蓝色箭头) 以及心膈角 (粉色箭头)。

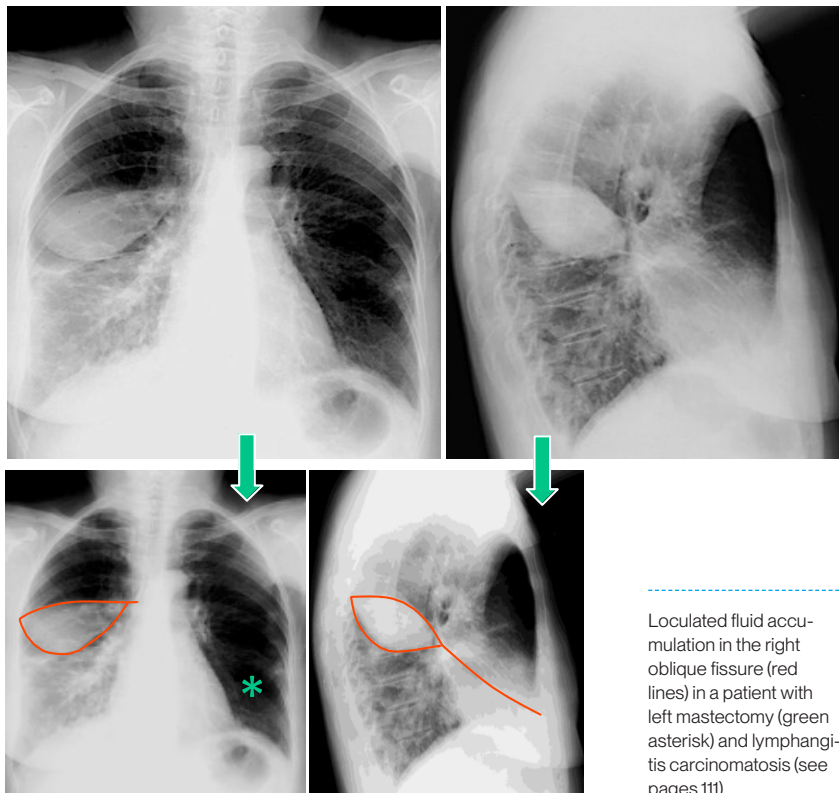
Interlobar fluid accumulation is most frequently seen in patients with congestive cardiac failure. It is either a transudate due to heart failure or it is the end result of an inflammatory process (less often).

Some interlobar fluid accumulations are walled off by pleural scarring while other fluid accumulations enter the fissures as an extension from the free pleural space.

<!=> ATTENTION

- / Loculated pleural effusion (= trapped pleural fluid does not layer out in dependent position) can mimic pleural masses.
- / Causes of pleural fluid loculation include pleural scarring, thick fluid with pus (empyema) or lung distortion, e.g., following surgery.

During heart failure pleural reactions are very frequent.



Loculated fluid accumulation in the right oblique fissure (red lines) in a patient with left mastectomy (green asterisk) and lymphangitis carcinomatosa (see pages 111)

Upon resorption, scars or thickened pleura remain.

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叶间积液最常见于充血性心力衰竭患者。其可为心力衰竭引起的漏出液，或为炎症过程的最终转归（较为少见）。

部分叶间积液被胸膜瘢痕包裹，而另一些积液则从游离胸膜腔延伸至肺裂内。

心力衰竭时，胸膜反应极为常见。

积液吸收后，瘢痕或胸膜增厚仍然存在。

<!=> 注意

- / 包裹性胸腔积液 (= 被困积液无法在体位低位均匀分布) 可类似胸膜肿块。
- / 胸腔积液分隔的原因包括胸膜瘢痕形成、含脓液的黏稠积液 (脓胸) 或肺结构扭曲，如术后。

左侧乳腺切除术后 (绿色星号) 合并癌性淋巴管炎 (参见第 111 页) 患者的右斜裂内包裹性积液 (红色线)。



<!=> ATTENTION

The typical aspect of loculated pleural fluid accumulations on CXRs includes an elongated opacity along the direction of the fissures and with tapering ends.

CT is usually not needed to make the diagnosis unless the opacities fail to resolve after congestive cardiac failure treatment.



Loculated fluid accumulations in the right oblique fissure (orange asterisks) and in the horizontal fissure (blue asterisks) in a patient with congestive cardiac failure. Note cardiomegaly (pink arrow) and blunted left and right posterior costophrenic angles (green arrows) due to bilateral pleural effusions. Corresponding CT images with axial (A), coronal (B) and sagittal (C) reconstructions of the same patient show pleural effusions trapped in the right oblique (orange asterisks) and horizontal (blue asterisks) fissures and free pleural fluid bilaterally (green asterisks). As the patient is lying on his back, the free pleural fluid extends posteriorly (yellow arrow-heads) and laterally (purple arrowhead) along the pleural cavity.

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<!=> 注意

CXR 上包裹性胸腔积液的典型表现为沿肺裂走行的长条形阴影，两端渐细。

通常不需要 CT 检查即可诊断，除非充血性心力衰竭治疗后阴影仍未消退。

充血性心力衰竭患者的右斜裂（橙色星号）及水平裂（蓝色星号）内包裹性积液。注意由于双侧胸腔积液导致的心脏扩大（粉色箭头）以及左右肋膈角变钝（绿色箭头）。同一患者的轴位 (A)、冠状位 (B) 及矢状位 (C) 重建 CT 图像显示胸腔积液聚积在右斜裂（橙色星号）及水平裂（蓝色星号）内和双侧游离胸膜腔积液（绿色星号）。患者仰卧位时，游离胸膜腔积液沿胸膜腔的后部（黄色箭头）和外侧（紫色箭头）延伸。

/ Pneumothorax

Pneumothorax = accumulation of air in the pleural space

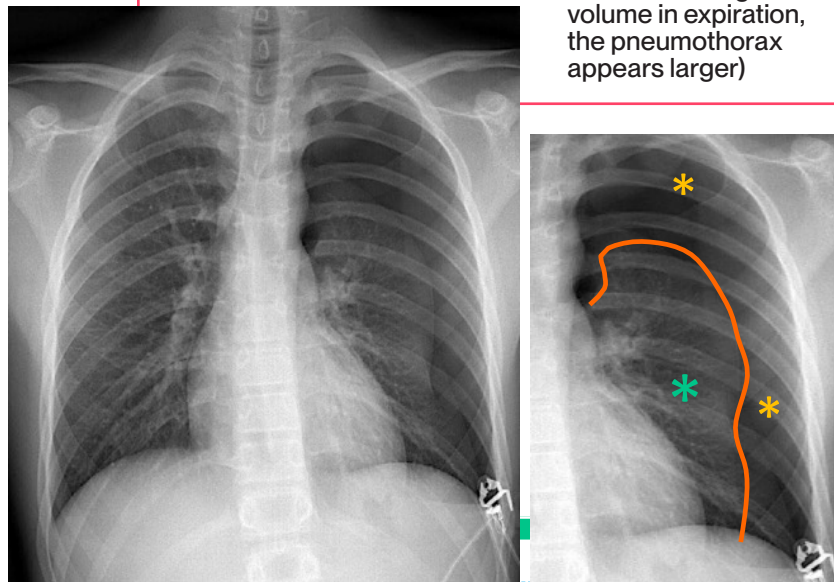
Causes include:

- / trauma (with rib fractures) and percutaneous lung biopsy
- / malignant tumours (typically osteosarcoma metastases)
- / emphysema, honeycomb lung (pulmonary fibrosis = destroyed and fibrotic lung tissue with cystic airspaces and fibrous walls and loss of acinar architecture)
- / spontaneous pneumothorax (typically in thin and tall adolescents and in smokers)

<!=> ATTENTION

Signs of a pneumothorax on CXRs include:

- / the lung "edge" (= visceral pleura) is outlined by air in the pleural cavity
- / usually, a pneumothorax is well seen on a PA CXR in inspiration – however, a small pneumothorax is better seen on a PA CXR done in expiration (because of reduced lung volume in expiration, the pneumothorax appears larger)



Spontaneous left pneumothorax (yellow asterisks). The left visceral pleura (orange line) is seen as a thin line outlining the collapsed left lung (green asterisk).

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/ 气胸

气胸 = 胸膜腔积气

病因包括:

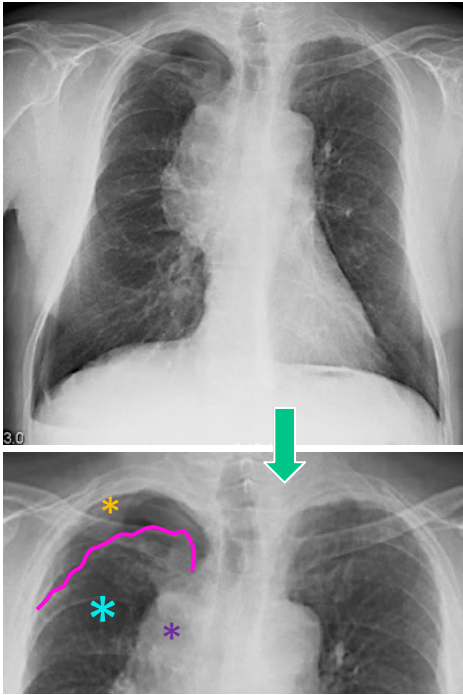
- / 创伤 (合并肋骨骨折) 与经皮肺活检
- / 恶性肿瘤 (典型为骨肉瘤转移)
- / 肺气肿、蜂窝肺 (肺纤维化 = 肺组织破坏、纤维化, 伴囊性气腔及纤维性壁, 腺泡结构丧失)
- / 自发性气胸 (多见于体型瘦高的青少年及吸烟人群)

<!=> 注意

CXR 上的气胸征象包括:

- / 肺 "边缘" (= 脏层胸膜) 被胸膜腔内的气体清晰勾勒
- / 通常, 吸气时后前位 CXR 可清晰显示气胸, 但少量气胸在呼气时后前位 CXR 上更加清晰 (由于呼气时肺容积减小, 气胸显示更大)

左侧自发性气胸 (黄色星号)。左侧脏层胸膜 (橙色线) 为一条细线, 勾勒出萎陷的左肺 (绿色星号)。

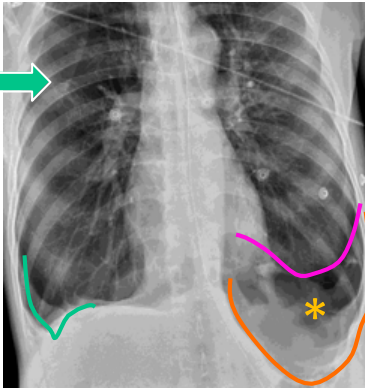


On erect CXRs, a small pneumothorax is typically seen at the lung apices. The figure above shows a small right pneumothorax (yellow asterisk) after CT-guided biopsy of a large mediastinal mass (purple asterisk). The right visceral pleura (pink line) is seen as a thin line outlining the partially collapsed left lung (turquoise asterisk).

On supine CXRs, the only sign of a pneumothorax (yellow asterisk) may be an abnormally deepened costo-phrenic angle, known as the “deep-sulcus sign” (orange line). It is due to collection of air basally within the non-dependent regions of the lung in the supine position.



Deep sulcus sign (orange line) on the left. Visceral pleura (pink line) of the partly collapsed left lung. Left pneumothorax (yellow asterisk). Normal lateral right costophrenic angle (green line).



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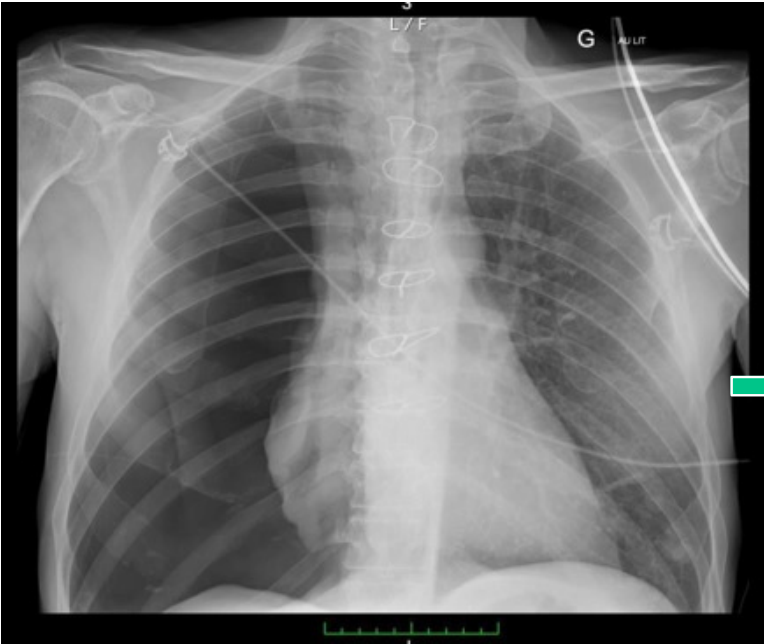
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在仰卧位 CXR 上，气胸（黄色星号）的唯一征象可能是肋膈角异常加深，称为“深沟征”（橙色线）。这是由于仰卧位时气体基本上会聚积于肺非依赖区。

左侧深沟征（橙色线）。部分萎陷左肺的脏层胸膜（粉色线）。左侧气胸（黄色星号）。正常右侧肋膈角（绿色线）。

直立位 CXR 上，少量气胸典型地见于肺尖。上图显示一个纵隔大肿块（紫色星号）CT 引导下活检后右侧少量气胸（黄色星号）。右侧脏层胸膜（粉色线）为一条细线，勾勒部分萎陷的左肺（蓝绿色星号）。

Tension pneumothorax occurs when air continues to penetrate the pleural cavity. This leads to further progressive lung compression and an increased volume of the affected hemithorax.

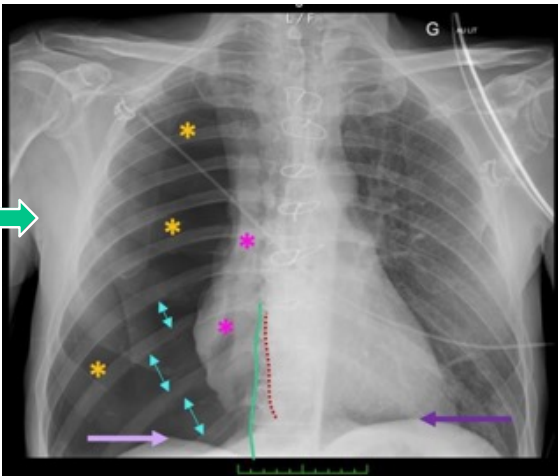


Tension pneumothorax (yellow asterisks) after cardiac surgery. The right lung (pink asterisks) is entirely collapsed. Shift of the mediastinum to the left (note that the right cardiac border (dark red line) projects medially of the right paraspinal line (green line)). Expansion of the right hemithorax and increased distance between the ribs (turquoise arrows) of the right hemithorax. Inferior displacement of the right hemidiaphragm (light purple arrow) in comparison to the left hemidiaphragm (purple arrow).

<!=> ATTENTION

Signs of a tension pneumothorax on CXRs include:

- / the mediastinum is displaced away from the pneumothorax
- / the diaphragm is depressed and
- / the distance between the ribs is larger



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当气体持续进入胸膜腔, 可发生张力性气胸, 导致患侧肺进一步进行性压缩和患侧胸腔容积增大。

<!=> 注意

CXR 上的张力性气胸征象包括:

- / 纵隔向气胸对侧移位
- / 患侧膈肌受压和
- / 患侧肋骨间距增宽

心脏手术后的张力性气胸 (黄色星号)。右肺 (粉色星号) 完全萎陷。纵隔向左侧移位 (注意右心缘 (深红色线) 投影于右椎旁线 (绿色线) 的内侧)。右侧胸腔扩张, 右侧胸腔肋骨间距增大 (蓝绿色箭头)。右侧膈肌 (淡紫色箭头) 较左侧膈肌 (紫色箭头) 下移。

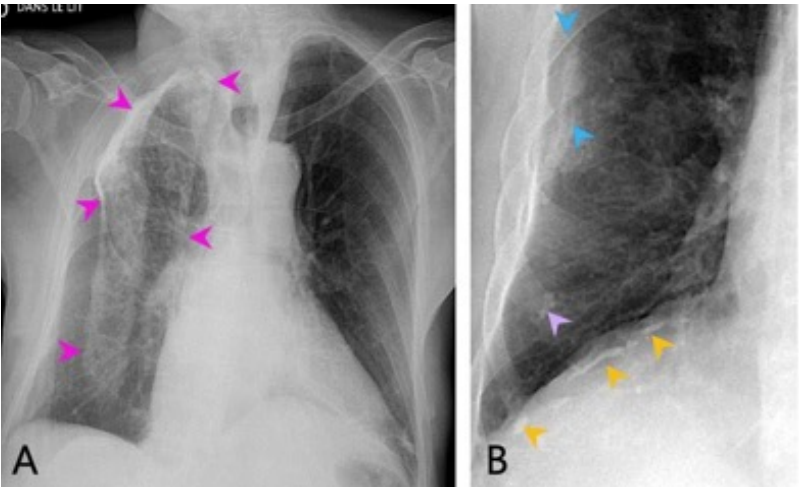
/ Pleural Thickening and Plaques

Pleural thickening = descriptive term, which corresponds to thickening of the visceral or parietal pleura. It can occur because of infection (e.g., tuberculosis, pleural empyema) and trauma (delayed complication of haemothorax) or it can be a manifestation of pleural plaques or of pleural tumours. Pleural plaques are the most common manifestation of asbestos exposure. Neoplastic conditions causing

pleural thickening include pleural mesothelioma, pleural metastases and tumours with secondary pleural invasion.

Calcification of pleural plaques is common especially in patients with asbestos

exposure, which tends to involve the diaphragmatic pleura. Calcified pleural plaques are also seen in tuberculosis, after empyema and haemothorax. The plaques, which originate from the parietal pleura, most often involve the lower chest pleura.

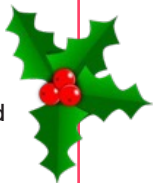


Two different patients with calcified pleural plaques. A. Large calcified plaque (pink arrowheads) in a patient with a previous history of tuberculosis. B. Patient with asbestos exposure and calcified plaques along the diaphragm (yellow arrowheads), anterior/posterior pleura (purple arrowhead) and lateral pleura (blue arrowheads). The left lateral plaque shows soft tissue thickening and calcifications.

<!=> ATTENTION

Signs of pleural plaques on CXRs include:

- / pleural-based convex soft tissue opacities when these are perpendicular to the film/detector and poorly defined opacities when these are parallel to the film/detector
- / holy leaf aspect (= irregular and thickened plaque edges)
- / calcifications
- / blunted costophrenic angles (the differential diagnosis includes pleural effusion). However most often the costophrenic angles and the apical pleura are spared by pleural plaques



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胸膜增厚 = 描述性术语，指脏层胸膜或壁层胸膜增厚。其发生可由于感染（如结核、脓胸）、创伤（血胸的迟发并发症），也可能是胸膜斑块或胸膜肿瘤的表现。胸膜斑块是石棉暴露最常见的表现。引起胸膜增厚的肿瘤包括胸膜间皮瘤、胸膜转移瘤和肿瘤伴发胸膜浸润。

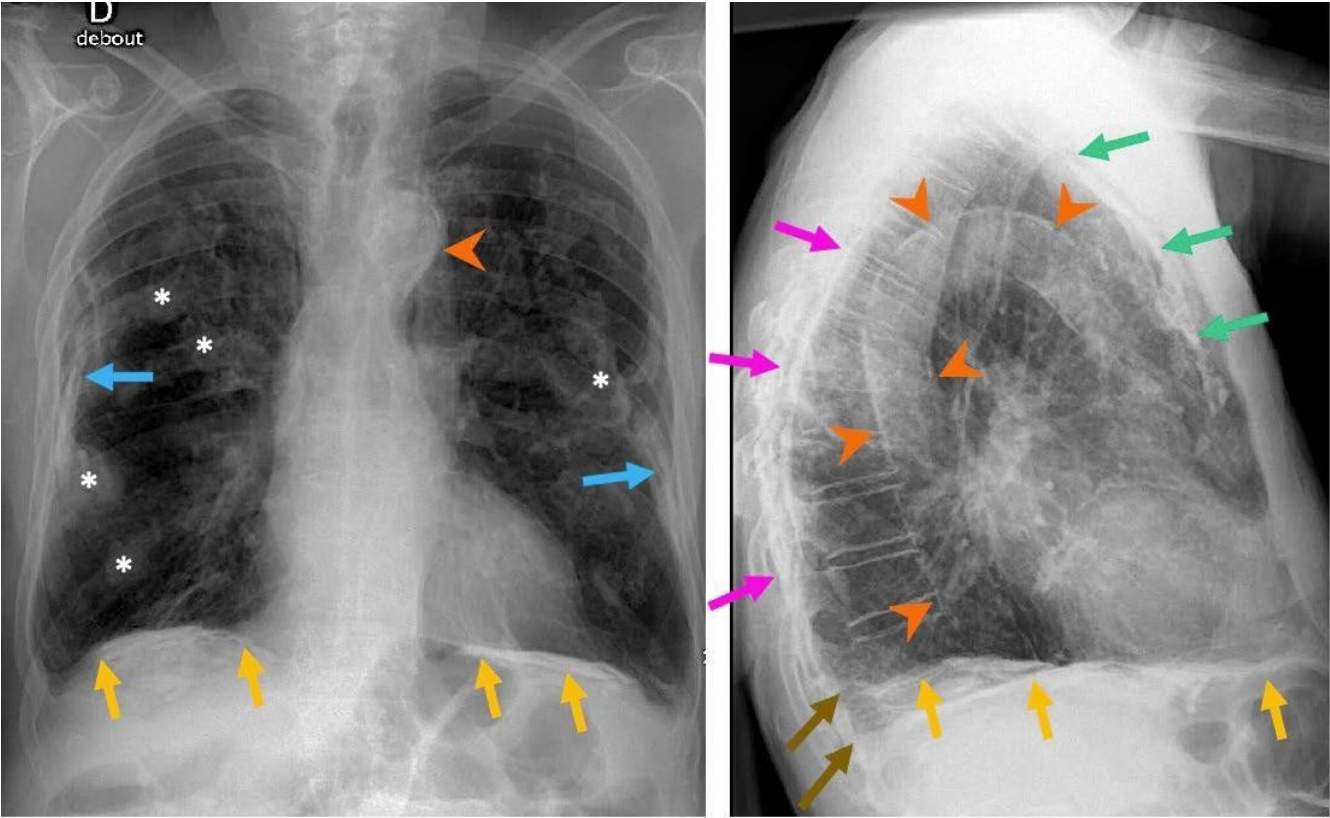
胸膜斑块的钙化较为常见，尤其在石棉暴露患者中，且常累及膈胸膜。钙化胸膜斑块也可见于结核、脓胸及血胸后。起源于壁层胸膜的斑块最常累及下肺胸膜。

<!=> 注意

CXR 上的胸膜斑块征象包括:

- / 当斑块与胶片/探测器垂直时，表现为基于胸膜的凸状软组织阴影；当斑块与胶片/探测器平行时，表现为边界不清的阴影
- / “圣叶征” (= 不规则且增厚的斑块边缘)
- / 钙化
- / 肋膈角变钝（鉴别诊断包括胸腔积液）。但胸膜斑块通常不累及肋膈角及肺尖胸膜

两例不同患者的钙化胸膜斑块。A. 有结核病既往史患者的大钙化斑块（粉色箭头）。B. 石棉暴露患者，膈肌（黄色箭头）、前/后胸膜（紫色箭头）及外侧胸膜（蓝色箭头）可见钙化斑块。左侧外侧斑块显示软组织增厚及钙化。



Patient with asbestos exposure and calcified pleural plaques along the diaphragm (yellow arrows), anterior pleura (green arrows), posterior pleura (pink arrows) and lateral pleura (blue arrows). Note that the anterior (green arrows) and posterior (pink arrows) plaques (*) show typical calcifications and a holy leaf aspect (*). Blunting of the costo-phrenic angles (brown arrows). Extensive aortic calcifications (orange arrowheads) due to atherosclerosis.

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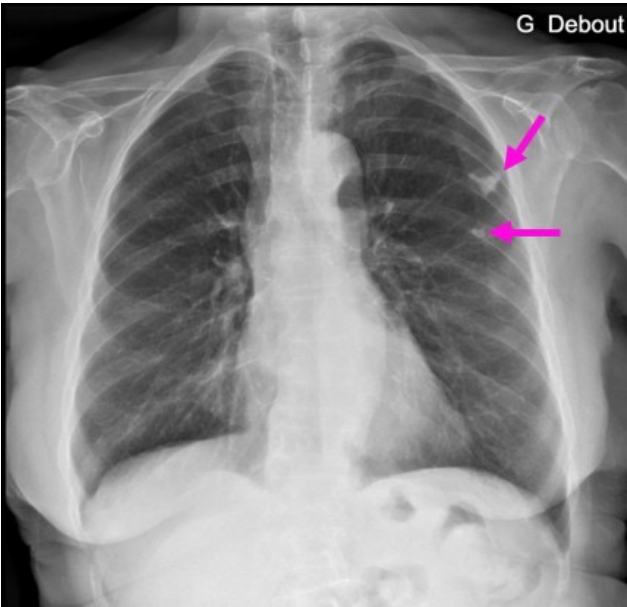
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石棉暴露患者，沿膈肌（黄色箭）、前胸膜（绿色箭）、后胸膜（粉色箭）及外侧胸膜（蓝色箭）的钙化胸膜斑块。注意前侧（绿色箭头）及后侧（粉色箭头）斑块（*）显示典型钙化及圣叶征（*）。肋膈角变钝（棕色箭头）。动脉粥样硬化引起的主动脉广泛钙化（橙色箭头）。

Pleural plaques are most often asymptomatic. They are found incidentally on a CXR. Most pleural plaques are benign and they do not require follow-up or aggressive treatment.



<!=> ATTENTION

CT is the imaging modality of choice to identify pleural plaques due to its high sensitivity and specificity compared to CXR. On CT, pleural plaques appear as quadrangular soft tissue thickenings ± calcifications.



Patient with incidentally found pleural plaques of the left anterolateral pleura (pink arrows) on a routine CXR (A). Corresponding axial CT image with bone window settings (B) shows that the plaque is almost entirely calcified. The patient also has an anterior mediastinal mass (see page 86).

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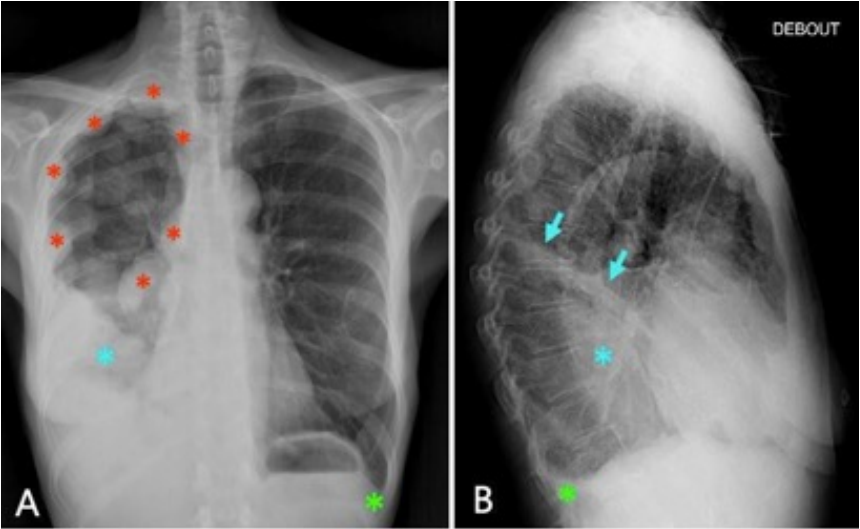
<!=> 注意

CT 敏感性和特异性高于 CXR，是识别胸膜斑块的影像学检查选择。在 CT 上，胸膜斑块表现为四边形软组织增厚 ± 钙化。

胸膜斑块大多无症状，常于 CXR 中偶然发现。多数胸膜斑块为良性，无需随访或积极治疗。

患者在常规 CXR (A) 中偶然发现左前外侧胸膜斑块 (粉色箭头)。对应的骨窗轴位 CT 图像 (B) 显示该斑块几乎完全钙化。该患者也有一个前纵隔肿块 (参见第 86 页)。

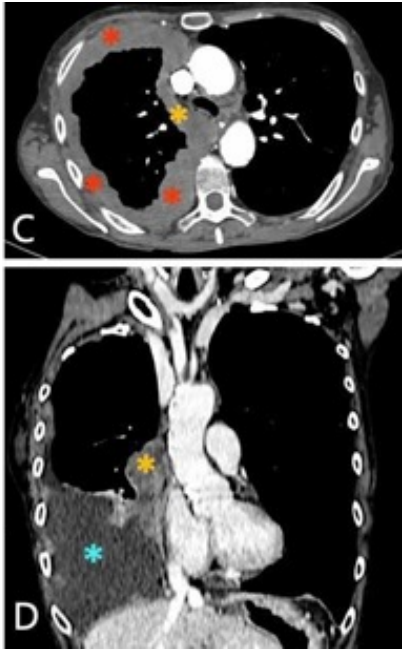
Most pleural malignant lesions are metastases from lung cancer, breast cancer, ovarian cancer or lymphoma. Pleural metastases are more common than pleural mesothelioma. The first manifestation of pleural metastases is pleural effusion due to impaired lymphatic drainage or increased capillary permeability.



Patient with histologically proven right pleural metastases from head and neck squamous cell carcinoma. Nodular pleural thickening (orange asterisks) on PA CXR (A) and lateral CXR (B), large right pleural effusion (turquoise) and small left pleural effusion (green asterisks). Corresponding axial (C) and coronal (D) CT images show extensive nodular thickening of the right pleura (orange asterisks) including the mediastinal pleura (yellow asterisks) corresponding to tumour dissemination and an associated right pleural effusion (turquoise asterisk). There was equally a small pleural effusion on the left (not shown).

<!=> ATTENTION

Characteristic imaging features of malignant pleural lesions include pleural effusion and nodular pleural thickening.



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大多数胸膜恶性病变为肺癌、乳腺癌、卵巢癌或淋巴瘤的转移。胸膜转移瘤较胸膜间皮瘤更常见。胸膜转移瘤的首发表现为胸腔积液，其机制为淋巴引流受损或毛细血管通透性增加。

<!=> 注意

恶性胸膜病变的影像学特征包括胸腔积液和结节性胸膜增厚。

经组织学证实头颈部鳞状细胞癌右侧胸膜转移的患者。前后位 CXR (A) 和侧位 CXR (B) 可见结节性胸膜增厚 (橙色星号)，大量右侧胸腔积液 (蓝绿色) 和少量左侧胸腔积液 (绿色星号)。相应的轴位 (C) 和冠状位 (D) CT 图像显示，右侧胸膜广泛结节性增厚 (橙色星号) 包括纵隔胸膜 (黄色星号)，对应为肿瘤播散，并伴有右侧胸腔积液 (蓝绿色星号)。左侧也有同等少量胸腔积液 (未显示)。

/ The Abnormal Mediastinum

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/ Pneumomediastinum

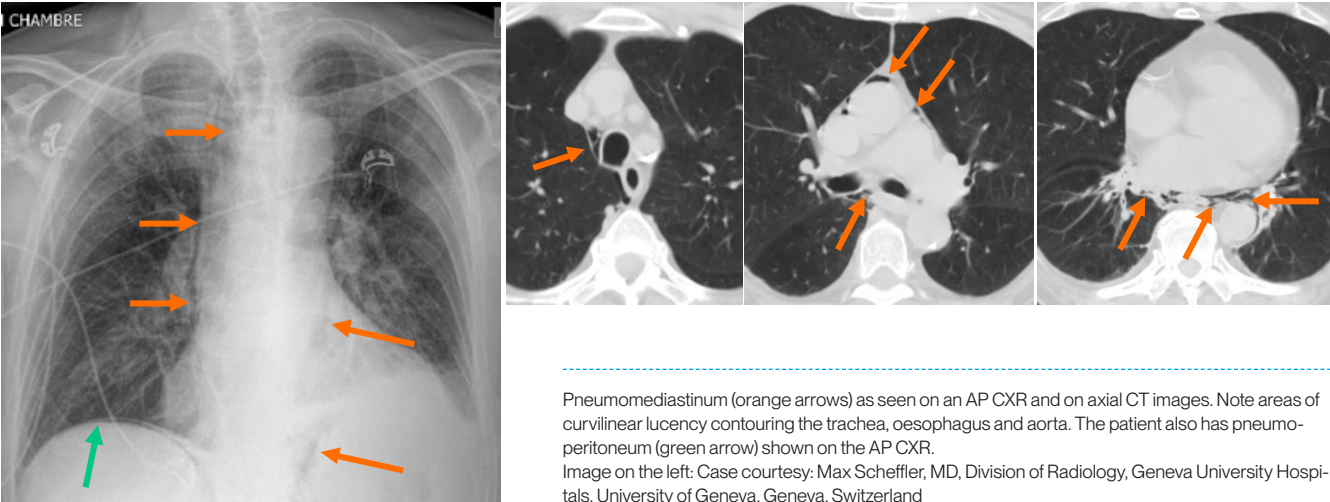
Pneumomediastinum = extraluminal gas in the mediastinum

Causes comprise chest trauma, vigorous exercise, post-surgical situations, tracheobronchial and oesophageal perforation (caused by endoscopy, foreign bodies or malignant tumours) and certain types of infection. As

with pneumothorax, spontaneous pneumomediastinum and tension pneumomediastinum can also occur. Except for tension pneumomediastinum, which can be rapidly fatal, pneumomediastinum usually requires no drainage.

Radiologic signs include curvilinear lucencies that contour the mediastinal structures. In children, the thymus may appear elevated and outlined by air (angel wing sign)

> see eBook chapter on Paediatric Radiology.



Pneumomediastinum (orange arrows) as seen on an AP CXR and on axial CT images. Note areas of curvilinear lucency contouring the trachea, oesophagus and aorta. The patient also has pneumoperitoneum (green arrow) shown on the AP CXR. Image on the left: Case courtesy: Max Scheffler, MD, Division of Radiology, Geneva University Hospitals, University of Geneva, Geneva, Switzerland

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/ 纵隔气肿

纵隔气肿 = 纵隔内出现腔外气体

病因包括胸部创伤、剧烈运动、术后状态、气管支气管和食管穿孔（可由内窥镜检查、异物或恶性肿瘤引起），以及特定类型的感染。与气胸类似，也可发生自发性和张力性纵隔气肿。其中，张力性纵隔气肿可能迅速致命，除此之外，纵隔气肿通常无需引流处理。

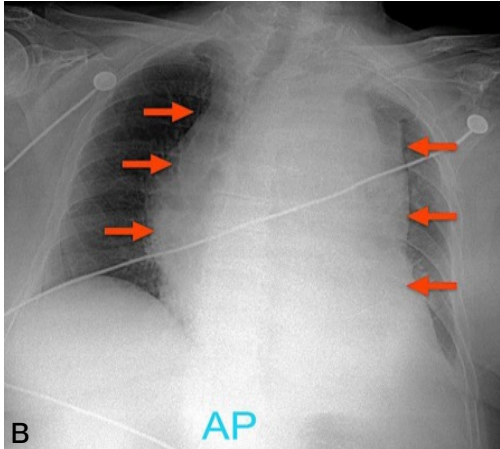
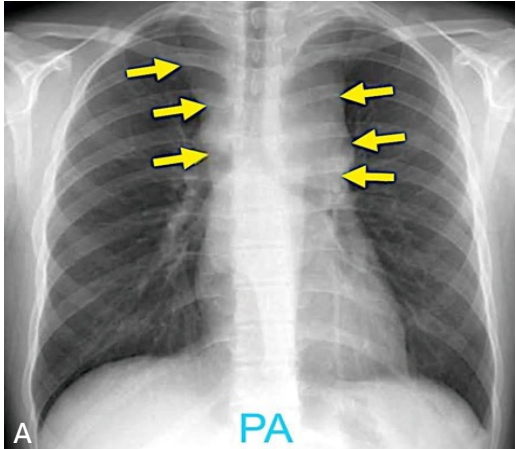
影像学表现包括弯曲透亮影并可勾勒出纵隔结构。在儿童中，胸腺可显示抬高并被气体勾勒（天使翼征）

> 请参阅《儿科放射学》电子书章节。

前后位 CXR 和轴位 CT 图像上显示纵隔气肿（橙色箭头）。注意弯曲透亮区勾勒出气管、食管及主动脉。在前后位 CXR 上，患者还合并气腹（绿色箭）。左图：病例来源：Max Scheffler 医学博士，日内瓦大学医院放射科，日内瓦大学，日内瓦，瑞士

/ Mediastinal Widening

On CXRs, the mediastinum is considered as widened when it is larger than 6cm on the PA projection or larger than 8 cm on the AP projection. Widening of the mediastinum has many different causes including neoplastic, infectious, traumatic and congenital. Some of the most important life-threatening concerns with a widened mediastinum include acute aortic dissection, acute aortic rupture and cardiac tamponade.



Two different patients with a widened mediastinum on the PA and on the AP projection, respectively. The patient in A had a lymphoma. The patient in B had traumatic aortic rupture with mediastinal haematoma.

<!=> ATTENTION

A widened mediastinum can also be caused by a poor CXR technique, e.g., due to inappropriate distance between the X-ray source and the detector plate or due to patient rotation. Therefore, assessing the quality of the CXR technique is very important before making the diagnosis of a widened mediastinum.

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/ 纵隔增宽

在 CXR 上, 如果纵隔在后前位投照上大于 6 cm 或在前后位投照上大于 8 cm, 即可认为纵隔增宽。纵隔增宽有多种原因, 包括肿瘤性、感染性、创伤性和先天性。纵隔增宽最需要关注的危及生命的一些情况包括急性主动脉夹层、急性主动脉破裂和心包填塞。

<!=> 注意

纵隔增宽也可能由 CXR 技术不佳所致, 例如, X 线源与探测器板距离不合适或由于患者体位旋转。因此, 在诊断纵隔增宽之前, 评估 CXR 技术的质量非常重要。

分别在后前位和前后位投照的两例不同纵隔增宽患者。A 患者患有淋巴瘤。B 患者患有创伤性主动脉破裂伴纵隔血肿。

/ Mediastinal Masses (MMs)

Slightly > 50% of mediastinal masses (MMs) are in the prevascular (anterior) mediastinal compartment. About 25% are in the visceral (middle) compartment and about 25% of MMs are in the paravertebral (posterior) compartment.

In many cases, contrast-enhanced CT (CE CT) in combination with clinical presentation ± MRI ± FDG PET CT are sufficient to make the diagnosis. However, image-guided or surgical histologic sampling can be necessary for a precise histologic tumour diagnosis and to guide further management.

If a large MM involves several compartments, to enable correct identification of the compartment from which a mass lesion originated, the “centre method” and the “structure displacement method” are used to interpret CT images.

- / the “centre method” states that the largest size of a mass lesion seen on axial CT images corresponds to the compartment from which the mass originated
- / the “structure displacement method” states that a large MM tends to displace structures from abutting

compartments, e.g., an anterior MM may displace posteriorly structures from the middle mediastinum

To diagnose MMs on CXRs several criteria are applied: the angle border sign and the silhouette sign.

- / the angle border sign allows distinguishing between a mediastinal and a pulmonary mass located next to the mediastinum > the sign is explained on the next page
- / the silhouette sign refers to the loss of normal borders of intrathoracic structures: for example, a mass in the right anterior mediastinum may obscure the SVC and the right heart border a mass in the posterior mediastinum may result in loss of the paraspinal stripes. The hilum overlay sign is a useful sign to localize mediastinal abnormalities, see next pages

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/ 纵隔肿块 (MM)

略高于 50% 的纵隔肿块 (MM) 位于血管前（前）纵隔区。约 25% 的病变位于内脏区（中）纵隔区，约 25% 的 MM 位于椎体旁（后）纵隔区。

在很多病例中，对比增强 CT (CE CT) 结合临床表现 ± MRI ± FDG PET-CT，足以做出诊断。然而，为了获得精准的组织学诊断并指导进一步治疗，仍需进行影像引导下或手术的组织学取样。

如果较大的 MM 累及多个区域，为了正确识别肿块起源的区域，CT 影像解读时可采用“中心法”和“结构移位法”。

- / “中心法”认为，肿块在轴位 CT 图像上最大截面的所在区域，即为其起源区域。
- / “结构移位法”认为，较大的 MM 会使邻近区域的结构移位，例如，前部 MM 可将中纵隔结构向后推移

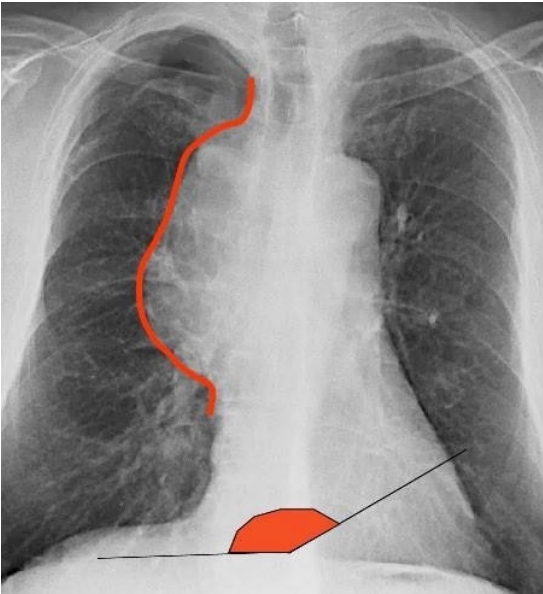
在 CXR 诊断 MM 中应用几个标准：角界征和剪影征。

- / 角界征有助于区分纵隔肿块和邻近纵隔的肺部肿块和，具体解释见下页
- / 剪影征是指胸腔内结构的正常边界消失：例如，右前纵隔的肿块可使 SVC 和右心缘模糊，而后纵隔的肿块可能导致椎旁条纹消失。肺门重叠征也是定位纵隔异常的有用征象，见下页

/ How to Distinguish a Mediastinal Mass (MM) from a Pulmonary Mass (PM)

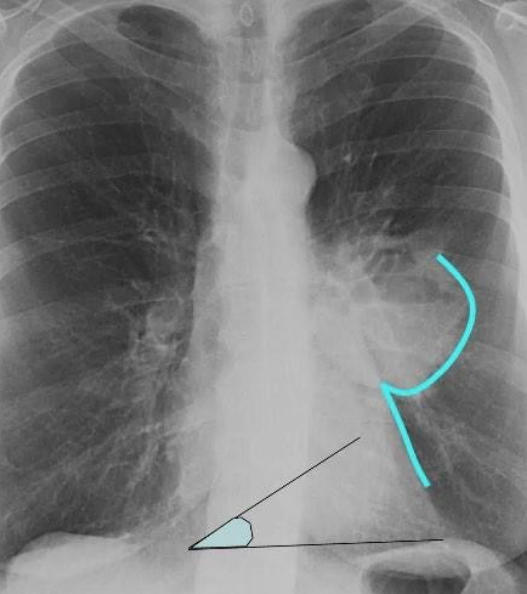
>|< COMPARE

Mediastinal Mass



- / Obtuse angle with the lung → angle border sign
- / Mediastinal lines interrupted (silhouette sign)

Pulmonary Mass



- / Acute angle with the lung → angle border sign
- / Mediastinal lines are not interrupted (no silhouette sign)

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/ 如何区分纵隔肿块 (MM) 与肺部肿块 (PM)

>|< 比较

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肺部肿块

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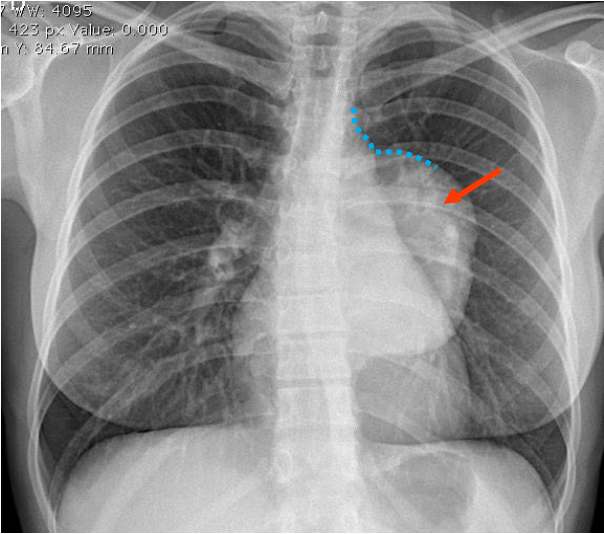
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- / 与肺形成钝角 → 角界征
- / 纵隔线中断 (剪影征)

- / 与肺形成锐角 → 角界征
- / 纵隔线未中断 (无剪影征)

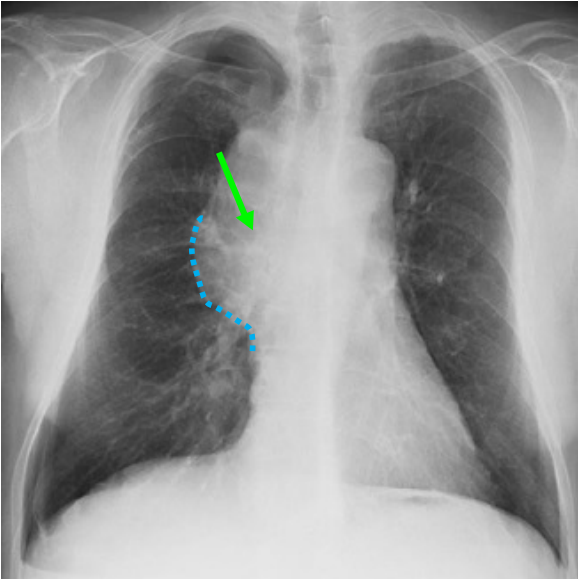
/ The Hilum Overlay Sign

The hilum overlay sign is used to localise an opacity, which projects in the hilar region on a frontal CXR (and if no lateral projection is available). If the silhouette of the hilar vessels is seen “through the



The mass is in the mediastinum (obtuse angle, blue line). The silhouette of the right hilum vessels (red arrow) is not obliterated by the mass. The mass is, therefore, either in the anterior or in the posterior mediastinum.

mass”, then the mass is either located anteriorly or posteriorly. In other words, the mass is not located in the middle mediastinum. If the mass arises from the middle mediastinum or from the hilum, the silhouette of the hilar vessels is not visible anymore.



The mass is in the mediastinum (obtuse angle, blue line). The silhouette of the left hilum vessels (green arrow) is obliterated by the mass. The mass is, therefore, in the middle mediastinum.

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/ 肺门重叠征

肺门重叠征用于定位正面 CXR 上肺门区域的阴影（若无侧位投照）。如果可以看到肺门血管的轮廓“穿过肿块”，则说明该肿块位于前方或后方。换句话说，肿块不在中纵隔。如果肿块起源于中纵隔或肺门，则肺门血管的轮廓将不再可见。

肿块位于纵隔内（表现为钝角，蓝线所示）。右肺门血管的轮廓（红色箭头）未被肿块遮挡。

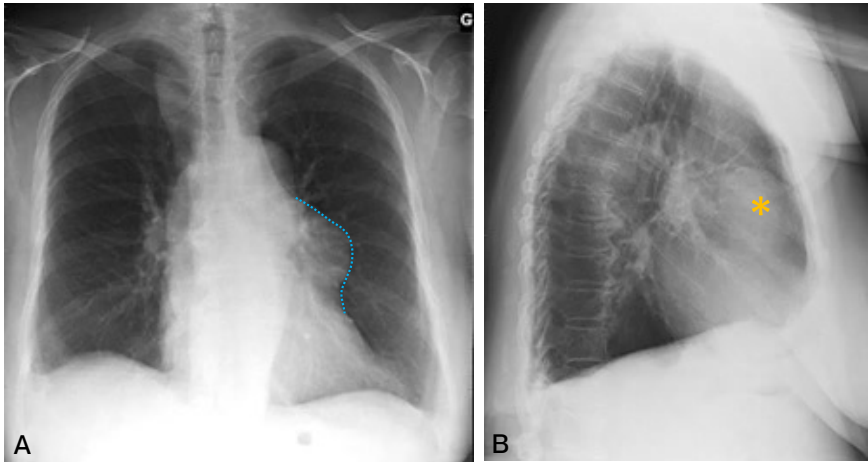
肿块位于纵隔内（表现为钝角，蓝线所示）。左肺门血管的轮廓（绿色箭头）被肿块遮挡。因此，肿块位于前纵隔或后纵隔。

/ CT for Characterisation of MMs

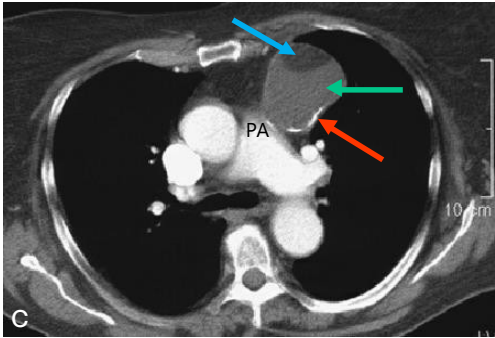
<!=> ATTENTION

CT is used for the following purposes in MMs:

- / accurate localisation of a MM
- / precise assessment of the contents of a MM: fat, calcifications, teeth, air, fluid, solid tissue
- / assessment of invasion, compression or displacement of mediastinal structures (e.g., trachea, superior vena cava, heart, vertebral column)
- / biopsy under CT guidance



The mass is in the mediastinum (obtuse angle, blue line in A). The silhouette of the right hilum vessels is not obliterated by the mass. The mass is, therefore, either in the anterior or in the posterior mediastinum (hilum overlay sign). On the lateral CXR (B), there is obliteration of the retrosternal space (yellow asterisk). The mass is, therefore, in the anterior mediastinum. CT (C) shows the precise position of the well-delineated mass located in the anterior mediastinum, its relationship to the pulmonary artery (PA) and its contents (fat (blue arrow), fluid (green arrow) and rim-like calcifications, red arrow) suggesting the diagnosis of a mature cystic teratoma.



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/ 用于 MM 定性检查的 CT

<!=> 注意

在 MM 中 CT 被用于以下目的:

- / MM 的准确定位
- / MM 成分的精准评估: 脂肪、钙化、牙齿、气体、液体、实性组织
- / 评估纵隔结构 (例如气管、上腔静脉、心脏、脊柱) 的侵犯、压迫或移位
- / CT 引导下的活检

肿块位于纵隔内 (表现为钝角, A 图蓝线)。右肺门血管的轮廓未被肿块遮挡。因此, 肿块位于前纵隔或后纵隔 (肺门重叠征)。侧位 CXR (B) 上, 胸骨后间隙消失 (黄色星号)。因此, 肿块位于前纵隔。CT (C) 显示前纵隔界限清楚之肿块的精确位置, 肿块与肺动脉 (PA) 的关系, 及内部成分 (脂肪 (蓝色箭头)、液体 (绿色箭头) 和环状钙化 (红色箭头)), 提示成熟囊性畸胎瘤诊断。

/ Anterior Mediastinal Masses (AMMs)

/ Differential Diagnosis (DD) and Radiologic Signs

Anterior (prevascular) MMs are located anteriorly to the pericardium and below the clavicle (ITMIG classification). The differential diagnosis of anterior MMs includes lesions arising in the thymus (e.g., thymoma, thymic carcinoma, thymic cyst), thyroid masses (e.g., goitre, thyroid cancer), masses arising in lymph nodes and germ cell tumours (e.g., teratoma, seminoma). The most common masses in the anterior mediastinum are of lymph node or of thymic origin.

<!=> ATTENTION

MNEMONIC for anterior MMs (the “4 Ts”)

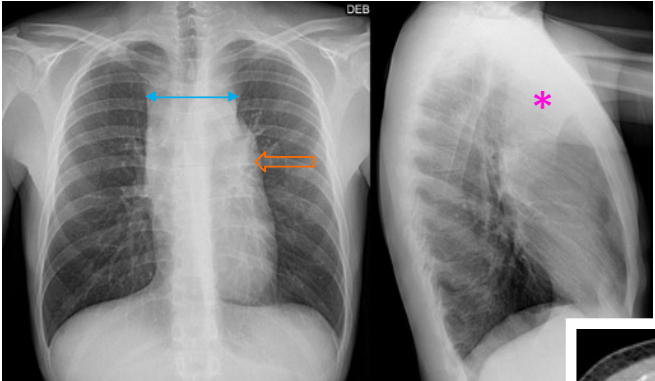
- / T > thymus
- / T > thyroid
- / T > “terrible” lymphoma
- / T > teratoma (> germ cell tumours)



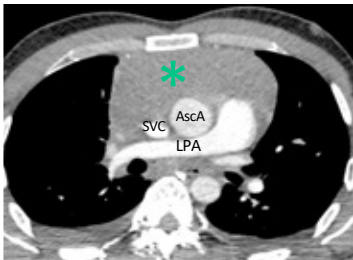
<!=> ATTENTION

Signs of anterior MMs on CXRs:

- / displaced anterior junction line
- / retrosternal space obliteration
- / cardio-phrenic angle obliteration
- / hilum overlay sign



Mediastinal enlargement (blue arrow) on the PA CXR. Obliteration of the retrosternal space (pink asterisk) on the lateral CXR. Hilum overlay sign (orange arrow) on the PA CXR. Axial CT image obtained prior to biopsy confirms anterior mediastinal origin. Note posterior displacement of middle compartment structures by the tumour (green asterisk). Ascending Aorta (AsCA), left pulmonary artery (LPA), superior vena cava (SVC). Biopsy revealed non-Hodgkin lymphoma.



<!=> ATTENTION

CT is the mainstay for diagnosis!

In most cases, CXR does not allow distinction between the different types of MMs.

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/ 前纵隔肿块 (AMM)

/ 鉴别诊断 (DD) 与影像学征象

前 (血管前) MM 位于心包前方、锁骨下方 (ITMIG 分型)。前 MM 的鉴别诊断包括: 胸腺病变 (例如胸腺瘤、胸腺癌、胸腺囊肿)、甲状腺肿块 (如甲状腺肿、甲状腺癌)、淋巴结肿块和生殖细胞肿瘤 (如畸胎瘤、精原细胞瘤)。前纵隔最常见的肿块来源为淋巴结或胸腺。

<!=> 注意

前 MM 记忆口诀 (“4 T” 法则)

- / T > 胸腺 (thymus)
- / T > 甲状腺 (thyroid)
- / T > “可怕的” 淋巴瘤 (“terrible” lymphoma)
- / T > 畸胎瘤 (Teratoma) (> 泛指生殖细胞肿瘤)

<!=> 注意

CXR 上前 MM 征象:

- / 前联合线移位
- / 胸骨后间隙消失
- / 心膈角消失
- / 肺门重叠征

<!=> 注意

CT 是主要的诊断手段!

在大多数病例中, CXR 无法区分不同类型的 MM。

前后位 CXR 上纵隔增宽增宽 (蓝色箭头)。侧位 CXR 上胸骨后间隙 (粉色星号) 消失。前后位 CXR 上肺门重叠征 (橙色箭头)。活检前获得的轴位 CT 图像证实肿块来源于前纵隔。注意肿块使中纵隔区结构向后移位 (绿色星号)。升主动脉 (AsCA)、左肺动脉 (LPA)、上腔静脉 (SVC)。活检结果为非霍奇金淋巴瘤。

/ Thymic Epithelial Tumours

Thymic epithelial tumours, though rare, are the most common primary neoplasms of the thymus and anterosuperior mediastinum.

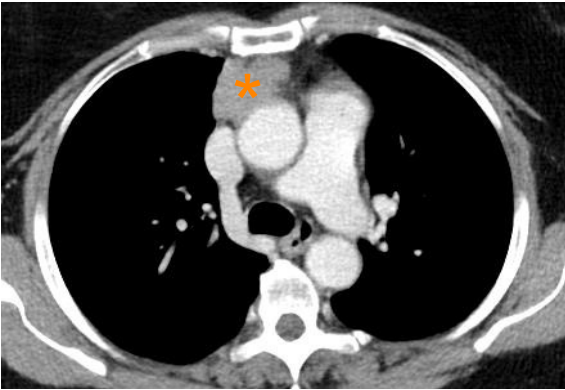
The WHO classification of thymic tumours divides them according to histological appearance (which reflects the likelihood of invasiveness) into:

- / thymoma (types A, AB, B1, B2, B3 and other types)
- / thymic carcinoma (e.g., squamous cell carcinoma, salivary gland-like carcinoma, thymic carcinoma not otherwise specified and other carcinoma types)
- / thymic neuroendocrine neoplasms (e.g., carcinoid)

Thymomas are associated with over 30 conditions, notably myasthenia gravis (10% - 20% of cases), pure red cell aplasia (50% of cases), systemic lupus erythematosus, rheumatoid arthritis, Graves' disease and Cushing syndrome. Most thymomas are located in the anterior mediastinum, while 4% arise in ectopic sites.

<∞> REFERENCE

WHO Classification of Tumours Editorial Board. WHO Classification of Thoracic Tumours. (2021) ISBN: 9789283245063



59-year-old woman who presented with myasthenia gravis. Axial CT image shows a well-defined lobulated homogeneous mass (orange asterisk) in the prevascular (anterior) mediastinum. Histology revealed thymoma type B3 ("atypical thymoma": epithelial cell sheets with mild to moderate atypia and scant lymphocytes). The clinical behaviour of this tumour type is more similar to thymoma than carcinoma.

52-year-old man with previous history of asthma presented with increasing respiratory complaints. Axial CT shows a large, relatively well-defined, slightly heterogeneous mass (green asterisk) in the prevascular (anterior) mediastinum. Associated pleural fluid (blue asterisks) and compression atelectasis (pink asterisk). Histology revealed thymoma type B1 (tumour with large areas indistinguishable from normal thymic cortex and areas resembling thymic medulla). This tumour type has a non-aggressive behaviour even in advanced stages.

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/ 胸腺上皮肿瘤

胸腺上皮肿瘤虽然罕见，但却是胸腺及前上纵隔最常见的原发性肿瘤。

WHO 根据组织学形态（反映其侵袭性可能性）将胸腺肿瘤分为：

- / 胸腺瘤（A、AB、B1、B2、B3 型及其他类型）
- / 胸腺癌（如鳞状细胞癌、涎腺样癌、未特指型胸腺癌及其他癌症类型）
- / 胸腺神经内分泌肿瘤（如类癌）

胸腺瘤与 30 多种疾病相关，尤以重症肌无力（10%-20% 的病例）、纯红细胞再生障碍性贫血（50% 的病例）、系统性红斑狼疮、类风湿性关节炎、Graves 病和库欣综合征。大多数胸腺瘤位于前纵隔，约 4% 发生于异位部位。

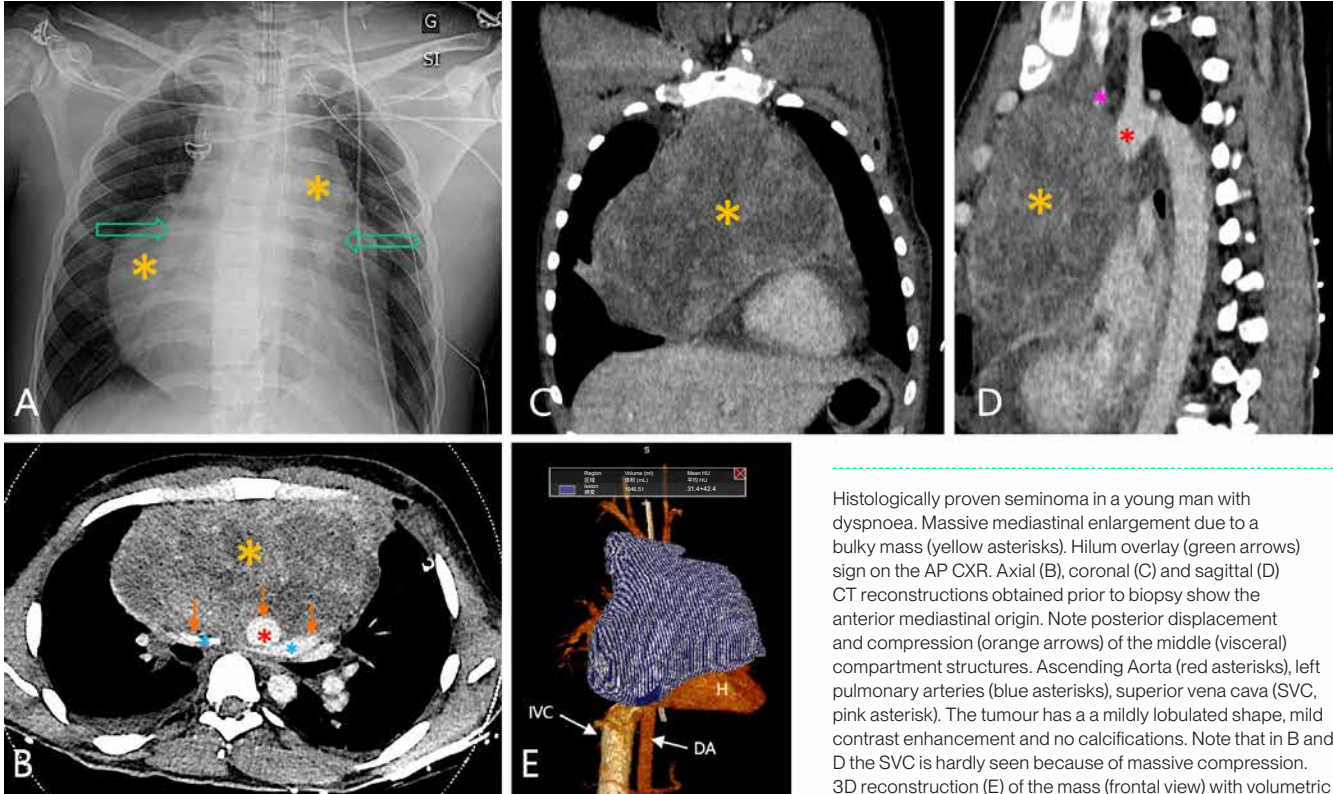
59 岁女性重症肌无力患者。轴位 CT 图像显示血管前（前）纵隔区一边界清晰、分叶状、均质肿块（橙色星号）。组织学为 B3 型胸腺瘤（“非典型胸腺瘤”：上皮细胞呈片状，轻至中度异型，淋巴细胞稀少）。该类型肿瘤的临床行为更接近胸腺瘤，而非癌。

52 岁男性，有哮喘既往史，呼吸症状加重。轴位 CT 显示血管前（前）纵隔区一大的、边界相对清楚、轻度不均质肿块（绿色星号）。伴有胸腔积液（蓝色星号）和压迫性肺不张（粉色星号）。组织学为胸腺瘤 B1 型（肿瘤大部分区域与正常胸腺皮质难以区分，部分区域类似胸腺髓质）。这种肿瘤类型即使在晚期也表现为非侵袭性。

<∞> 参考文献

WHO Classification of Tumours Editorial Board. WHO Classification of Thoracic Tumours. (2021) ISBN: 9789283245063

/ Germ Cell Tumours (Seminoma)



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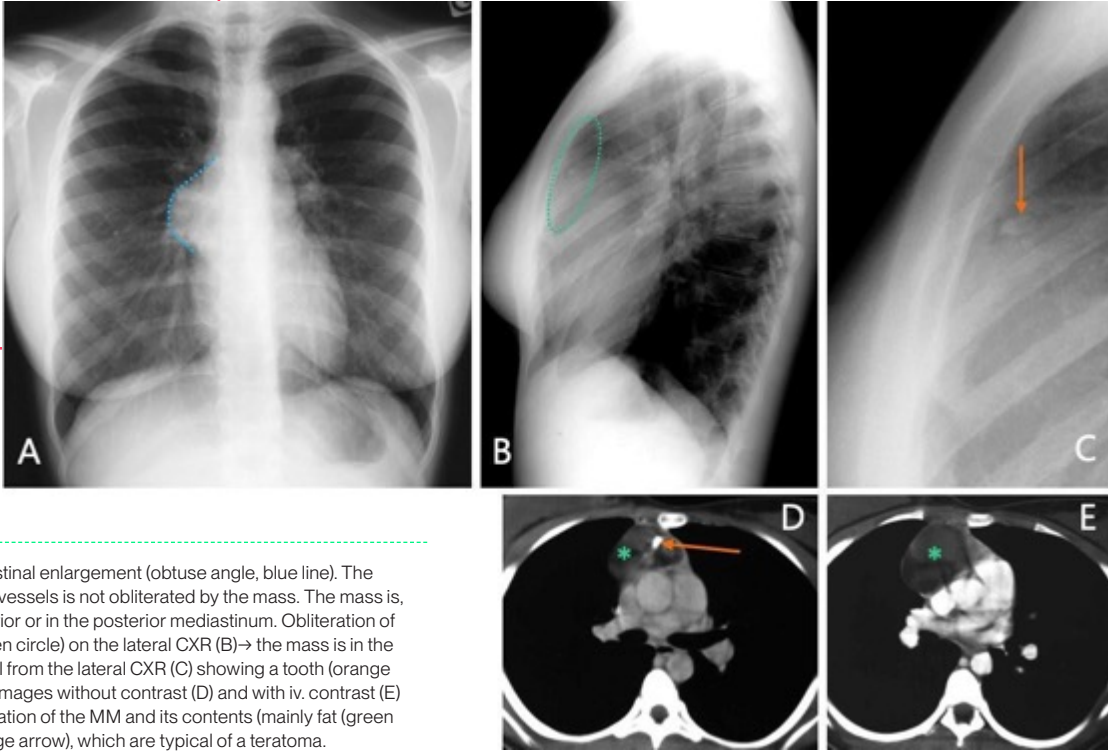
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一名年轻男性呼吸困难患者，组织学证实为精原细胞瘤。巨大肿块（黄色星号）导致纵隔显著增宽。前后位 CXR 上的肺门重叠征（绿色箭头）。活检前获得的 CT 轴位 (B)、冠状位 (C) 和矢状位 (D) 重建显示肿块起源于前纵隔。注意肿块导致中纵隔（内脏）区结构受压并向后移位（橙色箭头）。升主动脉（红色星号）、左肺动脉（蓝色星号）、上腔静脉（SVC，粉色星号）。肿瘤形态呈轻度分叶，轻度对比增强，无钙化。注意，在 B 和 D 图中，SVC 因严重受压几乎难以辨认。肿块的三维重建（E，正面视图）和体积测量（体积 = 1046 mL）。可见降主动脉 (DA)。可见下腔静脉 (IVC)。

<!/ ATTENTION

Although CT does not always allow distinction between different MM, the correct histologic diagnosis is possible whenever specific features are identified on CT scans, e.g., in teratoma, dermoid, cysts or vascular malformations.



PA CXR (A) showing mediastinal enlargement (obtuse angle, blue line). The silhouette of the right hilum vessels is not obliterated by the mass. The mass is, therefore, either in the anterior or in the posterior mediastinum. Obliteration of the retrosternal space (green circle) on the lateral CXR (B)→ the mass is in the anterior mediastinum. Detail from the lateral CXR (C) showing a tooth (orange arrow) within the mass. CT images without contrast (D) and with iv. contrast (E) show the precise lesion location of the MM and its contents (mainly fat (green asterisks) and a tooth, orange arrow), which are typical of a teratoma.

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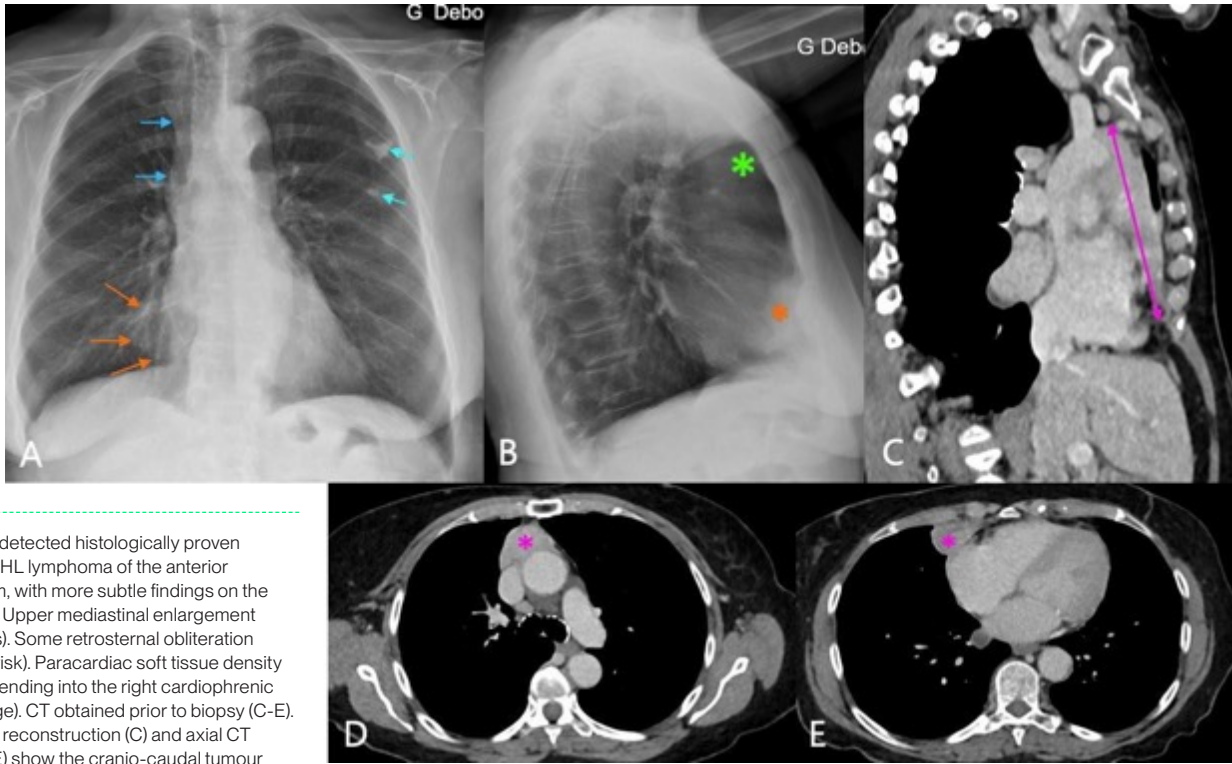
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<!/ 注意

虽然 CT 并不总能区分不同的 MM，但当 CT 影像显示出特异性表现时（如畸胎瘤、皮样瘤、囊肿或血管畸形），通常可以做出正确的组织学诊断。

后前位 CXR (A) 显示纵隔增宽（表现为钝角，蓝线所示）。右肺门血管的轮廓未被肿块遮挡。因此，肿块位于前纵隔或后纵隔。侧位 CXR 上胸骨后间隙（绿环）消失 (B)，肿块位于前纵隔。侧位 CXR (C) 的细节显示肿块内有牙齿（橙色箭头）。CT 平扫 (D) 和静脉增强 CT (E) 显示 MM 的精准定位及其内容物（主要为脂肪（绿色星号）和牙齿（橙色箭头）），是畸胎瘤的典型特征。

/ Lymphoma



Incidentally detected histologically proven low grade NHL lymphoma of the anterior mediastinum, with more subtle findings on the CXRs (A, B). Upper mediastinal enlargement (blue arrows). Some retrosternal obliteration (green asterisk). Paracardiac soft tissue density (orange) extending into the right cardiophrenic angle (orange). CT obtained prior to biopsy (C-E). Parasagittal reconstruction (C) and axial CT images (D, E) show the cranio-caudal tumour extent (pink). The calcified pleural plaques (turquoise arrows) seen on the PA CXR were also seen on the CT scans (see page 73).

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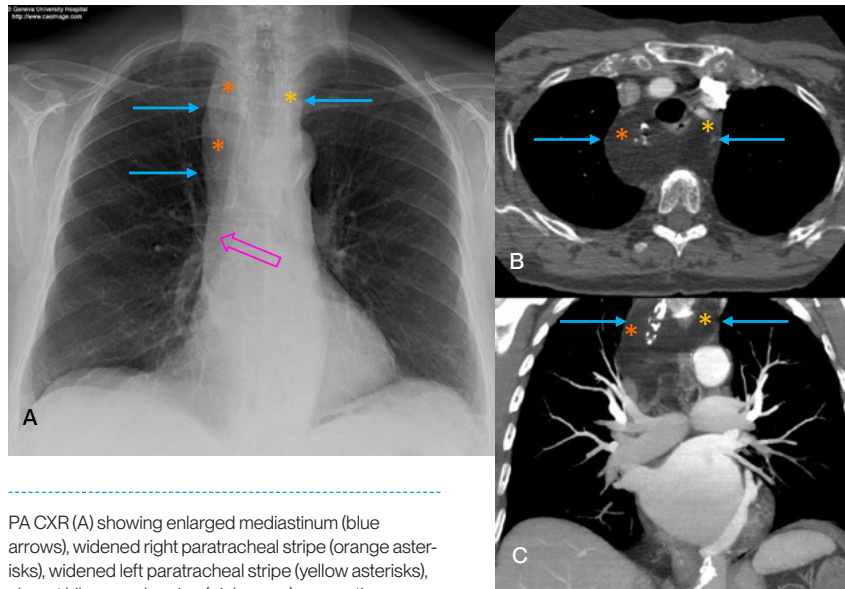
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偶然检出、组织学证实的前纵隔低级别 NHL 淋巴瘤，其 CXR 征象较不明显 (A, B)。上纵隔增宽 (蓝色箭头)。部分胸骨后间隙消失 (绿色星号)。心包旁软组织密度影 (橙色) 延伸至右心膈角 (橙色)。活检前获得的 CT 图像 (C-E)。旁矢状位重建图像 (C) 和轴位 CT 图像 (D, E) 头尾方向的肿瘤范围 (粉色)。后前位 CXR 上见钙化胸膜斑块 (蓝绿色箭头) 在 CT 扫描中亦可见 (见第 73 页)。

/ Middle Mediastinal Masses (MMMs)

/ Differential Diagnosis (DD) and Radiologic Signs



PA CXR (A) showing enlarged mediastinum (blue arrows), widened right paratracheal stripe (orange asterisks), widened left paratracheal stripe (yellow asterisks), absent hilum overlay sign (pink arrow) suggesting a middle mediastinal mass. Contrast-enhanced axial CT image (B) and coronal MIP (C) reconstruction confirm the presence of a middle MM. The mass contains fatty tissue and was a lipoma at surgery.

<!=> ATTENTION

Middle (visceral compartment) MMs include

- / lymphadenopathy
- / vascular masses, e.g., aneurysms arising from the aorta or pulmonary arteries
- / tumours of the trachea and main bronchi, heart, pericardium, vagal and phrenic nerves or oesophagus
- / congenital cysts (bronchial, oesophageal, pericardial)
- / hiatus hernia



<!=> ATTENTION

Signs of middle MMs on CXRs:

- / no hilum overlay sign
- / widened paratracheal stripes
- / widened right azygo-oesophageal recess
- / convex aorto-pulmonary window (APW)
- / mass anterior to the spine on lateral CXR
- / doughnut sign with the left or right bronchus on a lateral CXR

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<!=> 注意

中部 (内脏区) MM 包括

- / 淋巴结病
- / 血管肿块, 例如主动脉或肺动脉的动脉瘤
- / 气管和主支气管、心脏、心包、迷走神经和膈神经或食管肿瘤
- / 先天性囊肿 (支气管、食管、心包)
- / 裂孔疝

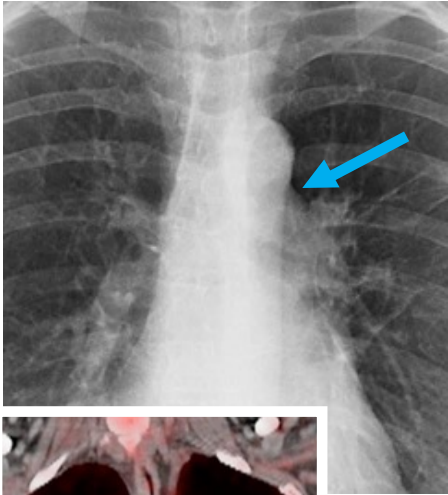
<!=> 注意

CXR 上中部 MM 的征象:

- / 无肺门重叠征
- / 气管旁线增宽
- / 右奇静脉-食管隐窝增宽
- / 主动脉肺动脉窗 (APW) 凸出
- / 侧位 CXR 上脊柱前肿块
- / 侧位 CXR 上左/右支气管环形征

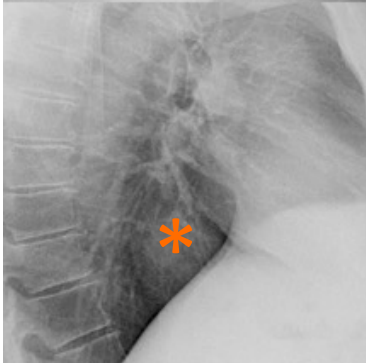
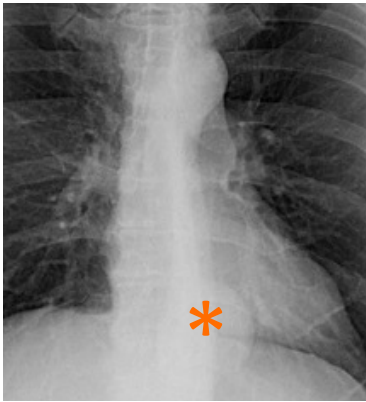
后前位 CXR (A) 显示纵隔增宽 (蓝色箭头)、右气管旁线增宽 (橙色星号)、左气管旁线增宽 (黄色星号)、无肺门重叠征 (粉色箭头), 提示中纵隔肿块。对比增强轴位 CT 影像 (B) 与冠状位 MIP (C) 重建证实存在中部 MM。该肿块含脂肪组织, 经手术确认为脂肪瘤。

Convex APW (blue arrow)
on PA CXR



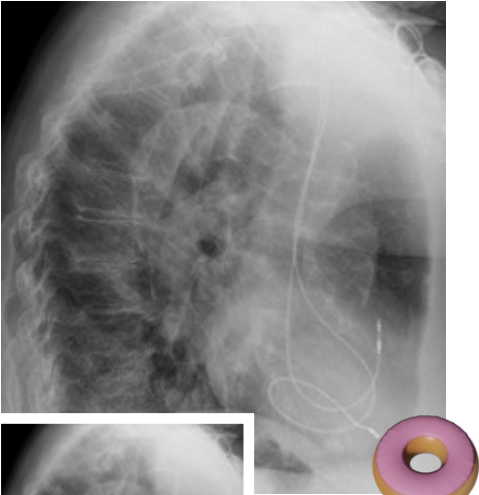
Convex APW
due to meta-
static lymph
nodes in lung
cancer

MM anterior to the spine
(orange asterisk) on lateral
CXR



Hiatus hernia

Doughnut sign (pink circles)
on lateral CXR



The doughnut
sign on the lateral
CXR is the result
of enlarged
lymph nodes
surrounding
the radiolucent
trachea and
upper lobe
bronchi.

Lateral CXR image from:
https://commons.wikimedia.org/wiki/File:Doughnut_sign_im_seitlich_en_Roentgenbild_der_Lunge_94W_-_CR_seitlich_-_001.jpg

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后前位 CXR 上的
凸出的 APW
(蓝色箭头)

侧位 CXR 上
脊柱前 MM
(橙色星号)

侧位 CXR 上环
形征 (粉色环)

由肺癌转移性
淋巴结导致的
APW 凸出

裂孔疝

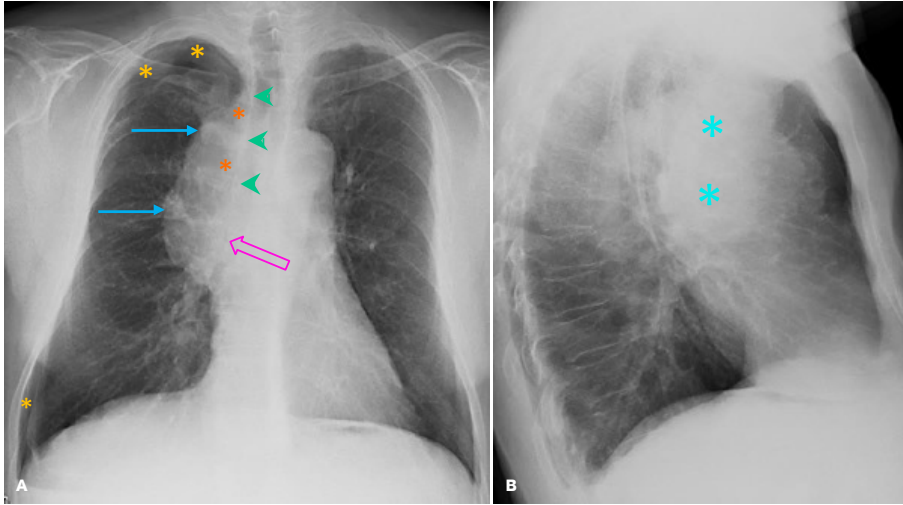
侧位 CXR 上的环形征是肿大淋
巴结围绕透亮的气管及上叶支气
管所形成。

侧位 CXR 图片来源:
https://commons.wikimedia.org/wiki/File:Doughnut_sign_im_seitlich_en_Roentgenbild_der_Lunge_94W_-_CR_seitlich_-_001.jpg

/ Small Cell Lung Cancer (SCLC)

About 20% of lung cancers are small cell lung cancers (SCLCs). SCLC is a neuroendocrine subtype of lung cancer associated with cigarette smoking. It has “small cells” at histology and unique clinical and imaging

features, as well as distinguishing management implications. More than 90% of SCLCs are located centrally as the tumours typically arise from the mucosa of the mainstem or lobar bronchi. Therefore, they can manifest



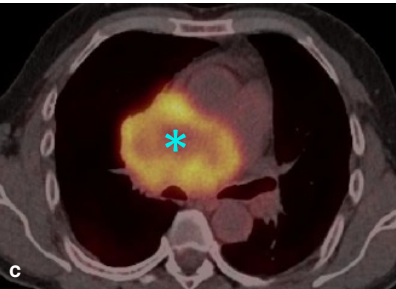
PA CXR (A) showing mediastinal enlargement on the right (blue arrows), widened right paratracheal stripe (orange asterisks), absent hilum overlay sign (pink arrows) and displaced trachea to the left (green arrows) suggesting a middle mediastinal mass. The lateral CXR (B) confirms that the MM (turquoise asterisks) is in the visceral compartment. As the CXR was performed after image guided biopsy, a small pneumothorax (yellow asterisks) caused by the biopsy is seen. Histology revealed SCLC. FDG PET CT (C) performed for staging purposes shows that the infiltrative middle MM (turquoise asterisk) has a high glucose metabolism. There were no distant metastases.

as MMs on CXRs. SCLC is often necrotic and haemorrhagic and it infiltrates mediastinal structures.

SCLC is the most common cause of superior vena cava (SVC) obstruction, which manifests with facial, neck and upper extremity swelling, dyspnoea or headache. SCLC is often also associated with paraneoplastic syndromes. Lymph nodes and distant metastases are common. Prognosis is rather poor. Staging of SCLC is done in the same way as the staging of non-SCLC (NSCLC) > see page 90.

<!=> ATTENTION

SCLC presents only rarely as a solitary lung nodule.



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/ 小细胞肺癌 (SCLC)

约 20% 的肺癌为小细胞肺癌 (SCLC)。SCLC 是肺癌的一种神经内分泌亚型，与吸烟相关。其组织学特征为“小细胞”，和独特的临床和影像学特征，以及不同的管理特点。90% 以上的 SCLC 位于中央，因为肿瘤通常起源于主支气管或肺叶支气管的黏膜。因此，在 CXR 上可表现为 MM。SCLC 常发生坏死、出血，并可浸润纵隔结构。

SCLC 是上腔静脉 (SVC) 阻塞的最常见原因，表现为面部、颈部和上肢肿胀、呼吸困难或头痛。SCLC 也常与副肿瘤综合征相关。淋巴结和远处转移很常见。预后较差。SCLC 的分期方法与非 SCLC (NSCLC) 相同，见第 90 页。

<!=> 注意

SCLC 很少表现为孤立性肺结节。

后前位 CXR (A) 显示右侧纵隔增宽 (蓝色箭头)、右侧气管旁线增宽 (橙色星号)、无肺门重叠征 (粉色箭头) 和气管左移 (绿色箭头)，提示中纵隔肿块。侧位 CXR (B) 证实该 MM (蓝绿色星号) 位于内脏区。由于 CXR 是在影像引导下活检后拍摄的，可见因活检导致的少量气胸 (黄色星号)。组织学结果为 SCLC。为分期目的进行的 FDG PET-CT (C) 显示浸润性中部 MM (蓝绿色星号) 呈高葡萄糖代谢。未见远处转移。

/ Non-Small Cell Lung Cancer (NSCLC)

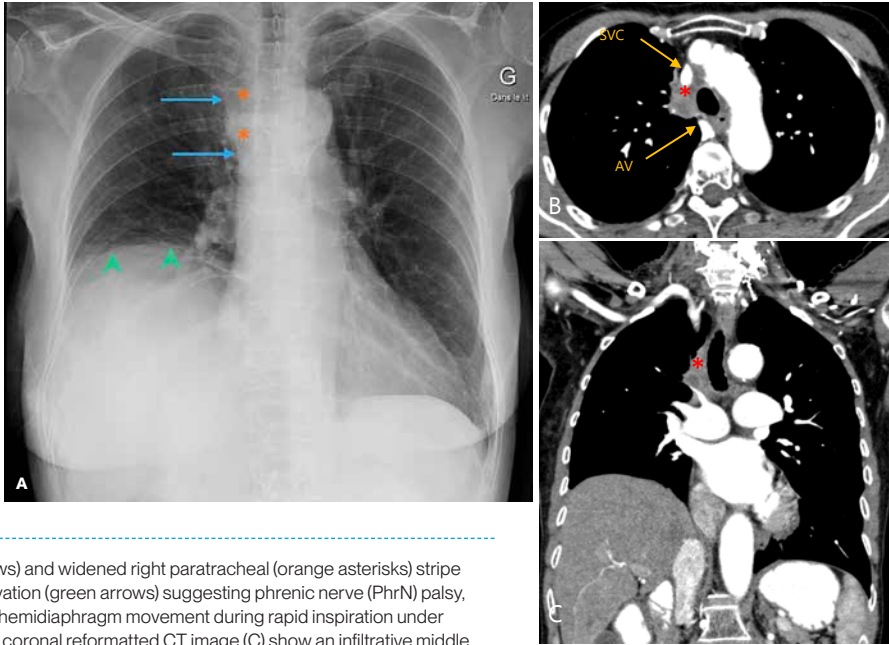
Non-small cell lung cancer (NSCLC) can also manifest as an MMM. NSCLC does not have “small cells” at histology. NSCLC includes many different histologic tumour types, e.g., squamous cell carcinoma (SCC), adenocarcinoma (AC), large cell carcinoma, carcinoid and many more. AC is the most common histologic type of lung cancer followed by SCC. SCC is the most common type of Pancoast tumour (> see page 62).

SCC of the lung typically arises centrally. Regional lymph node metastases and distant metastases to the adrenal glands, liver, brain and bone are common.

Central tumour location results in enlargement of the mediastinum and hilum on CXRs due to tumour and lymph node involvement. Bronchus obstruction can lead to lobar collapse or pneumonitis. Cavitation in SCC represents a more aggressive tumour subtype.

Staging of NSCLC is done according to the TNM classification system. Survival depends on stage, histological and immunohistochemical characteristics. In general,

for the same stage, survival in SCC is better than in AC.



PA CXR (A) showing mediastinal enlargement (blue arrows) and widened right paratracheal (orange asterisks) stripe suggesting a middle MM. Note right hemidiaphragm elevation (green arrows) suggesting phrenic nerve (PhrN) palsy, which was confirmed by the “sniff test” (= observation of hemidiaphragm movement during rapid inspiration under fluoroscopy). Axial contrast-enhanced CT image (B) and coronal reformatted CT image (C) show an infiltrative middle MM (red asterisks) with encasement of the superior vena cava (SVC) and dilatation of the azygos vein (AV). The MM is located along the right PhrN, which descends lateral to the SVC and right atrium in the mediastinum.

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/ 非小细胞肺癌 (NSCLC)

非小细胞肺癌 (NSCLC) 也可表现为 MMM。NSCLC 组织学没有“小细胞”。NSCLC 包括多种不同的组织学肿瘤类型，例如鳞状细胞癌 (SCC)、腺癌 (AC)、大细胞癌、类癌等。AC 是最常见的肺癌组织学类型，其次为 SCC。SCC 是最常见的肺上沟瘤肿瘤类型（详见第 62 页）。

肺部 SCC 通常起源于肺中央部位。区域淋巴结转移以及肾上腺、肝、脑和骨的远处转移较为常见。

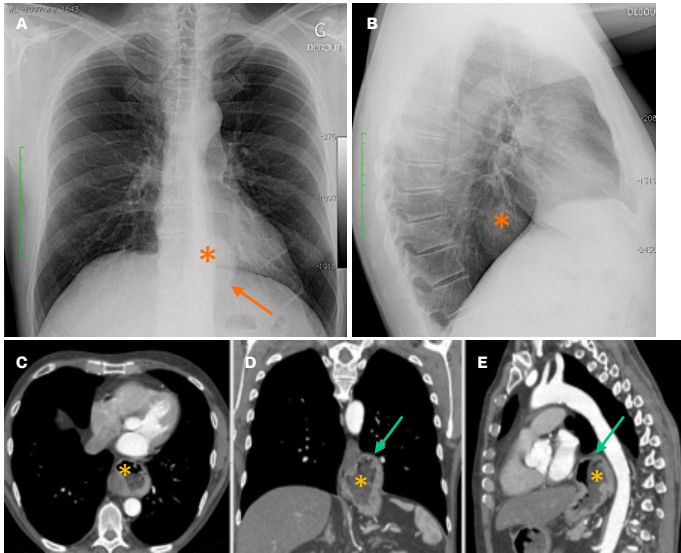
肿瘤位于中央部位时，由于肿瘤和淋巴结受累，导致 CXR 上可见纵隔和肺门增大。支气管阻塞可导致肺叶塌陷或肺炎。SCC 的空洞代表一种更具侵袭性的肿瘤亚型。

NSCLC 的分期按照 TNM 分类系统。患者生存期取决于分期、组织学和免疫组化特征。总体上，同期患者中，SCC 的生存期优于 AC。

后前位 CXR (A) 显示纵隔增宽 (蓝色箭头) 和右气管旁线增宽 (橙色星号)，提示中部 MM。注意右半膈肌抬高 (绿色箭头)，提示膈神经 (PhrN) 麻痹，通过“吸气试验” (即在透视下快速吸气时观察半侧膈肌运动) 证实。对比增强轴位 CT 影像 (B) 和冠状位重建 CT 影像 (C) 显示浸润性中部 MM (红色星号)，包绕上腔静脉 (SVC)，并伴奇静脉 (AV) 扩张。该 MM 沿着右侧 PhrN 分布，PhrN 在纵隔内从 SVC 和右心房的外侧向下延伸。

/ Hiatus Hernia (HH)

Hiatus hernia (HH) is the result of herniation of abdominal contents (most often of the stomach) through the diaphragmatic oesophageal hiatus into the chest cavity. Sliding HH is the most common type

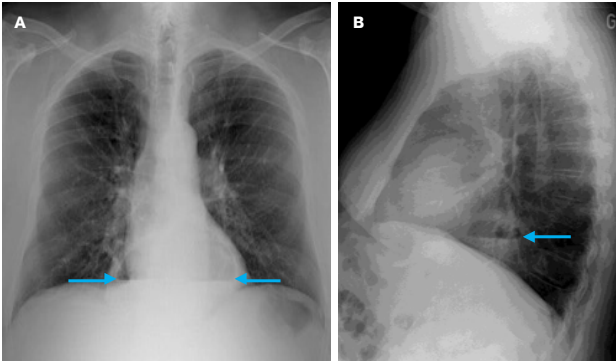


PA CXR (A) and lateral CXR (B) showing a retrocardiac middle MM (orange asterisks) partly projecting below the diaphragm (orange arrow). Axial contrast-enhanced CT (C), coronal (D) and sagittal (E) reformatted images show a sliding HH (yellow asterisks) with the gastric fundus (green arrows) extending well above the diaphragm.

(>90%) while rolling (para-oesophageal) HH and mixed (rolling and sliding) hernias are uncommon. If the gastric fundus is above the diaphragm, the HH presents as a retrocardiac middle MM.

<!=> ATTENTION

- / Patients with HH can be entirely asymptomatic, in which case HH is an incidental finding.
- / In minimally symptomatic and in older patients watchful waiting is recommended.
- / Symptomatic HH, especially the rolling, the mixed types and HHs containing other viscera than the stomach are usually managed surgically.



PA CXR (A) and lateral CXR (B) showing a retrocardiac middle MM with a gas-fluid level (blue arrows) typical of the diagnosis of a HH.

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/ 食管裂孔疝 (HH)

食管裂孔疝 (HH) 是腹腔内容物 (通常是胃) 通过膈肌的食管裂孔疝入胸腔的结果。滑动型 HH 是最常见的类型 (> 90%), 而滚动型 (食管旁型) HH 和混合型 (滚动型 + 滑动型) 较为少见。如果胃底位于膈肌以上, 则 HH 表现为心后型 MM。

<!=> 注意

- / HH 患者可能完全无症状, 这种情况 HH 为偶然发现。
- / 对于症状轻微或老年患者, 建议观察等待。
- / 有症状的 HH, 尤其是滚动型、混合型, 以及包括胃以外其他内脏的 HH, 通常需要手术治疗。

后前位 CXR (A) 和侧位 CXR (B) 显示心后的中部 MM (橙色星号), 部分投照在膈肌下 (橙色箭头)。对比增强轴位 CT (C)、冠状位 (D) 和矢状位 (E) 重建图像显示滑动型 HH (黄色星号), 胃底 (绿色箭头) 延伸至膈肌上方。

/ Posterior Mediastinal Masses (PMMs)

/ Differential Diagnosis (DD) and Radiologic Signs

<!=> ATTENTION

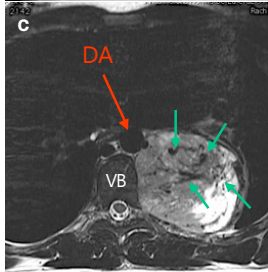
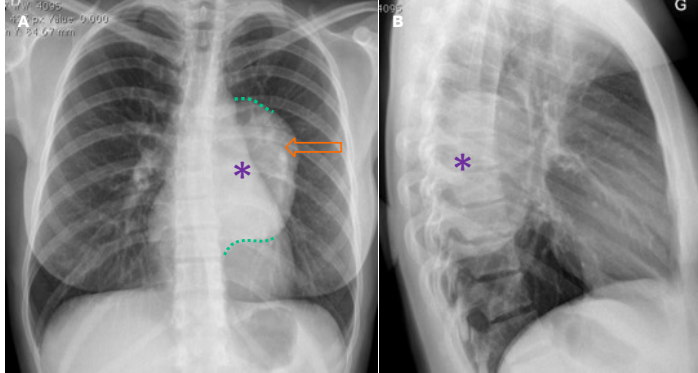
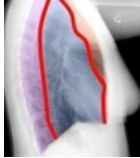
Posterior (paravertebral compartment) MMs include

- / neurogenic tumours, e.g., schwannoma, neurofibroma, malignant peripheral nerve sheath tumour, paraganglioma, pheochromocytoma, neuroblastoma
- / non-neurogenic tumours, e.g., chordoma, lymphoma, metastases
- / vascular lesions, e.g., descending thoracic aortic aneurysm
- / infection, e.g., abscess (from spinal infection)
- / meningoceles (in neurofibromatosis)
- / neurenteric cysts (with vertebral anomalies)

<!=> ATTENTION

Signs of posterior MM on CXRs

- / hilum overlay sign
- / cardiac border clearly seen
- / widened paraspinal and para-aortic lines
- / mass projecting on the spine on lateral CXR



For paraganglioma
> See also eBook chapter on Endocrine System

The mass is in the mediastinum (obtuse angle (green line) in A). The silhouette of the left hilum vessels is not obliterated. The mass is, therefore, either in the anterior or in the posterior mediastinum (hilum overlay sign, orange arrow). The cardiac border is clearly seen > this is a posterior MM (purple asterisks). Lateral CXR (B) confirms the posterior mediastinal position. MRI (C) shows a well-delineated posterior MM, its relationship to the descending aorta (DA) and thoracic vertebral bodies (VB) and multiple flow voids (= low signal in enlarged and tortuous vessels with vigorously flowing blood, green arrows) suggesting a paraganglioma. Surgery confirmed the diagnosis.

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<!=> 注意

后部 (椎旁区) MM 包括

- / 神经源性肿瘤, 如神经鞘瘤、神经纤维瘤、恶性周围神经鞘瘤、副神经节瘤、嗜铬细胞瘤、神经母细胞瘤
- / 非神经源性肿瘤, 如脊索瘤、淋巴瘤、转移瘤
- / 血管病变, 如胸降主动脉瘤
- / 感染, 如脓肿 (源于脊柱感染)
- / 脑脊膜膨出 (见于神经纤维瘤病)
- / 神经管原肠囊肿 (伴椎体异常)

<!=> 注意

后部 MM 在 CXR 上的征象

- / 肺门重叠征
- / 心脏边界清晰可见
- / 椎旁线和主动脉旁线增宽
- / 侧位 CXR 上肿块投影于脊柱上

肿块位于纵隔内 (A 图中的钝角 (绿色线))。左肺门血管轮廓未被遮挡。因此, 肿块位于前纵隔或后纵隔 (肺门重叠征, 橙色箭头)。心脏边界清晰可见, 这是后部 MM (紫色星号)。侧位 CXR (B) 可确认后纵隔位置。MRI (C) 显示轮廓清晰的后部 MM, 其与降主动脉 (DA)、胸椎椎体 (VB) 的关系, 以及多发流空现象 (即在扩张、迂曲的血管内血流旺盛导致低信号, 绿色箭头), 提示副神经节瘤。手术证实该诊断。

对于副神经节瘤
> 另请参阅《内分泌系统》电子书章节

/ Aneurysm of the Descending Aorta

Thoracic aneurysms are often identified incidentally on CXRs. Their shape and size can be very variable. If the axial diameter of the ascending aorta is > 5 cm and the axial diameter of the descending aorta is > 4 cm, the term aneurysm is used. Although aneurysms are usually obvious on PA and

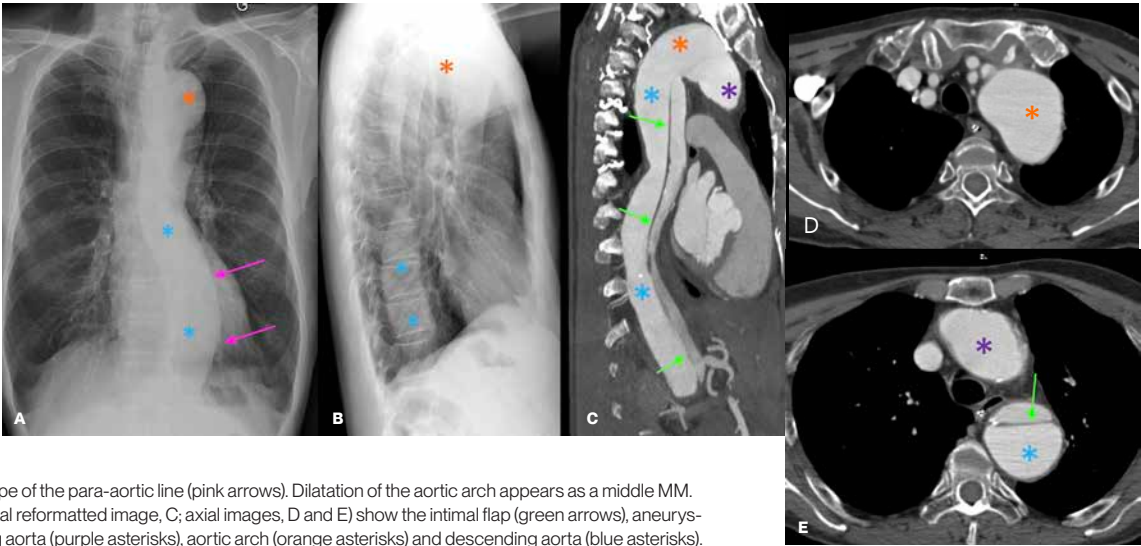
lateral CXRs, due to magnification effects, the size of the aneurysm cannot be reliably assessed.

CT angiography and MR angiography are the modalities of choice to image aortic aneurysms.

<∞> REFERENCE

> See also eBook chapter on Vascular Imaging

Patient with known aortic dissection Stanford type B (> see eBook chapter on Vascular Imaging) and aneurysmal dilatation of the ascending aorta, aortic arch and descending aorta. PA CXR (A) and lateral CXR (B) showing aortic arch dilatation (orange asterisks) and dilatation of the descending aorta (blue asterisks). Dilatation of the descending aorta appears as a tubular posterior MM. Note displacement and curved shape of the para-aortic line (pink arrows). Dilatation of the aortic arch appears as a middle MM. Contrast-enhanced CT (sagittal reformatted image, C; axial images, D and E) show the intimal flap (green arrows), aneurysmal dilatation of the ascending aorta (purple asterisks), aortic arch (orange asterisks) and descending aorta (blue asterisks).



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/ 降主动脉瘤

胸主动脉瘤常在 CXR 上偶然发现。其形态和大小差异较大。如果升主动脉轴向直径 > 5 cm, 降主动脉轴向直径 > 4 cm, 可诊断为主动脉瘤。虽然动脉瘤在后前位和侧位 CXR 上通常较为明显, 但由于放大效应, 无法可靠评估动脉瘤的大小。

CT 血管成像是成像主动脉瘤的影像学方法。

<∞> 参考文献

> 另请参阅《血管成像》电子书章节

Stanford B 型主动脉夹层患者 (详见《血管成像》电子书章节) 和升主动脉、主动脉弓及降主动脉的动脉瘤样扩张。后前位 CXR (A) 和侧位 CXR (B) 显示主动脉弓扩张 (橙色星号) 和降主动脉扩张 (蓝色星号)。降主动脉扩张表现为管状后部 MM。注意主动脉旁线移位和弯曲 (粉色箭头)。主动脉弓扩张表现为中部 MM。对比增强 CT (矢状位重建图像 C; 轴位图像 D 和 E) 显示内膜片 (绿色箭头)、升主动脉 (紫色星号)、主动脉弓 (橙色星号) 和降主动脉 (蓝色星号) 的动脉瘤样扩张。

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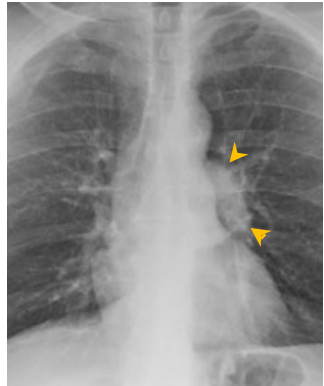
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/ Differential Diagnosis and Radiologic Signs

The hila contain the proximal pulmonary arteries, bronchi, pulmonary veins and lymph nodes. Normal sized lymph nodes do not cause hilar enlargement. Hilar enlargement can be unilateral or bilateral. It is caused by enlarged lymph nodes, enlarged pulmonary arteries or bronchial masses. Most often, a significant degree of hilar enlargement needs to be present to be detected on CXRs. In addition to CT and PET CT, bronchoscopy, endobronchial ultrasound and mediastinoscopy may be needed for the diagnosis.



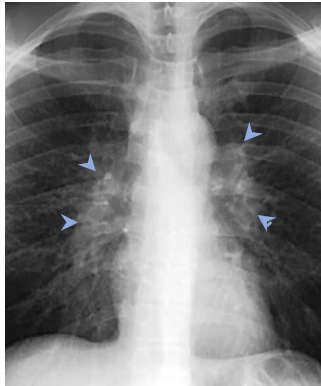
Case courtesy of Alborz Jahangiri, Radiopaedia.org, rID: 47026

* Most common causes of unilateral enlargement

<!=> ATTENTION

Differential diagnosis of unilateral hilar enlargement

- / bronchogenic carcinoma*
- / lymphadenopathy
- / lymphoma (more often bilateral)
- / metastases from lung cancer and non-lung primary neoplasms*
- / infection (tuberculosis*, mycoplasma)
- / enlarged pulmonary artery
- / unilateral pulmonary massive embolus
- / aneurysm of the pulmonary artery
- / pulmonary stenosis with post-stenotic left dilatation



* Most common causes of bilateral enlargement

<!=> ATTENTION

Differential diagnosis of bilateral hilar enlargement

- / bronchogenic carcinoma
- / lymphadenopathy
- / lymphoma (often bilateral and asymmetric)
- / metastases from lung cancer and non-lung primary neoplasms
- / sarcoidosis*
- / infection (tuberculosis, mycoplasma)
- / silicosis
- / enlarged pulmonary arteries
- / pulmonary arterial hypertension*

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/ 鉴别诊断与影像学征象

肺门包含近端肺动脉、支气管、肺静脉和淋巴结。正常大小的淋巴结不会导致肺门增大。肺门增大可表现为单侧或双侧。其原因包括淋巴结肿大、肺动脉扩张或支气管肿块。大多数情况下，只有当肺门明显增大时，CXR 上才能发现。除 CT 和 PET-CT 外，诊断时还可能需要进行支气管镜检查、支气管内超声和纵隔镜检查。

<!=> 注意

单侧肺门增大的鉴别诊断

- / 肺癌*
- / 淋巴结病
- / 淋巴瘤（多为双侧）
- / 肺癌及非肺原发性肿瘤转移*
- / 感染（结核*、支原体）
- / 肺动脉扩张
- / 单侧肺大面积栓塞
- / 肺动脉瘤
- / 肺动脉狭窄伴狭窄后左侧扩张

病例来源: Alborz Jahangiri, Radiopaedia.org, rID: 47026

* 单侧肺门增大的常见原因

<!=> 注意

双侧肺门增大的鉴别诊断

- / 肺癌
- / 淋巴结病
- / 淋巴瘤（多为双侧且不对称）
- / 肺癌及非肺原发性肿瘤转移
- / 结节病*
- / 感染（结核、支原体）
- / 矽肺
- / 肺动脉扩张
- / 肺动脉高压*

* 双侧肺门增大的常见原因

/ Bilateral Hilar Enlargement

/ Sarcoidosis

Sarcoidosis is a non-caseating granulomatous disease of unknown aetiology with pulmonary, mediastinal, cardiac, central nervous system, head and neck and skin manifestations. It typically affects adults in their 2nd – 4th decades of life. The incidence is highest in African-Americans followed by northern European Caucasians.

More than 90% of patients with sarcoidosis have lung and mediastinal involvement although about 50% of

patients are asymptomatic. Skin involvement, salivary gland, lacrimal gland and ocular involvement is common.

Pulmonary involvement is the major cause of morbidity and mortality. Pulmonary sarcoid granulomas typically occur along the bronchovascular lymphatics and along the interlobular septa. On CT scans, the following pulmonary changes are seen: nodules/micronodules with a perilymphatic distribution, alveolar opacities and centrally predominant pulmonary fibrosis (see description of the different pulmonary opacities later in this chapter.

<!=> ATTENTION

PA CXRs are used to stage pulmonary sarcoidosis based on the presence and pattern of nodal and parenchymal involvement, whereas high resolution CT (HRCT) and FDG PET CT are usually employed to guide therapeutic decisions. Nevertheless, CT is more sensitive than CXRs for assessing sarcoidosis.

>=< FURTHER KNOWLEDGE

The stage of sarcoidosis as assessed by CXRs does not correlate with the level of clinical severity. Stage 0
> normal CXR, no granulomas
Stage 1 > hilar or mediastinal nodal enlargement due to granulomas
Stage 2 > both lymphadenopathy and pulmonary changes due to granulomas
Stage 3 > only pulmonary granulomas
Stage 4 > pulmonary fibrosis
The likelihood of spontaneous resolution decreases continuously from stage 1 (up to 90% spontaneous resolution) to stage 5 (0% spontaneous resolution).

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/ 结节病

结节病是一种病因不明的非干酪性肉芽肿性疾病，可累及肺部、纵隔、心脏、中枢神经系统、头颈部和皮肤。本病多见于 20~40 岁的成年人。非裔美国人发病率最高，其次是北欧白种人。

超过 90% 的结节病患者存在肺和纵隔受累，但约 50% 的患者无症状。皮肤、唾液腺、泪腺和眼部受累也较为常见。

肺部受累是导致发病和死亡的主要原因。肺结节病肉芽肿多沿支气管血管淋巴管和小叶间隔分布。CT 扫描可见以下肺部改变：分布于淋巴管周围的结节/微结节、肺泡阴影，以及以中心为主的肺纤维化（各种肺部阴影的说明详见本章后续内容）。

<!=> 注意

后前位 CXR 用于根据淋巴结的存在和肺实质受累及其特征模式对肺结节病进行分期，而高分辨率 CT（high resolution CT，HRCT）和 FDG PET-CT 通常用于指导治疗决策。然而，CT 评估结节病的灵敏度高于 CXR。

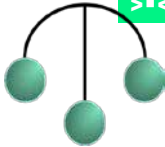
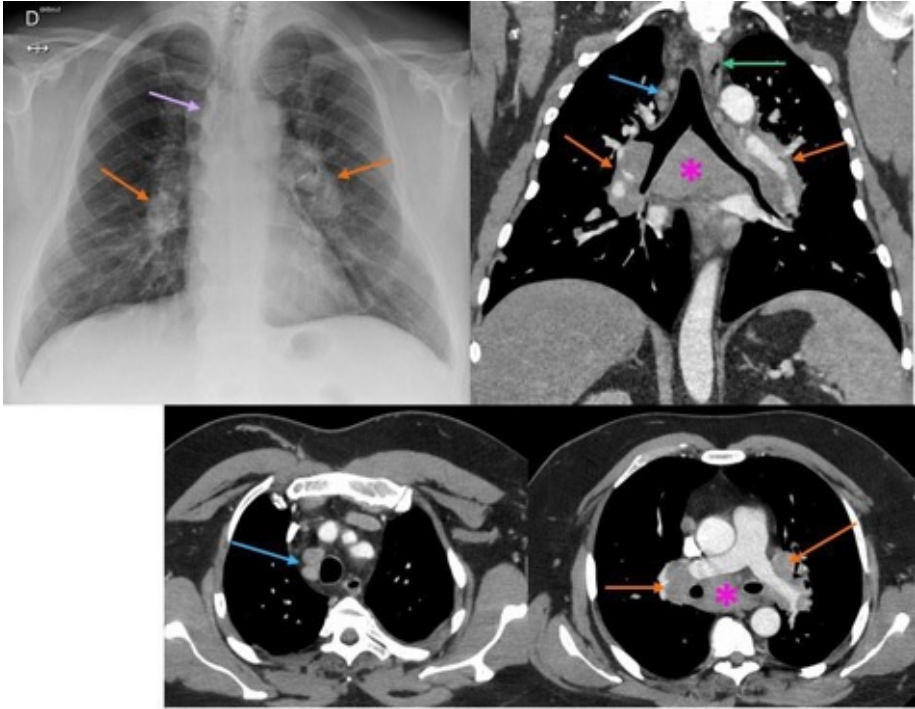
>=< 进阶知识

CXR 评估的结节病分期与临床严重程度不相关。0 期
> CXR 正常，无肉芽肿
1 期 > 由肉芽肿引起的肺门或纵隔淋巴结增大
2 期 > 由肉芽肿引起的淋巴结病和肺部变化
3 期 > 仅见肺部肉芽肿
4 期 > 肺纤维化
从 1 期（高达 90% 的自发缓解）至 5 期（0% 的自发缓解），自发缓解的可能性持续降低。

CXRs typically reveal bilateral symmetric and massive hilar enlargement (due to so-called “potato nodes” (orange arrows) because of bulky and irregular morphology) and an enlarged right paratracheal stripe (light purple arrow) due to right paratracheal enlarged nodes (blue arrows) on CT. The enlarged right paratracheal nodes are more easily identified on PA CXRs than the left paratracheal nodes (green arrow) on CT, aortopulmonary nodes and subcarinal nodes (pink asterisks) on CT.

While hilar nodes are nearly always involved in sarcoidosis, isolated mediastinal lymphadenopathy is rare.

Lymphadenopathy in long-standing sarcoidosis can display punctate or eggshell calcifications.



>=< FURTHER KNOWLEDGE

The combination of right paratracheal nodes, right and left hilar nodes is also known as the pawnbroker's sign or the 1-2-3 sign.

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CXR 通常显示双侧对称和巨大肺门增大（由于体积大且形态不规则，称为“马铃薯淋巴结”（橙色箭头）），以及（CT 显示）右气管旁淋巴结肿大（蓝色箭头）导致的右气管旁线增大（浅紫色箭头）。增大的右气管旁淋巴结在后前位 CXR 上比左气管旁淋巴结（CT 上可见，绿色箭头）、主肺动脉淋巴结和隆突下淋巴结（CT 上可见，粉色星号）更易识别。

虽然结节病几乎都累及肺门淋巴结，但孤立性纵隔淋巴结病较为罕见。

长期结节病的淋巴结病变可表现为点状或蛋壳样钙化。

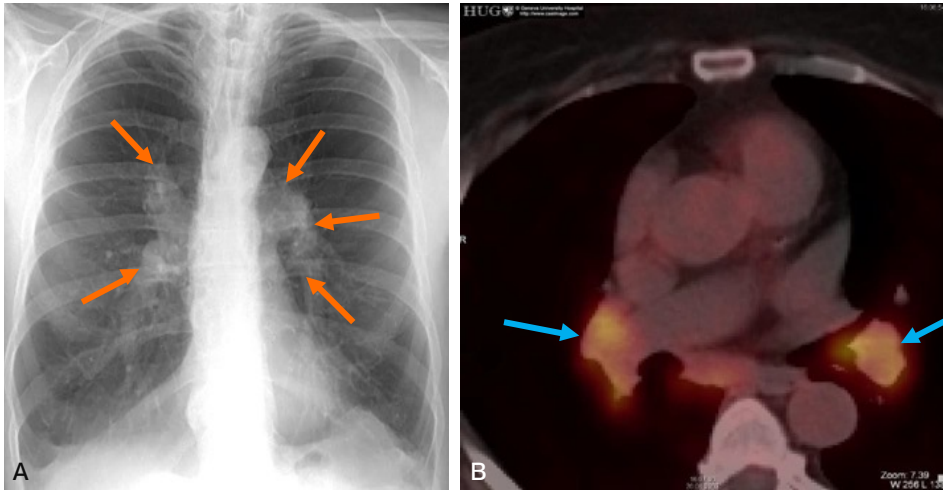
>=< 进阶知识

气管右旁与左、右肺门淋巴结同时肿大，也被称为“当铺征”或“1-2-3 征”。

/ Lymphoma

Lymphoma can be limited to lymph nodes or it can arise in any organ (extra-nodal disease).

Hodgkin lymphoma (HL) is less common than Non-Hodgkin lymphoma (NHL) although both tumour types are quite rare.



HL typically begins in lymph nodes of the neck, mediastinum, hila and armpits, whereas NHL can arise in lymph nodes anywhere in the body.

Extra-nodal disease is much more common in NHL than in HL. In HL, involvement of lung parenchyma is rare at initial presentation and it is most often due to contiguous spread of disease from mediastinal and/or hilar lymphadenopathy. However, in recurrent HL, involvement of lung parenchyma can occur without hilar/mediastinal involvement.

<!=> ATTENTION

Bilateral hilar involvement is more common in HL than in NHL at initial presentation.

PA CXR (A) shows bilateral enlargement of the hila (orange arrows). Axial FDG PET CT image (B) at the level of the hila shows strongly FDG avid enlarged lymph nodes (blue arrows). Histology revealed HL.

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/ 淋巴瘤

淋巴瘤可以局限于淋巴结，也可以发生于身体的任何器官（结外病变）。

霍奇金淋巴瘤 (HL) 发病率低于非霍奇金淋巴瘤 (NHL)，但两者总体都较为罕见。

HL 通常起源于颈部、纵隔、肺门和腋下淋巴结，而 NHL 则可发生于身体任何部位的淋巴结。

结外病变在 NHL 中比在 HL 中常见得多。HL 初次发病时，肺实质受累较为罕见，通常是由于纵隔和/或肺门淋巴结病变向邻近部位扩散所致。但在复发性 HL 中，肺实质受累可以在没有肺门/纵隔受累的情况下出现。

<!=> 注意

初次发病时，HL 双侧肺门受累比 NHL 更为常见。

后前位 CXR (A) 显示双侧肺门增大（橙色箭头）。肺门水平的轴位 FDG PET-CT 图像 (B) 显示 FDG 高度摄取的肿大淋巴结（蓝色箭头）。组织学结果为 HL。

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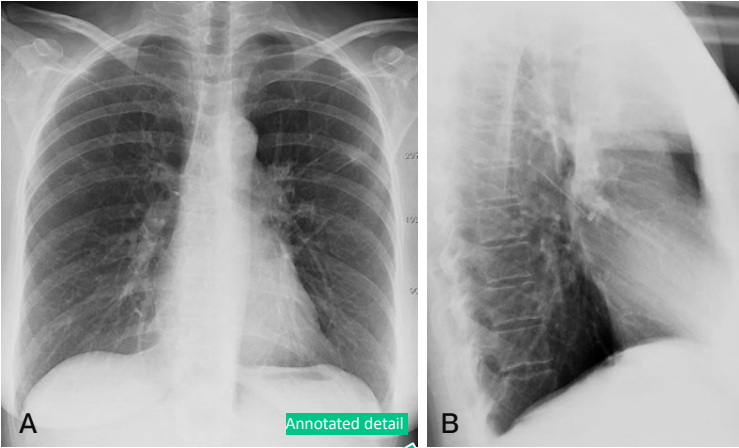
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PA CXR (A) and lateral CXR (B) showing convex APW (pink line), enlarged left hilum (turquoise line) and two lung nodules (green). FDG PET CT (C and D, coronal reformatted images) show two strongly FDG avid lung nodules and enlarged and hypermetabolic lymph nodes in the APW (pink arrows) and left hilum (turquoise arrows). Histology and genomic features confirmed primary lung adenocarcinoma with intrapulmonary metastasis and hilar and mediastinal lymph node metastases.

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/ 肺癌淋巴结转移

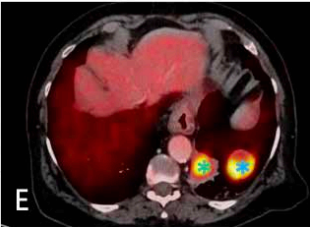
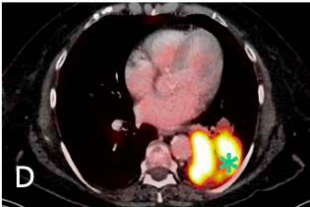
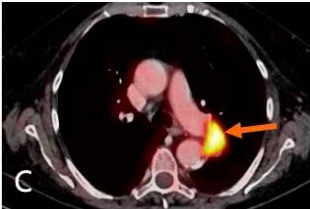
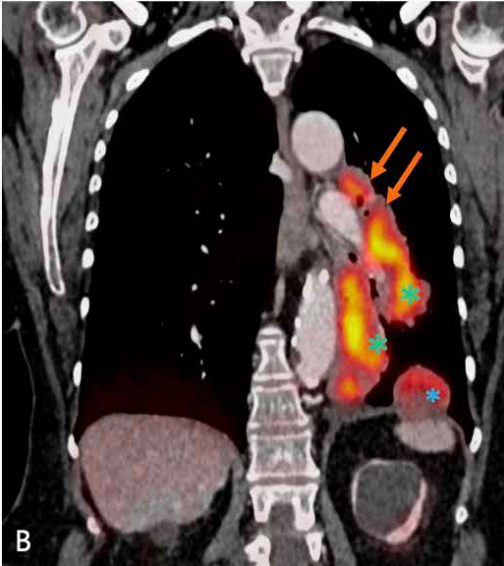
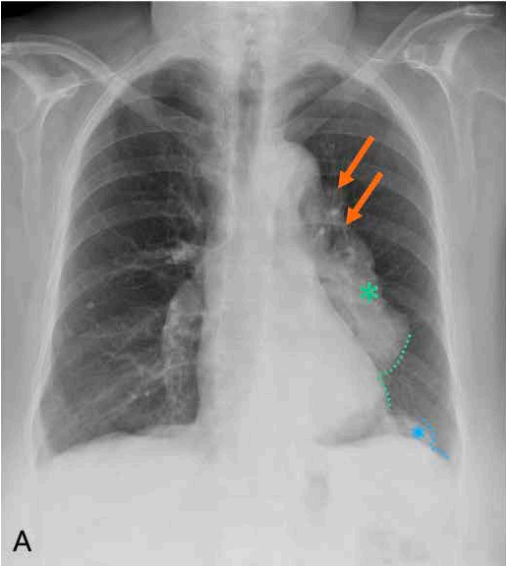
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后前位 (A) 和侧位 CXR (B) 显示 APW 凸出 (粉色线)、左肺门增大 (蓝绿色线) 和两个肺结节 (绿色)。FDG PET-CT (C 和 D, 冠状位重建图像) 显示两个 FDG 高摄取的肺结节, 以及 APW (粉色箭头) 和左肺门 (蓝绿色箭头) 中肿大且代谢活跃的淋巴结。组织学和基因组特征证实为原发性肺腺癌, 伴肺内转移及肺门和纵隔淋巴结转移。

/ Lymphoma

PA CXR (A) shows enlargement of the left hilum (orange arrows) and a pulmonary mass (green) located along the left mediastinal border (acute angle with the left heart border, green). This mass extends from the hilum into the left lower lobe (absent silhouette sign, therefore it is posterior to the heart). Note a second pulmonary mass located just above the left diaphragm (blue). FDG PET CT images (B - E) show that all mass lesions are strongly FDG avid. Histology revealed diffuse large B-cell lymphoma with hilar and left lower lobe involvement.



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后前位 CXR (A) 显示左肺门增大 (橙色箭头), 以及位于左纵隔边界的肺部肿块 (绿色, 肿块与左心缘形成锐角)。该肿块从肺门延伸至左肺下叶 (无剪影征, 提示位于心脏后方)。请注意, 第二个肺部肿块位于左膈肌正上方 (蓝色)。FDG PET-CT 影像 (B - E) 显示, 所有肿块病变表现出 FDG 高摄取。组织学显示弥漫性大 B 细胞淋巴瘤伴肺门和左下叶受累。

/ Abnormal Lung Parenchyma

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/ Pulmonary Acinus and Pulmonary Lobule

The lungs comprise the airspaces (alveoli) and the interstitium. The interstitium contains supporting connective tissue, branching bronchi and bronchioles, arteries, veins and lymphatics. The distal bronchioles divide into terminal bronchioles (the most distal segment of the conducting zone), which in turn give rise to respiratory bronchioles (start of the respiratory zone). Respiratory bronchioles divide into alveolar ducts which give rise to alveolar sacs and alveoli.

The pulmonary acinus is supplied by a first order respiratory bronchiole. It comprises 2000 - 4000 alveoli. The secondary pulmonary lobule also called pulmonary lobule contains about 30 acini. It is supplied by a distal pulmonary artery and a terminal bronchiole. The pulmonary lobules are separated by incomplete interlobular septa which contain the distal pulmonary veins and lymphatics. The size of the pulmonary lobules varies (a peripheral lobule is larger than a central lobule). The interlobular septa are in continuity with the peribronchovascular and subpleural interstitium.

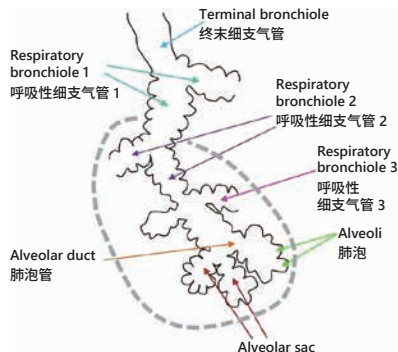
<=> ATTENTION

Pulmonary pathology may involve the alveoli, the interstitium or both.

Distinction between alveolar and interstitial abnormalities on CXR and HRCT are one of the most important factors to narrow down the differential diagnosis.

>< COMPARE

Pulmonary acinus 肺腺泡



Secondary pulmonary lobule 次级肺小叶

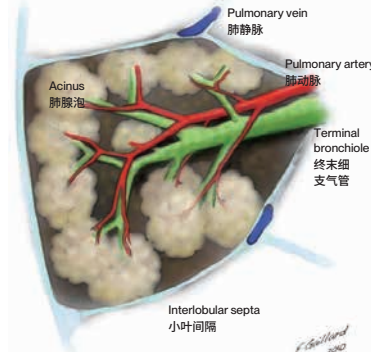


Image from: Gaillard F, Secondary pulmonary lobule (illustration). Case study, Radiopaedia.org <https://doi.org/10.53347/rID-8760>

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/ 肺腺泡及肺小叶

肺由气腔（肺泡）和间质组成。间质包括支持性结缔组织、分支支气管和细支气管、动脉、静脉及淋巴管。远端细支气管分为终末细支气管（导气部的最远端段），终末细支气管进一步分为呼吸性细支气管（呼吸部的起点）。呼吸性细支气管分为肺泡管，肺泡管再分出肺泡囊和肺泡。

肺腺泡通气来源于一级呼吸性细支气管，包含 2000~4000 个肺泡。次级肺小叶（又称肺小叶），约含有 30 个腺泡，由远端肺动脉供血，通气来自终末细支气管。肺小叶由不完整的小叶间隔分隔，内含远端肺静脉和淋巴管。肺小叶的大小不一（周边区域的小叶通常大于中央的小叶）。小叶间隔与支气管血管周围间质及胸膜下间质相连。

<=> 注意

肺部病变可累及肺泡、间质，或同时累及两者。

在 CXR 和 HRCT 上鉴别肺泡和肺间质异常是缩小鉴别诊断范围的关键因素之一。

>< 比较

图片来自: Gaillard F, 次级肺小叶 (插图)。病例分析, Radiopaedia.org <https://doi.org/10.53347/rID-8760>

/ Pulmonary Opacification Patterns

Pulmonary opacification is a nonspecific term that corresponds to a decreased ratio of gas to soft tissue (and therefore an increased attenuation on CXR and CT).

Pulmonary opacification can be divided into different patterns:

- / alveolar opacification (consolidation)
- / interstitial opacification
- / nodular opacification

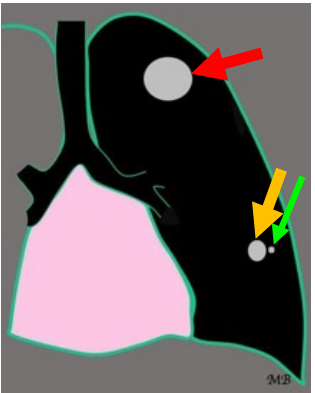
/ atelectatic opacification (some authors use the term “atelectasis* as a synonym of collapse while others use it only for partial collapse; in this chapter, both terms will be used as synonyms)



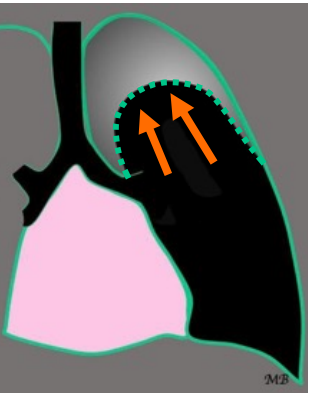
Alveolar opacification
肺泡性高密度影



Interstitial opacification
间质性高密度影



Nodules and masses
结节和肿块



Atelectatic opacification
肺不张性高密度影

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/ 肺部高密度影

肺部高密度影是一个非特异性术语，指的是肺内气体与软组织的比例减少（因此在 CXR 和 CT 上的衰减增加）。

肺部高密度影可分为不同影像表现类型：

- / 肺泡性高密度影（实变）
- / 间质性高密度影
- / 结节性高密度影
- / 肺不张性高密度影（部分文献作者将“不张”与“萎陷”视为同义词，有些则仅将其用于部分萎陷；本章中两者视为同义）

/ Alveolar Opacification (Consolidation)

Alveolar opacification (consolidation or airway opacification) seen on CXRs means that "something other than air" fills the alveoli.

Causes include transudate (lung oedema secondary to congestive heart failure, nephrotic syndrome, cirrhosis, hypoproteinaemia), exudate (inflammatory fluid/pus due to infection), haemorrhage, aspiration of gastric contents or of water (drowning) and cells (either due to lepidic tumour growth = tumour growth along the alveolar lining or caused by organising pneumonia). Correlation with clinical findings and patient history is a must as the observed attenuation on CXRs is nonspecific.

<!=> ATTENTION

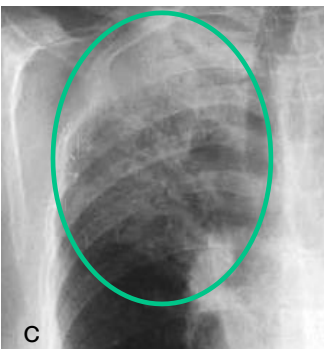
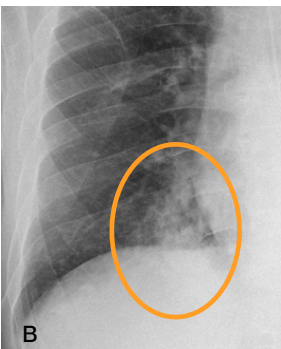
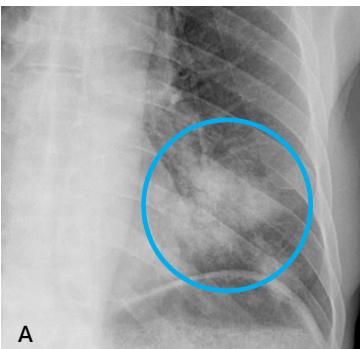
Features of alveolar opacification are:

- / ill-defined, patchy, coalescent areas of opacification
- / no loss of volume in the affected lung parts
- / air bronchogram > the air-filled bronchi (dark) are outlined by the opacified (whitish/grey) alveoli. If the bronchi contain fluid, there is no air bronchogram.
- / extension to a fissure without crossing it.

Alveolar opacification can display the following distribution patterns:

- / segmental or lobar
- / multiple opacities
- / bat wing (see pages 107 and 135)
- / reversed bat wing (see page 107)

Three different patients (A-C) with alveolar opacification on PA CXRs involving the lingula (A, silhouette sign), the right lower lobe (B, no silhouette sign) and the right upper lobe (C), respectively. Note ill-defined areas of patchy opacification and air-bronchogram especially well visible in C.



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/ 肺泡性高密度影 (实变)

肺泡性高密度影 (实变或气道高密度影) 在 CXR 上表现为“非空气成分”填充肺泡。

病因包括漏出液 (继发于充血性心力衰竭、肾病综合征、肝硬化、低蛋白血症的肺水肿)、渗出液 (感染引起的炎性液体/脓液)、出血、胃内容物吸入或水吸入 (溺水), 和细胞成分 (由于附壁肿瘤生长, 即肿瘤沿肺泡壁生长, 或由机化性肺炎引起)。由于 CXR 观察到的衰减不具有特异性, 必须结合临床表现和患者病史进行判断。

肺泡性高密度影的分布可表现为:

- / 节段性或肺叶性
- / 多发高密度影
- / 蝙蝠翼征 (见第 107、135 页)
- / 反蝙蝠翼征 (见第 107 页)

<!=> 注意

肺泡性高密度影的特征包括:

- / 边界模糊、斑片状、可融合的高密度区域
- / 受累肺野无体积损失
- / 空气支气管征 > 被高密度的 (白色/灰色) 肺泡包绕的充气支气管 (深色) 清晰可见。如果支气管内含有液体, 则无空气支气管征。
- / 可延伸至叶间裂但不会跨越裂隙。

下图为 3 例不同患者 (A-C) 后前位 CXR 的肺泡性高密度影, 分别累及肺舌叶 (A, 剪影征)、右下肺下叶 (B, 无剪影征) 和右肺上叶 (C)。注意, C 图尤其可见边界模糊的斑片状高密度影及空气支气管征。

/ Pneumonia

Pneumonia = infection of the lung by a pathogenic organism (as opposed to pneumonitis, which is a non-infective inflammation)

Pneumonia can be classified into many ways, e.g., according to:

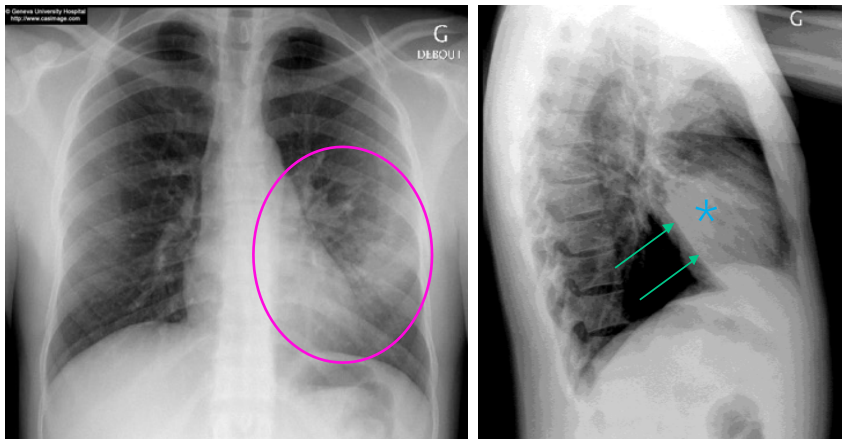
- / patterns of spread → lobar pneumonia (usually confined to a lobe) versus bronchopneumonia, i.e., initial peribronchiolar involvement → then spread to different lung segments and different lobes (multifocal involvement), which can progress to diffuse consolidation
- / infection setting → community acquired pneumonia versus hospital acquired versus ventilator associated pneumonia

<!=> ATTENTION

- / Pneumonia is one of the major death causes related to infection.
- / The most common bacterial pathogens include *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Klebsiella pneumoniae* and *Haemophilus influenzae*.
- / Viral pathogens include COVID-19 and varicella.
- / Fungal pneumonia (*Pneumocystis pneumonia*) is virtually never seen in immunocompetent patients.

<!=> ATTENTION

Lobar consolidation is the most common consolidation type.



Lobar consolidation involving the left upper lobe mainly the lingula (pink circle). Note air bronchogram and no volume loss. Sharply defined opacification (blue asterisk) by the left oblique fissure (green arrows) on the lateral CXR.

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/ 肺炎

肺炎 = 由致病微生物引起的肺部感染 (区别于肺炎症, 后者为非感染性炎症)

肺炎可通过多种方式分类, 例如依据:

- / 扩散模式 → 可分为大叶性肺炎 (通常局限于单一肺叶) 和支气管肺炎, 后者初期表现为细支气管周围受累 → 随病情发展扩散至不同的肺段和肺叶 (多灶性受累), 可进展为弥漫性实变
- / 感染环境 → 社区获得性肺炎、医院获得性肺炎和呼吸机相关性肺炎

<!=> 注意

- / 肺炎是感染相关的主要死亡原因之一。
- / 最常见的细菌性病原体包括肺炎链球菌、金黄色葡萄球菌、肺炎克雷伯菌和流感嗜血杆菌。
- / 病毒性病原体包括 COVID-19 和水痘。
- / 真菌性肺炎 (肺孢子菌肺炎) 在免疫功能正常的患者中非常罕见。

<!=> 注意

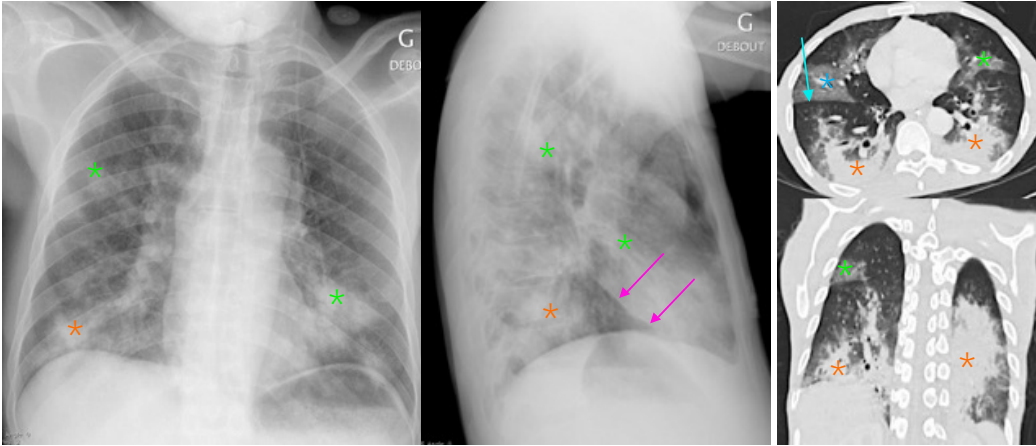
大叶性实变是最常见的实变类型。

左肺上叶肺叶实变, 主要累及舌段 (粉色圆圈)。可见空气支气管征, 无肺容积缩小。侧位 CXR 显示左斜裂 (绿色箭头) 旁边清晰的高密度影 (蓝色星号)。

/ Multifocal Distribution Pattern vs. Lobar Pattern

- / Pneumonia is the most common cause of lobar (see previous page) and multi-focal consolidation.
- / Lobar consolidation is also seen in patients with lung contusion and infarction, certain neoplasms (e.g., adenocarcinoma in situ formerly called bronchoalveolar carcinoma), as well as in some inflammatory conditions, e.g., sarcoidosis.
- / Besides bronchopneumonia, multifocal consolidation can also be a manifestation of neoplasms and septic emboli.

Multifocal alveolar opacification in bronchopneumonia (Staphylococcus aureus). Involvement of both lower lobes (orange asterisks), middle lobe (blue asterisk) and upper lobes (green asterisks) including the lingula. Note sharp delineation of the left oblique fissure (pink arrows) by upper lobe consolidation on the lateral CXR and sharp delineation of the horizontal fissure (turquoise arrow) on CT. On CT, vascular contours are not seen in the consolidated areas → see page 108 for distinguishing consolidation from ground glass opacity (GGO)..



<!=> ATTENTION

The clinical history is essential for the differential diagnosis, in particular distinction between acute and chronic consolidation. The most common causes of acute consolidation are pulmonary oedema due to heart failure, pneumonia and aspiration, whereas neoplasms and sarcoidosis are the most common causes of chronic consolidation.

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/ 多灶性分布与大叶性分布

- / 肺炎是导致大叶性（见前文）和多灶性实变的最常见病因。
- / 大叶性实变也可见于肺挫伤和梗死、某些肿瘤（如原位腺癌，以前称为细支气管肺泡癌）以及某些炎症性疾病（如结节病）患者。
- / 除支气管肺炎外，多灶性实变也可能是肿瘤和脓毒性栓子的表现。

<!=> 注意

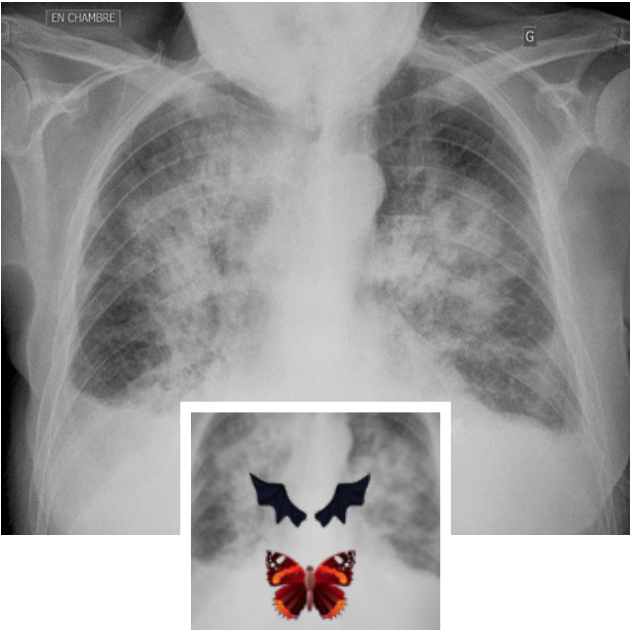
临床病史对于鉴别诊断至关重要，尤其是在区分急性和慢性实变方面。急性实变的最常见原因是心力衰竭引起的肺水肿、肺炎和误吸，而慢性实变则以肿瘤和结节病为主要病因。

金黄色葡萄球菌所致支气管肺炎的多灶性肺泡性高密度影。双下叶（橙色星号）、中叶（蓝色星号）和上叶（绿色星号）受累，包括舌段。侧位 CXR 上肺实变清晰显示左斜裂（粉色箭头），CT 清晰显示水平裂（蓝绿色箭头）。CT 显示，实变区内血管纹消失 → 参见第 108 页以区分实变与磨玻璃影 (GGO)。

/ Bat Wing and Reversed Bat Wing Distribution Pattern

>|< COMPARE

Bat wing opacities or butterfly opacities → bilateral perihilar alveolar opacities (see below). The pattern is seen on frontal CXRs and on CT. The most common cause is cardiogenic lung oedema (see page 137).



Reversed bat wing opacities → bilateral peripheral alveolar opacities sparing the perihilar regions (see below). The most common cause is chronic eosinophilic pneumonia (rare idiopathic eosinophil-rich inflammation typically affecting the upper lung zone alveoli) or sarcoidosis.



Case courtesy: Elswood T, Eosinophilic pneumonia. Case study, Radiopaedia.org <https://doi.org/10.53347/rID-74170>

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/ 蝙蝠翼征与反蝙蝠翼征

>|< 比较

蝙蝠翼状影或蝴蝶影 → 双侧肺门周围肺泡影（如下图），CXR 正位、CT 可见。最常见的原因是心源性肺水肿（见第 137 页）。

反蝙蝠翼状影 → 双侧外周肺泡影不累及肺门周围区域的表现（如下图），最常见的原因是慢性嗜酸性粒细胞性肺炎（一种主要累及上肺野肺泡的罕见特发性嗜酸性粒细胞增多性炎症）和结节病。

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病例提供：Elswood T, 嗜酸性粒细胞性肺炎。病例分析, Radiopaedia.org <https://doi.org/10.53347/rID-74170>

/ Alveolar opacification (consolidation) versus ground glass opacity (GGO)

Ground glass opacity (GGO) = radiologic descriptive term that corresponds to a hazy increase in lung attenuation (opacity) on CT. GGO does not obscure lung vasculature on CT and bronchial markings are preserved.

<!=> ATTENTION Although the term should only be used with CT, some radiologists also use it with CXRs.

Causes of GGO include:

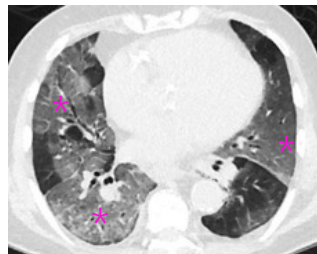
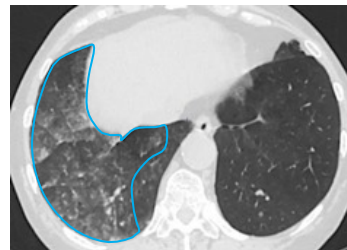
- / normal expiration
- / partial alveolar filling with transudate, exudate, blood or lepidic tumour growth
- / mild interstitial thickening due to inflammation or fibrosis beyond the resolution of current CT scanners
- / partial alveolar collapse

GGO can predominantly affect the upper, middle or lower lung zones. On axial CT images, the distribution can be centrilobular, peribronchovascular, peripheral, subpleural or diffuse.

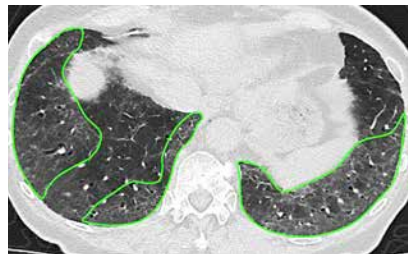
The distribution pattern plays an important role for the differential diagnosis, e.g., diffuse and bilateral GGO is typically seen in pneumocystis and other viral pneumonias or in heart failure.

<!=> ATTENTION Not all GGOs are pathological, e.g., if CT is obtained during expiration or in bed-ridden patients due to prolonged supine position.

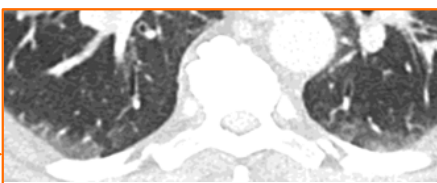
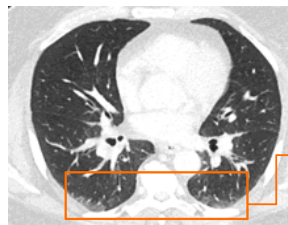
Partially nodular GGO in a patient with mucinous invasive lung adenocarcinoma (blue line).



Large areas of GGO (*) in Covid-19 pneumonia (pink asterisks).



Sub-pleural/peribronchovascular GGO in connective-tissue-related interstitial lung disease (green lines).



GGO in the dependant lung zones in the supine position.

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/ 肺泡性高密度影（实变）与磨玻璃影 (GGO)

磨玻璃影 (GGO) = 影像学描述性术语，特指 CT 上肺衰减（高密度）的模糊影。CT 上，GGO 不遮盖肺血管，支气管纹理仍可显示。

<!=> 注意

虽然该术语主要用于 CT，但一些放射医生在 CXR 诊断中也会使用此表述。

导致 GGO 的原因包括:

- / 正常呼气
- / 部分肺泡充盈，内含漏出液、渗出液、血液或肿瘤伏壁生长
- / 超出当前 CT 分辨率的炎症或纤维化导致的轻度间质增厚
- / 部分肺泡萎陷

GGO 可主要累及上、中或下肺野。轴位 CT 图像上，病灶分布可呈小叶中心型、支气管血管束周围型、肺外周型、胸膜下型或弥漫型。

这些分布特征具有重要鉴别诊断价值，如弥漫型和双侧 GGO 常见于肺孢子菌肺炎、病毒性肺炎及心力衰竭等疾病。

<!=> 注意

某些生理性因素也可导致 GGO 表现，包括呼气相 CT 伪影及长期卧床患者。

黏液性浸润性肺腺癌患者的部分结节性 GGO（蓝线）。

COVID-19 肺炎可见大面积 GGO (*)（粉色星号）。

结缔组织疾病相关间质性肺疾病中的胸膜下/支气管血管周围 GGO（绿线）。

仰卧位时重力依赖性肺野出现的 GGO。

/ Interstitial Opacification

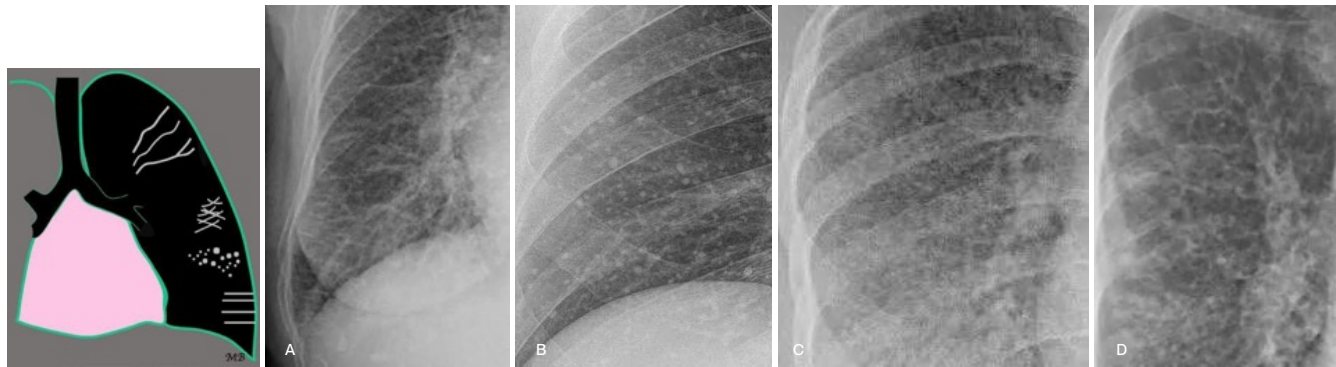
/ Pattern Types and Differential Diagnosis

Interstitial opacification means that the pathology is within or next to the lung interstitium (which includes alveolar epithelium, pulmonary capillary endothelium, basement membrane, perivascular and perilymphatic spaces).

Causes of acute interstitial opacification include interstitial oedema (see page 136) and viral pneumonia. Subacute interstitial

opacification is seen in lymphangitis carcinomatosa whereas chronic interstitial opacification is mostly seen in cystic fibrosis, connective tissue disorders, sarcoidosis, silicosis and tuberculosis.

Several patterns of interstitial opacification can be distinguished: reticular/linear, nodular, reticulonodular, cystic, honeycombing and GGO.



A. Linear pattern (Kerley lines) = network of fine lines caused by thickened connective tissue septa in a patient with cardiac failure. B. Nodular pattern in a patient with healed varicella pneumonia. C. Reticulonodular pattern (nodules and lines) in a patient with lymphangitis carcinomatosa. D. Coarse reticulations and honeycombing, which represent the end stage of many interstitial pathologies.

<!=> ATTENTION

- / It is often difficult to detect interstitial opacification on CXRs.
- / CT is the modality of choice to detect and assess the distribution of interstitial opacification and to distinguish between the different patterns. The combination of pattern types, distribution and associated chest findings plays an essential role for the differential diagnosis.

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/ 间质性高密度影

/ 表现类型和鉴别诊断

间质性高密度影是指病变位于肺间质（包括肺泡上皮、肺毛血管内皮、基底膜、血管周围和淋巴管周围间隙）内或附近。

急性间质性高密度影的病因包括间质性水肿（见第 136 页）和病毒性肺炎。亚急性间质性高密度影见于癌性淋巴管炎，而慢性间质性高密度影主要见于囊性纤维化、结缔组织疾病、结节病、硅肺病和肺结核。

间质性高密度影的表现类型可分为网状/线状、结节状、网状结节状、囊性、蜂窝状和 GGO。

<!=> 注意

- / CXR 通常难以检测到间质性高密度影。
- / CT 是检测和评估间质性高密度影分布及区分不同表现类型的首选方法。表现类型、分布和相关胸部发现的组合对鉴别诊断起着至关重要的作用。

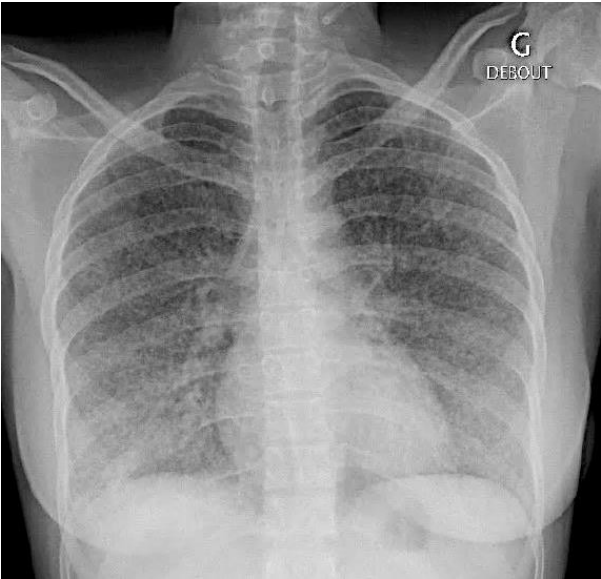
A. 线状影（Kerley 线）表现为心力衰竭患者因结缔组织间隔增厚而形成的细线性网状影。B. 已痊愈的水痘性肺炎患者中的结节性影征。C. 癌性淋巴管炎患者中的网状结节性影征（结节与线状影）。D. 粗大网状结构伴蜂窝状改变，代表许多间质性病变的终末期。

/ Micronodular Pattern on CXR

Micronodular interstitial opacification is characterised by 1 - 5 mm nodules, which are well defined and are not associated with air bronchograms. Nodules tend to be very numerous; when they are distributed randomly throughout the lungs, the term "miliary nodules" is used.

In febrile patients, tuberculosis, viral and fungal infections are the most common causes.

In afebrile patients, miliary tuberculosis, healed varicella pneumonia, sarcoidosis and miliary metastases (thyroid cancer, melanoma, breast cancer) are the top differential diagnoses.



CXR shows a diffuse bilateral nodular pattern, with a random micronodular pattern on CT. This patient had miliary tuberculosis.

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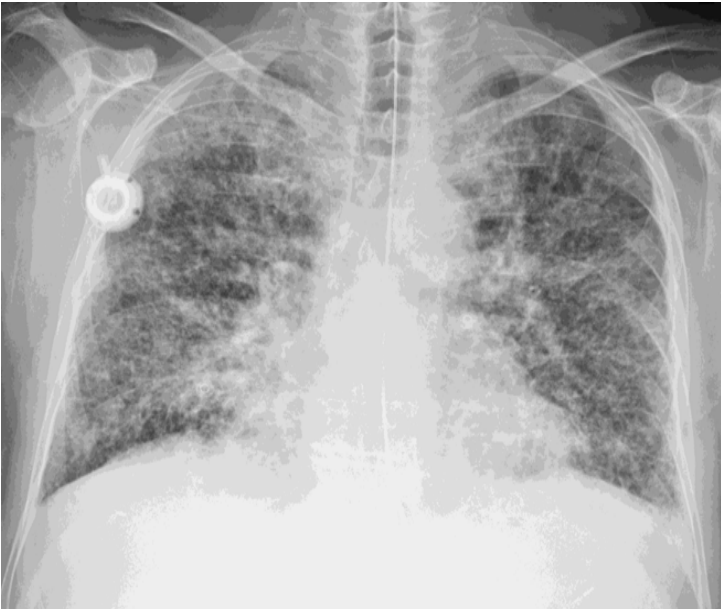
/ CXR 见微结节性影征

微结节性间质性高密度影的特征是存在 1-5 mm 的边界清晰结节，不伴有空气支气管征。当这些结节数量众多且随机分布于全肺时，称为“粟粒性结节”。

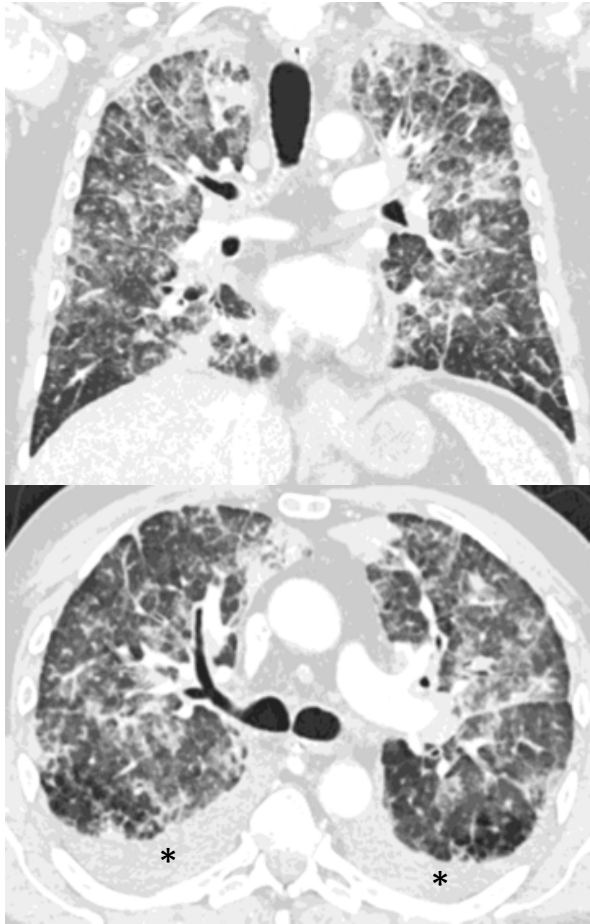
在发热患者中，最常见的病因包括结核、病毒感染和真菌感染。

对于无发热患者，鉴别诊断主要包括粟粒性结核、已治愈的水痘肺炎、结节病以及粟粒样肺转移瘤（原发肿瘤为甲状腺癌、黑色素瘤和乳腺癌）。

/ Reticulonodular Pattern on CXR



CXR shows a diffuse reticulo-nodular pattern. CT shows irregular inter-lobular reticulations, thickened bronchovascular bundles, patchy ground-glass opacifications and pleural fluid (*). This patient had lymphangitis carcinomatosa secondary to gastric cancer.



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/ CXR 上的网状结节性影

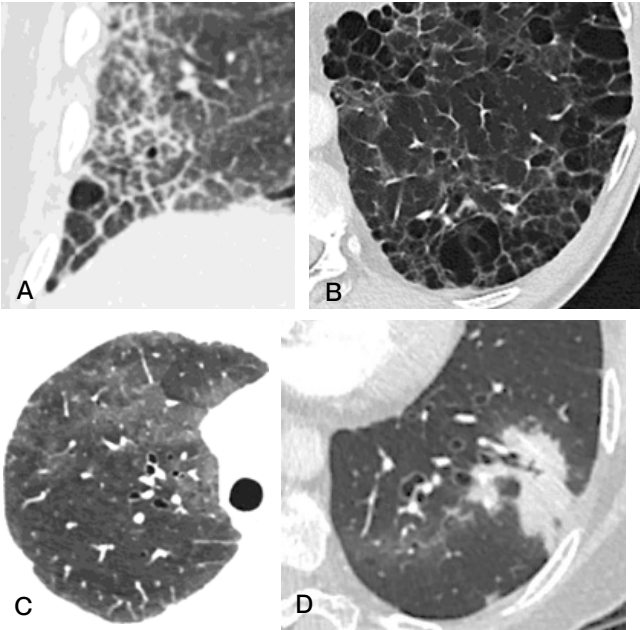
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CXR 显示弥漫性网状-结节影。CT 显示小叶间不规则网状结构、支气管血管束增厚、斑片状磨玻璃影和胸腔积液 (*)。该患者有继发于胃癌的癌性淋巴管炎。

/ Patterns on CT Scans

The most common interstitial patterns on CT are intra- and inter-lobular reticulations (A), honeycombing (B), ground-glass opacification (C), consolidations (D) and micronodules (E).

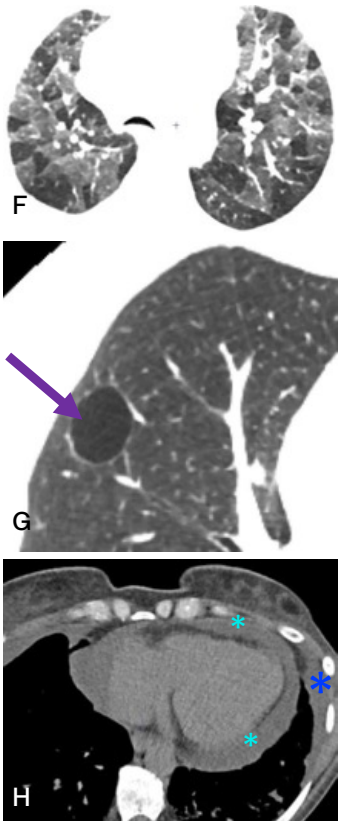


<!-- ATTENTION

Several patterns (A-E) usually coexist in the same patient.

These patterns are not specific to interstitial lung diseases.

However, associated signs such as mosaic attenuation (F), cysts (purple arrow, G) or extra-pulmonary findings (e.g., pericardial (turquoise asterisks) or pleural (blue asterisks) effusion, H) are sometimes crucial in reaching the final diagnosis in chronic interstitial lung diseases.



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 - / 间质性高密度影
 - / CT 表现类型
- 肺水肿
- 肺动脉高压
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/ CT 扫描影征

<!-- 注意

同一患者通常同时存在几种影像表现类型 (A-E)。

这些表现类型并非间质性肺疾病特有。

然而, 马赛克衰减 (F)、囊肿 (紫色箭头, G) 等相关体征或肺外发现 (如心包 (蓝绿色星号) 或胸膜 (蓝色星号) 积液, H) 有时是慢性间质性肺疾病获得最终诊断的关键。

CT 上最常见的间质表现是小叶内和小叶间网状结构 (A)、蜂窝状结构 (B)、磨玻璃影 (C)、实变 (D) 和微结节 (E)。

/ Nodular Opacification

Lung nodules are rounded opacities located in the pulmonary interstitium. They comprise pulmonary nodules (≤ 3 cm, yellow & green arrow) and pulmonary masses (> 3 cm, red arrow). Nodules < 6 mm in average diameter are called micronodules according to the Fleischner Society Glossary. Pulmonary nodules can be solitary or multiple.

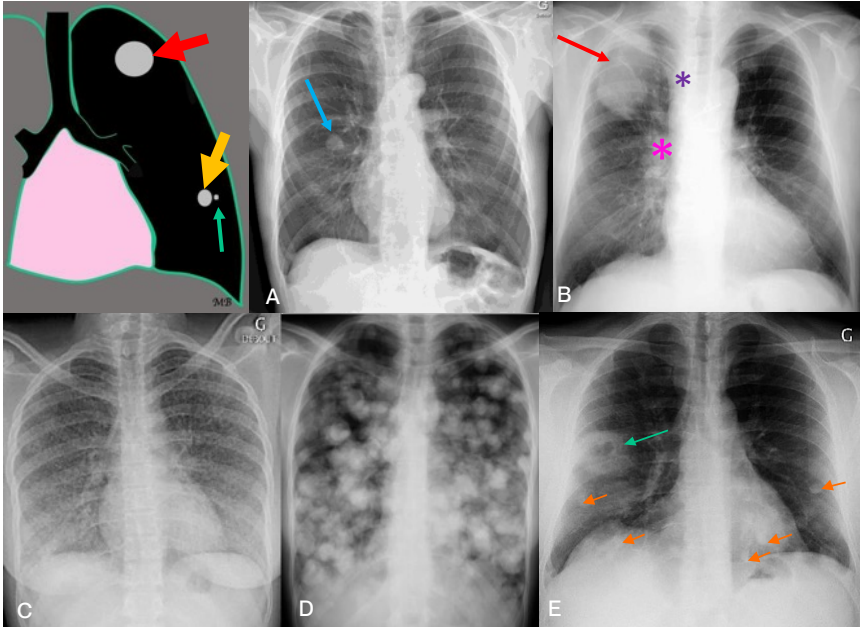
Pulmonary nodules are often detected incidentally on CXRs or on CT.

CXRs have a limited value for nodule detection and characterisation. CT is superior to CXR for the detection of lung nodules.

On CXRs, pulmonary nodules are well-defined lesions of soft tissue density, surrounded by lung parenchyma that tends to be normally aerated.

<!=> ATTENTION

The prevalence of lung cancer increases with the size of the nodule ($< 1\%$ in nodules < 5 mm; $1\% - 30\%$ in nodules > 5 mm and < 10 mm; $30-80\%$ in nodules > 10 mm)



Lung nodules and masses. A. Solitary lung nodule ((blue arrow)hamartoma). B. Lung mass ((red arrow)lung cancer, squamous cell carcinoma) with enlarged paratracheal stripe (purple asterisk) and hilar enlargement (pink asterisk) due to lymph node metastases. C. Multiple micronodules in miliary tuberculosis. D. Metastatic follicular thyroid cancer with pulmonary nodules of varying size. E. Multiple nodules (orange arrows) and a cavitary mass ((green arrow)=gas-filled mass with thick borders) in a patient with granulomatosis with polyangiitis (GPA, formerly called Wegener's granulomatosis).

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/ 结节性高密度影

肺结节是位于肺间质的圆形阴影。包括肺结节 (≤ 3 cm, 黄色和绿色箭头) 和肺部肿块 (> 3 cm, 红色箭头)。根据 Fleischner 学会术语, 平均直径 < 6 mm 的结节被称为微结节。肺结节可分为单发或多发。

肺结节通常在胸片或 CT 上偶然发现。

CXR 对肺结节的检出和特征评估存在局限性。CT 检测肺结节优于 CXR。

在 CXR 上, 肺结节表现为边界清晰的软组织密度影, 其周围通常环绕着正常充气的肺实质。

<!=> 注意

肺癌的患病率随着结节的增大而增加 (肺结节 < 5 mm 时患病率 $< 1\%$; > 5 mm 且 < 10 mm 时为 $1\%-30\%$; > 10 mm 时为 $30\%-80\%$)

肺结节和肿块。A. 孤立性肺结节 ((蓝色箭头) 错构瘤)。B. 肺肿块 ((红色箭头) 肺癌, 鳞状细胞癌) 伴淋巴结转移引起的气管旁带增宽 (紫色星号) 和肺门增大 (粉色星号)。C. 粟粒性肺结核中多发微结节。D. 转移性甲状腺滤泡状癌, 伴有大小不等的肺结节。E. 肉芽肿性多血管炎 (GPA, 以前称为韦格纳肉芽肿) 患者出现多发性结节 (橙色箭头) 和空洞肿块 ((绿色箭头) = 边界较厚的充气肿块)。

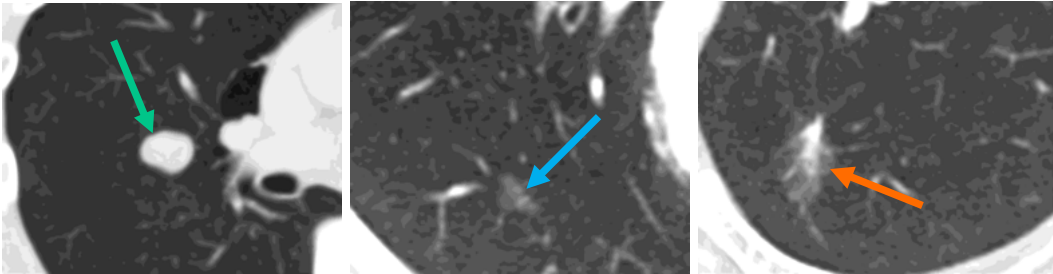
/ Solitary Pulmonary Nodule (SPN)

Solitary pulmonary nodule (SPN) = well-defined lung lesion < 30 mm in size surrounded by lung parenchyma and/or visceral pleura. SPNs have a rounded or oval shape and no linear shape. There is no associated lymphadenopathy, pneumonia or atelectasis.

SPNs can be solid ((green arrow) i.e., they obscure pulmonary vascular structures on CT), subsolid (= GGO without obscuring pulmonary vessels). Subsolid nodules can be further divided into nonsolid ((blue arrow) GGO only) and partly solid nodules ((orange arrow) GGO & solid part). The differential diagnosis of SPNs ranges from benign lesions to lung cancer. Recognition of early stages of lung cancer is essential for prognosis.

<=> REFERENCE

Snoeckx A et al. Evaluation of the solitary pulmonary nodule: size matters, but do not ignore the power of morphology. Insights Imaging. 2018 Feb;9(1):73-86. doi: 10.1007/s13244-017-0581-2. Epub 2017 Nov 15. PMID: 29143191; PMCID: PMC5825309.



>=< FURTHER KNOWLEDGE

- / Key factors to assess the malignant potential of a SPN include nodule size, growth and morphology.
- / Malignancy likelihood increases with nodule size and nodule growth rate. Malignancy prevalence in SPN < 5mm is < 1% and in SPN > 10 mm it is about 15%.
- / Benignity features include perifissural location, triangular morphology, fatty

content and central or pop-corn calcifications.

- / Features suggesting malignancy include spiculated or lobulated borders, pleural indentation, vascular convergence, bubble-like lucencies, subsolid morphology and cystic airspace with mural nodule.
- / To assess morphologic features of SPN, thin section CT with mediastinal and lung window settings is a must.

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/ 孤立性肺结节 (SPN)

孤立性肺结节 (SPN)=边界清晰的肺部病灶，直径 < 30 mm，被肺实质和/或脏层胸膜包围。SPN 表现为圆形或椭圆形病灶，不呈现线状形态。不伴有相关的淋巴结肿大、肺炎或肺不张。

SPN 可分为实性结节（绿色箭头，CT 表现为完全遮盖肺血管结构）和亚实性结节（即 GGO，肺血管结构仍可辨识）。亚实性结节可进一步分为非实性结节（蓝色箭头，仅 GGO）和部分实性结节（橙色箭头，同时包含 GGO 和实性组成）。SPN 的鉴别诊断涵盖从良性病变到肺癌的范围。早期肺癌的识别对患者预后非常重要。

>=< 进阶知识

- / 评估 SPN 恶性可能的关键因素包括结节大小、生长和形态。
- / 结节大小和生长速度越高，恶性肿瘤的可能性越大。SPN < 5 mm 时恶性概率 < 1%，SPN > 10 mm 时，恶性概率约为 15%。
- / 良性特征包括位于裂周、三角形形态、含有脂肪密度成分以及表现为中央型或爆米花样钙化。
- / 提示恶性肿瘤的特征包括边缘毛刺征或分叶征、胸膜凹陷、血管集束征、空泡征、亚实性形态以及囊腔伴壁结节形成。
- / 为评估 SPN 的形态学特征，必须采用薄层 CT 并用纵隔窗和肺窗观察。

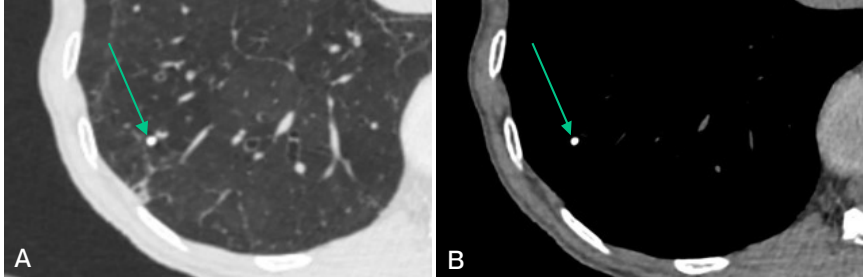
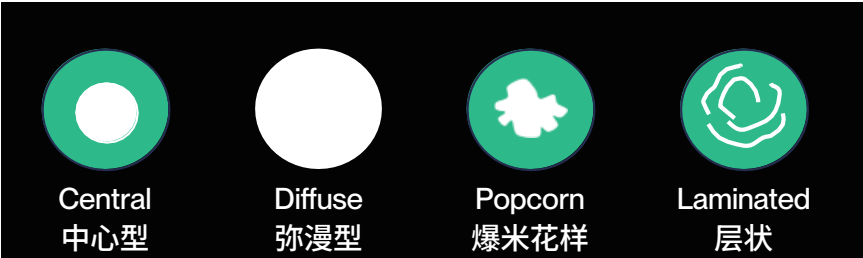
<=> 参考文献

Snoeckx A et al. Evaluation of the solitary pulmonary nodule: size matters, but do not ignore the power of morphology. Insights Imaging. 2018 Feb;9(1):73-86. doi: 10.1007/s13244-017-0581-2. Epub 2017 Nov 15. PMID: 29143191; PMCID: PMC5825309.

Benign features (1)

/ Benign patterns of calcification include central, diffuse, popcorn and laminated patterns, which are typically seen in granulomas and hamartomas. However, if patients have a known primary malignant tumour, e.g., osteosarcoma or gastro- intestinal (GI) cancer, these calcification patterns should not be regarded as benign as osteosarcoma metastases can have diffuse calcification patterns whereas GI cancer metastases can have central or popcorn calcifications.

/ Calcified granulomas (green arrows) as a response to healed infection are the most common cause of pulmonary nodule calcification. Calcification size is usually 2 - 5mm. Calcification location is typically central or diffuse. Often, calcified granulomas are associated with hilar nodal calcification. Images A (lung window) and B (soft tissue window) were obtained in the same patient with a benign calcified granuloma.



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良性特征 (1)

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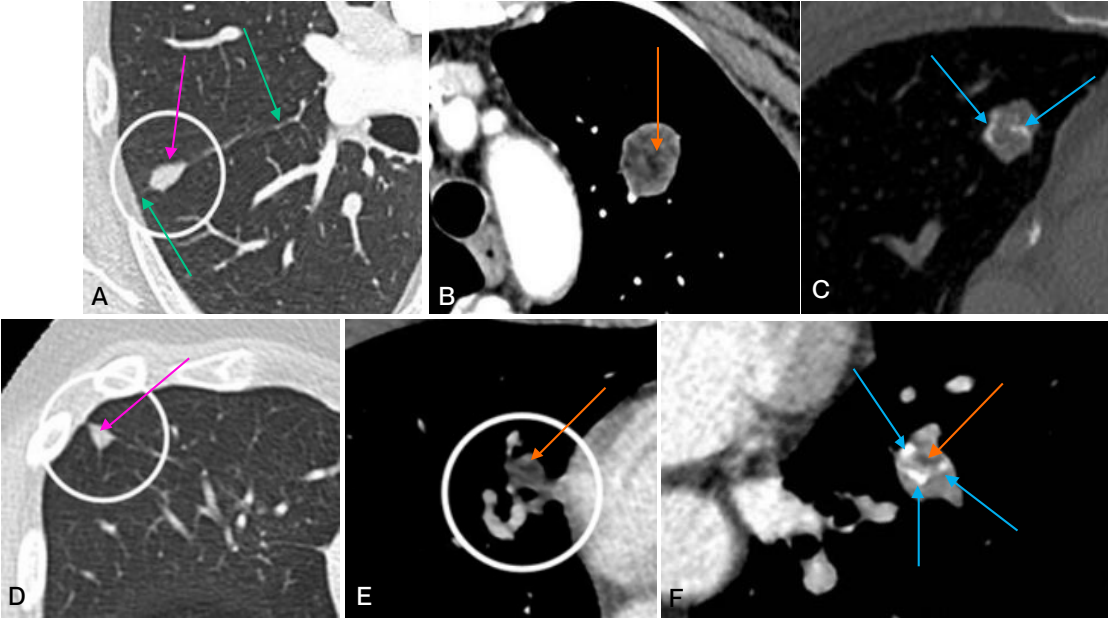
/ 良性钙化包括中央型、弥漫型、爆米花样和层状钙化影征，通常见于肉芽肿和错构瘤。然而，对于已知罹患原发性恶性肿瘤（如骨肉瘤或胃肠道 (GI) 癌）的患者，此类钙化影不应简单判定为良性表现，因为骨肉瘤转移灶可呈现弥漫性钙化，而 GI 癌转移则可能出现中央型或爆米花样钙化。

/ 感染痊愈后出现的钙化肉芽肿（绿色箭头）是肺结节钙化的最常见原因。钙化灶大小通常为 2-5 mm。钙化通常为中心分布型或弥漫性。钙化性肉芽肿常伴肺门淋巴结钙化。图像 A（肺窗）和 B（软组织窗）取自同一良性钙化性肉芽肿患者。

Benign features (2)

/ Perifissural location (green arrows, A) and triangular shape (pink arrows, A and D) corresponding to intrapulmonary lymph nodes.

/ Fatty content (orange arrows, B, E and F).
/ Pop-corn calcifications (blue arrows) typical of chondroid hamartomas (C and F).



Images reproduced from: Snoeckx A et al. Evaluation of the solitary pulmonary nodule: size matters, but do not ignore the power of morphology. Insights Imaging. 2018 Feb;9(1):73-86. doi: 10.1007/s13244-017-0581-2.

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良性特征 (2)

/ 肺内淋巴结对应的裂周位置 (绿色箭头, A) 和三角形形态 (粉红色箭头, A 和 D)。

/ 脂肪含量 (橙色箭头, B、E 和 F)。

/ 爆米花样钙化 (蓝色箭头) 是软骨样错构瘤 (C 和 F) 的典型特征。

/ 胸部影像学

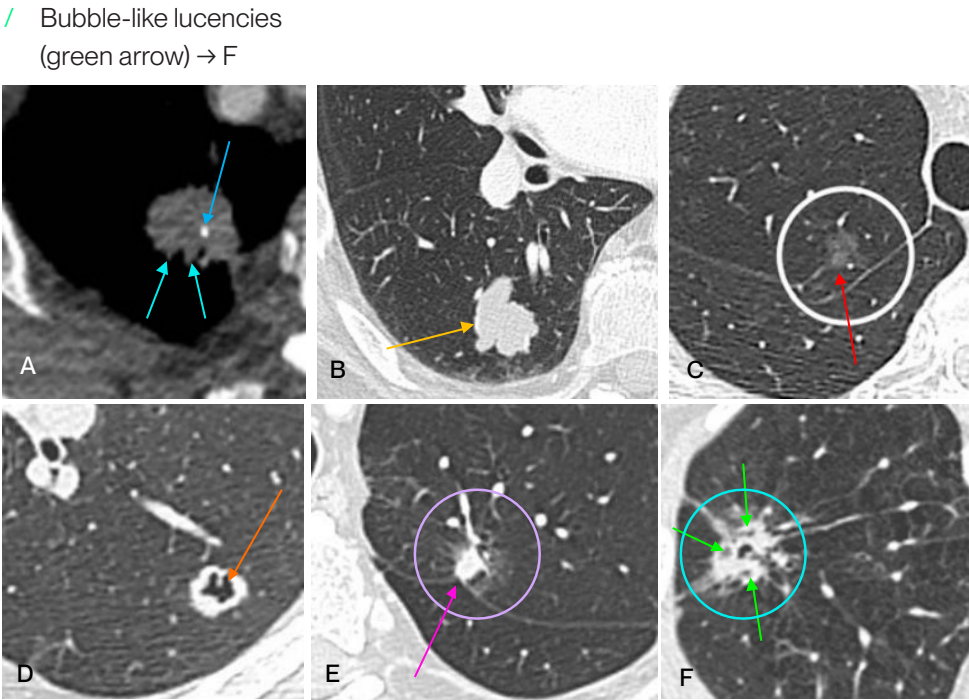
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影像来源: Snoeckx A et al. Evaluation of the solitary pulmonary nodule: size matters, but do not ignore the power of morphology. Insights Imaging. 2018 Feb;9(1):73-86. doi: 10.1007/s13244-017-0581-2.

Features rather suggesting malignancy

- / Scarce dot-like, rather peripheral calcifications (blue arrow) → A
- / Spiculated margins (turquoise) → A and F
- / Lobulated margins (yellow arrow) → B
- / Subsolid nodule (red arrow) → C
- / Part-solid (light purple circle) → E
- / Cavitation ((orange arrow) in the absence of an infectious cause or in not immunocompromised patients) → D
- / Retraction of pleura/fissure (pink arrow) → E



Images reproduced from: Snoeckx A et al. Evaluation of the solitary pulmonary nodule: size matters, but do not ignore the power of morphology. Insights Imaging. 2018 Feb;9(1):73-86. doi: 10.1007/s13244-017-0581-2.

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高度提示恶性肿瘤的特征

- / 偏外围点状钙化灶（蓝色箭头）→ A
- / 边缘毛刺（蓝绿色）→ A 和 F
- / 分叶状边缘（黄色箭头）→ B
- / 亚实性结节（红色箭头）→ C
- / 部分实性（浅紫色圆圈）→ E
- / 空洞（（橙色箭头）不存在感染性病因或非免疫功能低下的患者）→ D
- / 胸膜/叶间裂回缩（粉红色箭头）→ E
- / 空泡征（绿色箭头）→ F

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To evaluate nodule growth, volumetry rather than measurement of lesion size needs to be done.

Volume Doubling Time (VDT)

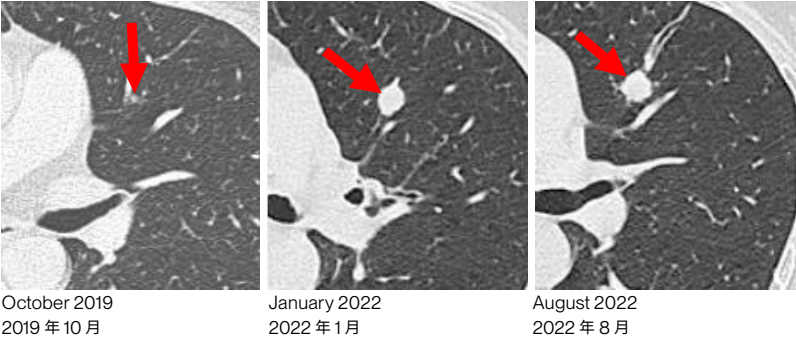
- / = time a growing nodule doubles its volume
- / = major volumetric parameter for screening and follow-up of chest CT
- / Principle:
 - / Malignant nodules are more likely to have a **VDT < 400 days (red arrows)** whereas benign nodules tend to have a **VDT > 500 days (green arrows)**.
 - / Solid malignant nodules tend to grow faster than benign nodules.
 - / Nevertheless, there is overlap between the growth rate of benign and malignant nodules.

<!=> ATTENTION

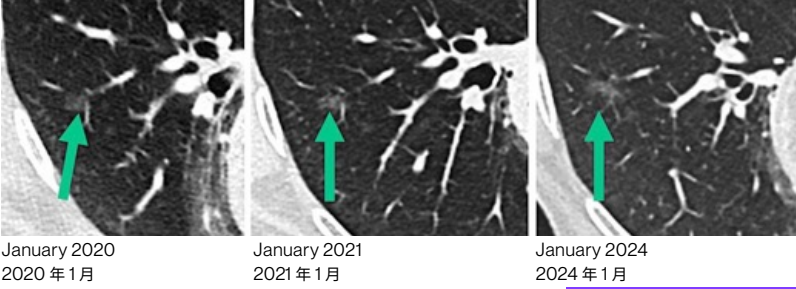
Software-based volumetry VDT is a major parameter in CT-based lung cancer screening (see page 124)
As CT acquisition parameters, e.g., slice thickness and window width have a major influence on VDT measurements, they should be kept as similar as possible for follow-up scans

Adenocarcinoma (VDT = 215 days)
腺癌 (VDT = 215 天)

>|< COMPARE



Most likely benign SPN (VDT = 1020 days)
极大可能是良性 SPN (VDT = 1020 天)



<=> REFERENCES

Hammer MM, Gupta S, Byrne SC. Volume Doubling Times of Benign and Malignant Nodules in Lung Cancer Screening. Curr Probl Diagn Radiol. 2023 Nov-Dec;52(6):515-518. doi: 10.1067/j.cpradiol.2023.06.014.
Anand Devaraj, Bram van Ginneken, Arjun Nair, David Baldwin. Use of Volumetry for Lung Nodule Management: Theory and Practice. (2017) Radiology. 284 (3): 630-644. doi:10.1148/radiol.2017151022

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评估结节生长时，需采用体积测定法而非测量病灶直径。

>|< 比较

体积倍增时间 (VDT)

- / = 结节体积增大一倍的时间
- / = 胸部 CT 筛查和随访的主要体积参数
- / 原理:
 - / 恶性结节的 VDT 通常 < 400 天 (红色箭头)，而良性结节的 VDT 通常 > 500 天 (绿色箭头)。
 - / 恶性实性结节的生长速度往往快于良性结节。
 - / 然而，良恶性结节在生长速率方面存在一定重叠。

<!=> 注意

基于软件的容积测定 VDT 是 CT 肺癌筛查中的主要参数 (见第 124 页)
由于 CT 采集参数 (例如层厚和窗宽) 对 VDT 测量有重大影响，因此在随访扫描时应尽可能保持这些参数相同。

<=> 参考文献

Hammer MM, Gupta S, Byrne SC. Volume Doubling Times of Benign and Malignant Nodules in Lung Cancer Screening. Curr Probl Diagn Radiol. 2023 Nov-Dec;52(6):515-518. doi: 10.1067/j.cpradiol.2023.06.014.
Anand Devaraj, Bram van Ginneken, Arjun Nair, David Baldwin. Use of Volumetry for Lung Nodule Management: Theory and Practice. (2017) Radiology. 284 (3): 630-644. doi:10.1148/radiol.2017151022

/ Follow-up of Incidentally Detected Pulmonary Nodules (PNs)

The Fleischner Society 2017 Guidelines for the management of incidentally detected pulmonary nodules prioritise minimising unnecessary follow- up imaging while ensuring timely detection of malignancy. These guidelines aim to balance the risk of overdiagnosis with the need for early detection of lung cancer.

Management is based on nodule type, nodule size, the presence of solitary versus multiple pulmonary nodules (SPN versus MPN), patient risk factors (e.g., smoking history, family history of lung cancer, fibrosis, emphysema, upper lobe location) and patient comorbidities. For solid nodules, follow-up intervals are determined by nodule size (< 6 mm, 6 - 8 mm, > 8 mm) or nodule volume (< 100 mm³, 100 – 250 mm³, > 250 mm³), morphology, location and growth rate. For subsolid nodules, management further depends on CT appearance (GGO versus part solid), the recommended follow-up for part solid being longer than for solid nodules.

<!=> ATTENTION

These guidelines do not apply to :

- / patients with known primary cancer (who are at risk for metastases)
- / patients with immunosuppression (who are at risk for infection)
- / lung cancer screening participants
- / patients < 35 years.

<==> REFERENCE

MacMahon H, Naidich DP, Goo JM, et al. Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017. Radiology. 2017 Jul;284(1):228-243. doi: 10.1148/radiol.2017161659. Epub 2017 Feb 23. PMID: 28240562.

Most pulmonary nodules < 1 cm are not detected on CXRs, therefore low dose CT (LDCT) with 1 mm continuous thin sections, 2D coronal and sagittal reconstructions is recommended for follow-up. However, larger solid nodules visible on CXRs and considered as “low risk” can also be followed with CXR due to the lower radiation exposure and lower cost of CXRs compared to CT.

Biopsy under bronchoscopy or CT guidance and minimally invasive surgery with lung-sparing techniques are recommended in lesions that display CT or FDG PET CT findings strongly suggesting malignancy. Transthoracic CT guided biopsy is very effective in experienced hands; however, it can yield false negative results in part-solid nodules and in very small solid nodules. The choice of the most appropriate procedure for tissue sampling is made in the setting of multidisciplinary tumour boards.

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/ 偶发肺结节 (PN) 的随访

Fleischner 学会 2017 年发布的针对偶发肺结节的管理指南强调在确保恶性肿瘤及时检出的前提下，优先考虑减少不必要的随访影像学检查。该指南旨在权衡过度诊断风险与肺癌早期发现需求之间的平衡。

临床决策需综合考量结节特征（类型、大小、单发或多发肺结节 (SPN vs. MPN)、患者危险因素（包括吸烟史、肺癌家族史、肺纤维化、肺气肿及上叶分布）以及合并症情况等多重因素。对于实性结节，随访间隔取决于结节大小 (< 6 mm, 6-8 mm, > 8 mm) 或结节体积 (< 100 mm³, 100-250 mm³, > 250 mm³)、形态、位置和生长速度。亚实性肺结节的处理取决于CT 表现（GGO 或部分实性），推荐部分实性结节的随访周期长于实性结节。

由于大多数直径<1 cm 的肺结节在 CXR 上难以检出，临床推荐采用 1 mm 薄层扫描联合 2D 冠状位及矢状位重建的低剂量 CT (LDCT) 进行随访。然而，对于 CXR 可明确显示且评估为“低风险”的较大实性结节，仍可选择 CXR 作为随访手段，因为与 CT 相比，CXR 的辐射剂量和成本较低。

当 CT 或 FDG PET-CT 征象高度提示恶性可能时，推荐行支气管镜或 CT 引导下活检，并考虑采用保留肺组织的微创手术治疗。由经验丰富者操作的胸 CT 引导活检十分有效，但对于部分实性结节和微小实性结节，可能产生假阴性。应由多学科肿瘤团队选择最合适的组织取样方法。

<!=> 注意

这些指南不适用于：

- / 已知患有原发性癌症的患者（有转移风险）
- / 免疫抑制患者（有感染风险）
- / 肺癌筛查受检者
- / 35 岁以下的患者。

<==> 参考文献

MacMahon H, Naidich DP, Goo JM, et al. Guidelines for Management of Incidental Pulmonary Nodules Detected on CT Images: From the Fleischner Society 2017. Radiology. 2017 Jul;284(1):228-243. doi: 10.1148/radiol.2017161659. Epub 2017 Feb 23. PMID: 28240562.

/ Lung Cancer

Lung cancer remains one of the leading causes of cancer-related morbidity and mortality worldwide, with significant public health implications. Smoking remains the primary risk factor (about 85% of cases), although other factors, e.g., exposure to second-hand smoke, environmental pollutants, workplace hazards (asbestos and chemicals), genetic predisposition and previous chronic lung diseases also play a role.

It is estimated that nearly 65% of all new lung cancer diagnoses are seen in former smokers or never smokers and 12% of new lung cancer cases are among never smokers.

Unfortunately, lung cancer is often diagnosed at an advanced stage, contributing to its high mortality rates. The prognosis varies depending on the histologic type of lung cancer, stage at diagnosis and patient's overall health. Non-small cell lung cancer (NSCLC) comprises most cases and generally has a poorer prognosis compared to small cell lung cancer (SCLC), which tends to be more aggressive but may respond better to chemotherapy and radiation therapy. Overall, only 25% of patients with lung cancer survive > 5 years.

Nevertheless, early diagnosis has been shown to dramatically improve survival, e.g., the NSCLC 2-year relative survival has increased by 5% - 6% for every stage of diagnosis in recent years. Furthermore, reduction in smoking and improved lung cancer detection and treatment have also reduced lung cancer mortality.

CT is the primary imaging modality for the detection and staging of lung cancer. It is used for the initial evaluation of suspicious nodules, masses or lymph-adenopathy, guiding further diagnostic interventions. PET CT is often utilised to precisely assess the extent of the primary tumour (improved separation of tumour from adjacent atelectasis and fibrosis compared to CT), to detect nodal metastases, distant metastases and synchronous second primary cancers (see page 23).

<=> REFERENCE

Siegal DA, et al. Proportion of never smokers among men and women with lung cancer in 7 US states. JAMA Oncol. 2021 Feb 1; 7(2): 302-304. doi: 10.1001/jamaoncol.2020.6362.

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肺癌持续位居全球癌症相关发病率和死亡率首位，对公共卫生构成重大挑战。吸烟仍是主要致病因素（约占病例数的 85%），但其他危险因素同样不容忽视，包括二手烟暴露、环境污染物接触、职业性危害物质（如石棉和化学制剂）暴露、遗传易感性以及慢性肺部疾病病史等。

据估算，新发肺癌病例中约 65% 发生于既往吸烟者或终身不吸烟人群，其中终身不吸烟者占比达 12%。

不幸的是，肺癌确诊时多已处进展期，这是其高死亡率的关键因素。预后主要取决于肿瘤组织学类型、确诊时的临床分期以及患者的整体健康状况。非小细胞肺癌 (NSCLC) 占绝大多数，其预后通常差于小细胞肺癌 (SCLC)，尽管后者更具侵袭性但对化疗和放疗可能有更好的治疗反应。总体而言，肺癌患者大于 5 年的生存率仅为 25%。值得关注的是，早期诊断已被证实能显著提高生存率，以 NSCLC 为例，近年来各分期的 2 年相对生存率均提升了 5%-6%。同时，随着吸烟率的下降以及肺癌检测和治疗技术的进步，肺癌死亡率已呈现下降趋势。

在影像学检查方面，CT 是肺癌检测和分期的主要手段。可用于对可疑肺结节、肿块或肿大淋巴结进行初步评估，从而为后续诊断干预提供依据。PET-CT 通常能更准确地评估原发肿瘤范围（较 CT 能更好地区分肿瘤与邻近肺不张或纤维化组织）、检测淋巴结转移和远处转移，以及发现同时性第二原发癌（详见第 23 页）。

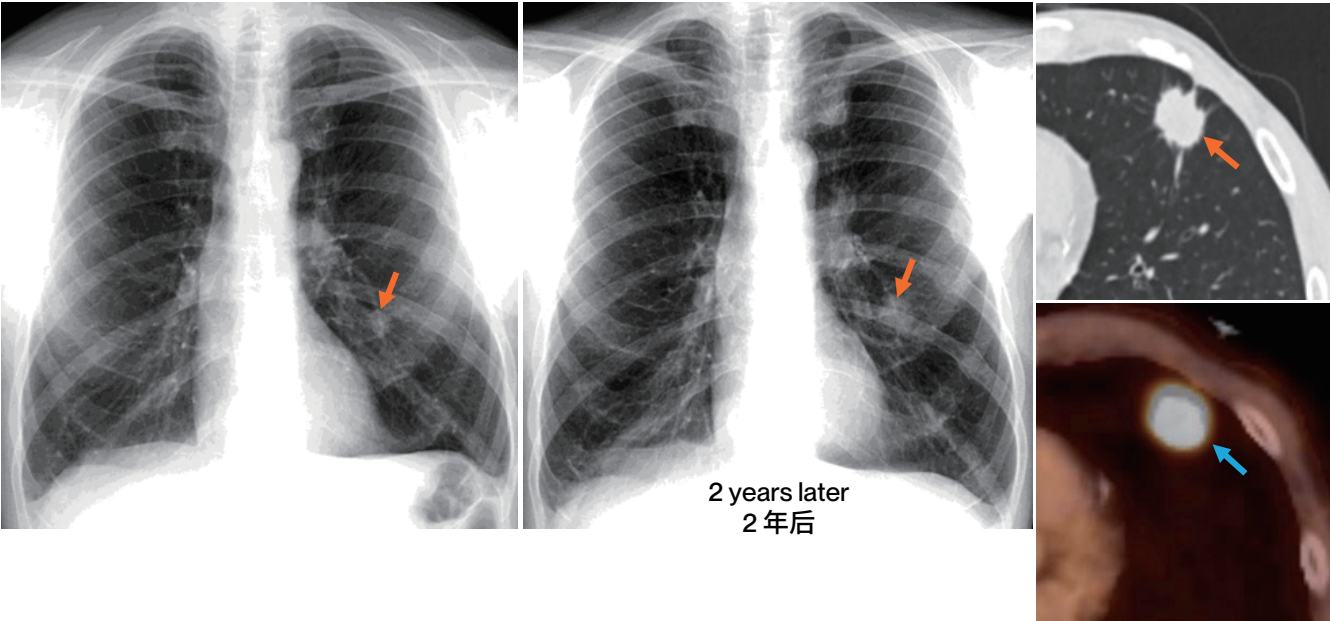
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Hirsch FR, Scagliotti GV, Mulshine JL, Kwon R, Curran WJ Jr, Wu YL, Paz-Ares L. Lung cancer: current therapies and new targeted treatments. Lancet. 2017 Apr 1; 389(10066): 299-311. doi: 10.1016/S0140-6736(16)30958-8. Epub 2016 Sep 6. PMID: 27609408.



CXR with a 2-year interval showing a growing lung nodule in the left lower zone (orange arrows). CT shows a spiculated lingular solid nodule (orange arrow), with a strong FDG hypermetabolism (blue arrow) on PET CT. Biopsy revealed lung adenocarcinoma.

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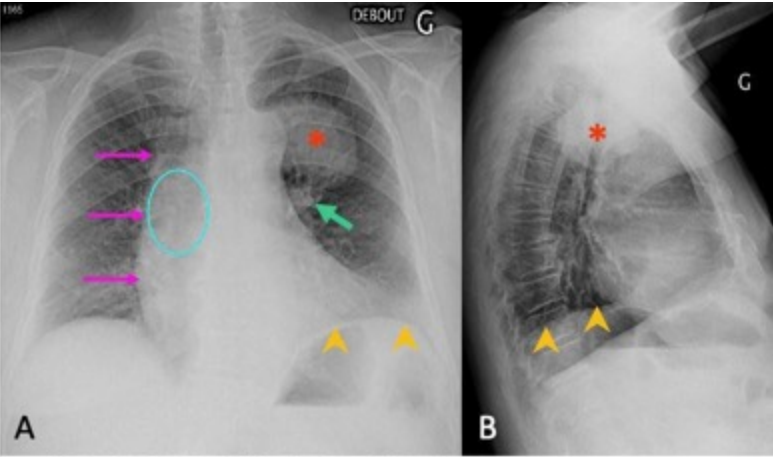
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间隔 2 年的 CXR 显示左下肺野肺结节生长 (橙色箭头)。CT 显示舌段毛刺样实性结节 (橙色箭头), PET-CT 显示 FDG 高代谢 (蓝色箭头)。活检显示肺腺癌。

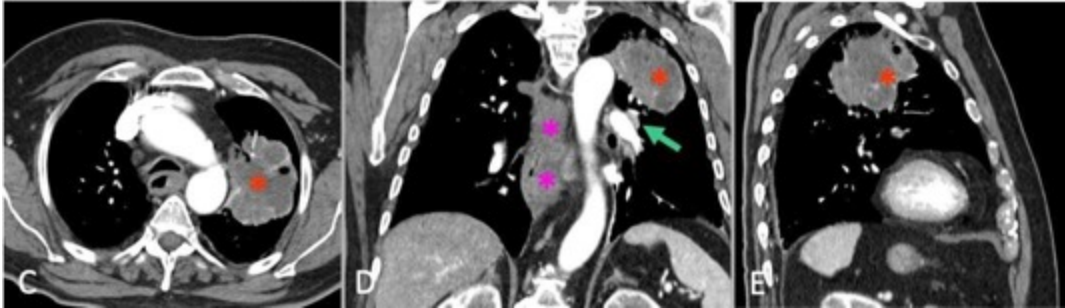
PA and lateral CXRs (A and B) showing a large lung mass in the left upper lobe (orange asterisks). There is enlargement of the left hilum (green arrow), lateral bulging of the right mediastinal border (pink arrows) and absent right hilum overlay sign (turquoise circle) suggesting contralateral hilar involvement. Corresponding axial, coronal and parasagittal CT images with soft tissue settings (C-E) confirming the large (6.4 x 7.2 x 5 cm), solid, mostly necrotic lung mass (orange asterisks) in the left upper lobe with hilar (green arrow) and contralateral mediastinal involvement (pink asterisks). Confluent contralateral metastatic necrotic lymph nodes (pink asterisks) are shown in D. Biopsy revealed squamous cell carcinoma of the lung. Slight elevation of the left hemidiaphragm (yellow arrows) due to diaphragmatic palsy (proven by ultrasonography) caused by phrenic nerve invasion. CT further revealed a single extra-thoracic metastasis in the liver (not shown).



According to the TNM classification (8th edition), the multidisciplinary tumour board classified this tumour as T4N3M1b because:

- / tumour size > 7 cm
- / contralateral mediastinal nodal involvement
- / single extra-thoracic metastasis (not shown).

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后前位和侧位 CXR (A 和 B) 显示左肺上叶巨大肺肿块 (橙色星号)。左肺门扩大 (绿色箭头), 右侧纵隔轮廓向外侧膨出 (粉红色箭头), 未出现右肺门重叠征 (蓝绿色圆圈) 提示该侧肺门受累。相应的轴位、冠状位和矢状位软组织窗 CT 图像 (C-E) 证实左肺上叶巨大 (6.4 x 7.2 x 5 cm)、实性、大部分坏死的肺肿块 (橙色星号), 伴肺门 (绿色箭头) 和对侧纵隔受累 (粉色星号)。D 图显示对侧融合性转移性坏死淋巴结 (粉色星号), 活检提示肺鳞状细胞癌。左侧膈肌轻度抬高 (黄色箭头), 由于膈神经侵犯引起的膈肌麻痹 (经超声检查证实)。CT 进一步显示肝脏有孤立性胸腔外转移 (未显示)。

根据 TNM 分类 (第 8 版), 多学科肿瘤团队将该病例分类为 T4N3M1b, 原因如下:

- / 肿瘤大小 > 7 cm
- / 对侧纵隔淋巴结受累
- / 孤立性胸腔外转移 (未示出)。

> 见下页。

/ Lung Cancer TNM Classification and the Multidisciplinary Tumour Board (MDTB)

The TNM classification of lung cancer = essential tool to accurately stage the disease.

TNM stands for Tumour, Node and Metastasis:

- / the "T" category assesses the primary tumour size and extent of invasion into nearby structures, e.g., main bronchus, pericardium, phrenic nerve
- / the "N" category refers to lymph node invasion (ipsilateral versus contralateral, hilar or mediastinal)
- / the "M" category denotes the presence of metastases to distant sites, e.g., contralateral lung, liver, bones or brain

The TNM staging system is typically determined through a combination of clinical/endoscopic findings, histology, cross-sectional imaging (CT, PET CT or MRI scans) and sometimes surgical exploration.

Once the TNM stage is determined, it provides valuable guidance for selecting the most appropriate treatment (surgery, chemotherapy, radiation therapy, immunotherapy or a combination thereof).

The TNM staging also helps in predicting patient prognosis, guiding discussions regarding potential outcomes and supportive care needs.

Ultimately, the TNM classification system plays a crucial role in personalised treatment planning and optimising patient outcomes in lung cancer management.

The TNM classification of lung cancer is done based on all available information in the setting of specialised multidisciplinary tumour boards

(MDTBs), which convene experts from various medical specialties to collaborate on individual patient cases, ensuring evidence- based treatment plans.

<!=> ATTENTION

MDTBs increase treatment efficacy, reduce treatment-related morbidity and improve patient outcomes. They promote synergy among specialists, optimise resource utilisation and uphold personalised care as the cornerstone of modern oncology practice. With the increasing complexity of cancer care and rapid advancements in treatment modalities, the utilisation of multidisciplinary tumour boards is more crucial than ever.

Schematic drawing of a lung cancer MDTB partly created with the aid of chatgpt.com.



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肺癌 TNM 分期系统是疾病精准分期的重要工具。

TNM 表示 Tumour (肿瘤)、Node (淋巴结) 和 Metastasis (转移)：

- / 其中，“T”代表原发肿瘤的大小及其对邻近结构（如主支气管、心包、膈神经）的侵犯程度
- / “N”代表淋巴结受累情况（同侧或对侧、肺门或纵隔）
- / “M”代表远处转移的存在，如对侧肺、肝、骨或脑转移

TNM 分期系统通常结合临床/内镜检查结果、组织学、横断面成像（CT、PET-CT 或 MRI 扫描），有时还需要手术探查来确定。

一旦确定 TNM 分期，即可为选择最合适的治疗方案（手术、化疗、放疗、免疫治疗或联合治疗）提供有价值指导。

TNM 分期系统不仅有助于预测患者预后，还能为潜在治疗结局和支持治疗需求的讨论提供指导。

这一分期系统在肺癌个体化治疗方案的制定和患者预后优化方面发挥重要的作用。

肺癌 TNM 分期的确定需要综合多学科肿瘤团队 (MDTB) 提供的全部可用信息，汇集各医学领域的专家共同讨论具体病例，确保治疗方案建立在循证医学基础上。

<!=> 注意

MDTB 显著提升了治疗效果，降低了治疗相关并发症发生率，并有效改善了患者预后。通过促进专家间的协作，MDTB 优化了医疗资源配置，并将个体化诊疗确立为现代肿瘤学实践的基石。随着肿瘤诊疗复杂度的提升和治疗手段的快速发展，MDTB 的重要性愈发凸显。

肺癌 MDTB 工作流程示意图（部分借助 chatgpt.com 创建）。

/ Lung Cancer Screening

Lung cancer screening of high-risk individuals (i.e., current or former smokers with a high number of pack years) aims to detect the disease at an early stage when treatment is more effective, thus reducing mortality rates.

>|< COMPARE

ADVANTAGES:

The primary screening technique is low-dose CT (LDCT) of the chest, which offers several advantages:

- + non-invasive and relatively quick, making it well-tolerated by patients
- + high sensitivity for the detection of lung nodules, allowing for the identification of potentially malignant lesions, enabling timely follow-up and further diagnostic evaluation to confirm or rule out cancer
- + LDCT lung cancer screening rather than CXR lung cancer screening has been shown to reduce lung cancer mortality rates

DISADVANTAGES:

- Despite its benefits, LDCT screening for lung cancer has certain limitations and challenges:
- the risk of false-positive findings can lead to unnecessary anxiety and invasive procedures –distinguishing between benign and malignant nodules on LDCT scans can be challenging, necessitating additional tests such as biopsy or repeat imaging
 - LDCT screening is associated with radiation exposure, albeit at a lower dose compared to standard CT scans - while the radiation risk is minimal, repeated screening over time may accumulate radiation doses

Implementing widespread lung cancer screening programs poses several challenges, such as:

- / identifying individuals who would benefit most from screening while minimising harm from overdiagnosis and unnecessary interventions
- / developing effective strategies for risk assessment and participant selection
- / ensuring access to high-quality screening facilities and expertise, particularly in underserved communities
- / addressing barriers such as cost, limited resources and participant awareness

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Sands J, Tammemägi MC, Couraud S, Baldwin DR, Borondy-Kitts A, Yankelevitz D, Lewis J, Granis F, Kauczor HU, von Stackelberg O, Sequist L, Pastorino U, McKee B. Lung Screening Benefits and Challenges: A Review of The Data and Outline for Implementation. J Thorac Oncol. 2021 Jan;16(1):37-53. doi: 10.1016/j.jtho.2020.10.127. Epub 2020 Nov 12. PMID: 33188913.

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/ 肺癌筛查

针对高危人群（包括包年数高的现吸烟者或既往吸烟者）的肺癌筛查项目，其核心价值在于早期发现疾病，在治疗效果最佳的阶段进行干预，从而显著降低疾病相关死亡率。

>|< 比较

优点：

- 主要的筛查技术是胸部低剂量 CT (LDCT)，其具有以下优点：
- + 非侵入性，检查相对迅速，患者耐受良好
 - + 对肺结节的检测灵敏度高，可识别潜在的恶性病变，从而能够及时进行随访和进一步的诊断评价，以确认或排除癌症
 - + LDCT 比 CXR 肺癌筛查可降低肺癌死亡率

缺点：

- 然而，尽管 LDCT 筛查具有一定优势，其应用仍面临局限性与挑战：
- 假阳性结果可能导致患者不必要的焦虑及侵入性检查 — 在 LDCT 扫描中准确区分良恶性结节存在难度，常需进一步行活检或重复影像学检查加以确认
 - 此外，LDCT 筛查虽辐射剂量低于常规 CT，但仍存在辐射暴露问题 — 尽管辐射风险极低，但长期反复筛查可能产生累积辐射效应

广泛实施肺癌筛查项目面临诸多挑战，例如：

- / 如何精准识别筛查获益最大的人群，同时最大限度降低过度诊断和不必要干预的风险
- / 建立有效的风险评估和筛查对象选择策略
- / 在资源匮乏地区确保高质量筛查设备和专业诊断技术的可及性
- / 克服经济成本、资源配置和公众认知等多重障碍

<∞> 参考文献

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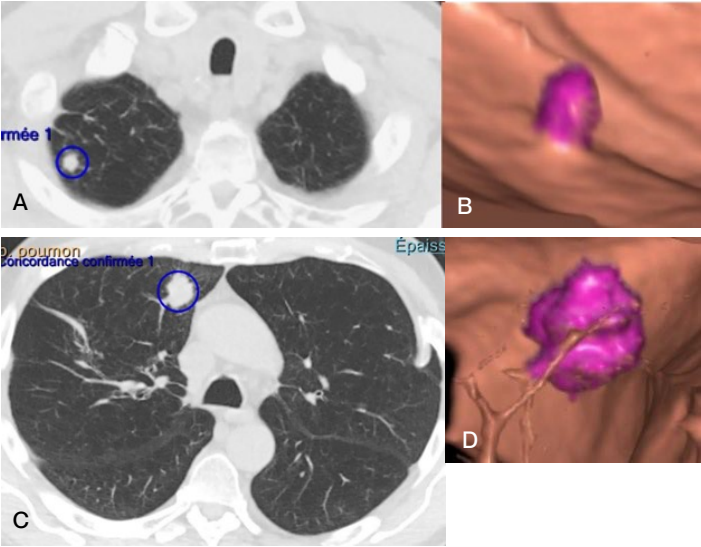
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/ Multiple Pulmonary Nodules (MPNs)

As opposed to the SPN, which is often detected incidentally, multiple pulmonary nodules (MPNs) are most often seen in symptomatic patients, in patients with an underlying malignancy or in immunocompromised patients. Exceptions to this rule comprise multiple calcified granulomas in patients with previous tuberculosis or previous chicken pox pneumonia (see page 109).

The differential diagnosis of MPNs larger than 5 mm mainly includes metastases, septic emboli, fungal infections, autoimmune diseases (e.g., granulomatosis with polyangiitis,

rheumatoid pulmonary nodules) and multiple arterio-venous malformations. Lung metastases most commonly arise from lung cancer, colorectal, kidney, pancreatic and breast cancer. Synchronous lung metastases are most often seen in lung cancer and are associated with poorer outcome.



<!=> ATTENTION

Pulmonary metastases have the following imaging features:

- / varying size
- / mainly found in the lower lung zones and peripheral lung zones
- / most often well-defined
- / cavitation typically in squamous cell carcinoma
- / calcification and pneumothorax typically in osteosarcoma
- / in many cancers, metastases show increased FDG uptake on PET CT scans

<==> REFERENCE

Chen H, Stoltzfus KC, Lehrer EJ, Horn SR, Siva S, Trifiletti DM, Meng MB, Verma V, Louie AV, Zaorsky NG. The Epidemiology of Lung Metastases. Front Med (Lausanne). 2021 Sep 20;8:723396. doi:10.3389/fmed.

Lung metastases detected 2 years post treatment of a head and neck SCC. A right apical upper lobe nodule (A and B) and a right anterior upper lobe nodule (C and D) were seen. Images B and D correspond to volume rendering reconstructions using an automated software for volume calculation.

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/ 多发性肺结节 (MPN)

与常在偶然检查中发现的孤立性肺结节 (SPN) 不同, 多发性肺结节 (MPN) 常见于具有临床症状、恶性肿瘤病史或免疫功能抑制状态的患者群体。需注意的是, 既往结核或水痘性肺炎病史患者出现的多发性钙化肉芽肿属于特殊例外情况 (详见 109 页)。

对于直径超过 5 mm 的多发性肺结节, 其鉴别诊断需重点考虑转移性病灶、脓毒性栓子、真菌感染、自身免疫性疾病 (如肉芽肿性多血管炎、类风湿性肺结节) 以及多发性动静脉畸形等可能性。肺转移最常见于肺癌、结直肠癌、肾癌、胰腺癌和乳腺癌。同时性肺转移最常见于肺癌, 预后较差。

<!=> 注意

肺转移具有以下影像学特征:

- / 病灶大小各异
- / 主要见于下肺野和外周肺野
- / 多数边界清晰
- / 空洞形成常见于鳞状细胞癌
- / 钙化和气胸, 尤其常见于骨肉瘤
- / 在许多癌症中, PET-CT 扫描显示转移灶 FDG 摄取增加

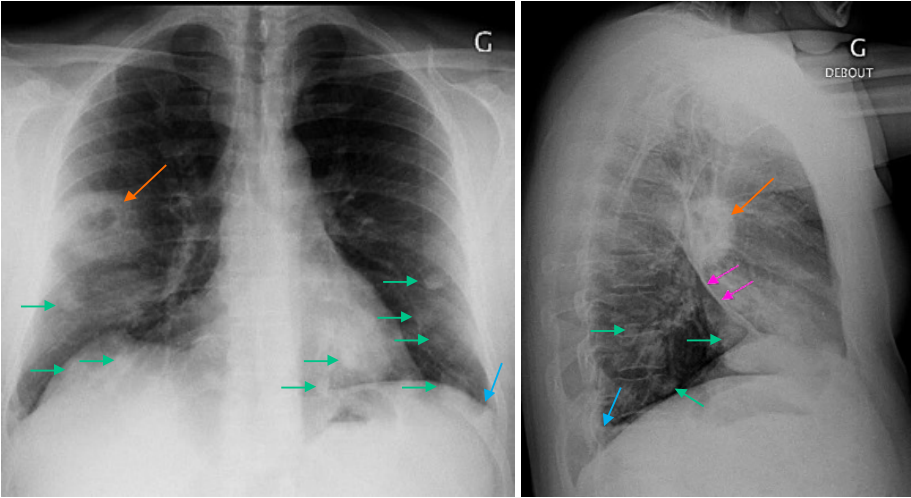
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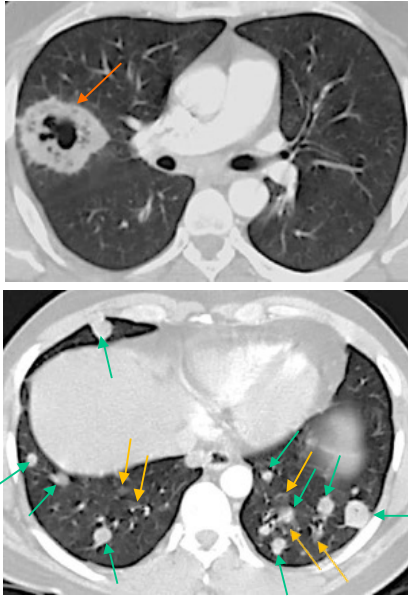
头颈部 SCC 治疗 2 年后检测到肺转移。右肺上叶尖段结节 (A 和 B) 和右肺上叶前段结节 (C 和 D)。图像 B 和 D 采用容积再现重建, 该技术基于自动化软件进行容积计算。

Granulomatosis with polyangiitis (GPA, formerly known as Wegener’s granulomatosis) is a non-caseating granulomatous vasculitis affecting the upper and lower respiratory tract, the kidneys, the central nervous system and the orbits. Although imaging findings vary,

the most common pulmonary manifestations include multiple cavitary nodules or cavitary masses, pulmonary haemorrhage (which can manifest as alveolar consolidation ± cavitation) and pleural effusions.



Multiple pulmonary nodules (green arrows) located in the lower lung lobes and a cavitary mass (orange arrows) in the right upper lobe in a patient with GPA. Note thickening of the main right fissure (pink arrows) due to interlobar pleural effusion. Pleural effusion also in the left posterior costophrenic recess (blue arrows). On CT, additional areas of GGO (yellow arrows) due to haemorrhage.



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肉芽肿性多血管炎（GPA，之前称为韦格纳肉芽肿）是一种累及上下呼吸道、肾脏、中枢神经系统和眼眶的非干酪样肉芽肿性血管炎。虽然影像学表现不同，但最常见的肺部表现包括多发性空洞性结节或空洞肿块、肺出血（可表现为肺泡实变 ± 空洞）和胸腔积液。

GPA 患者的下肺叶多发肺结节（绿色箭头）和右肺上叶空洞肿块（橙色箭头）。注：由于叶间胸腔积液，右侧主裂增厚（粉色箭头）。左后肋膈隐窝处也可见胸腔积液（蓝色箭头）。CT 显示额外的 GGO 区域（黄色箭头），系出血所致。

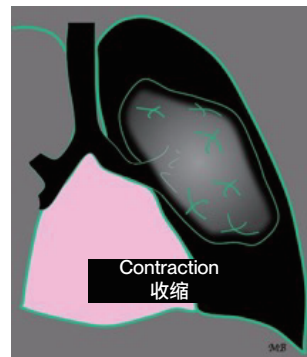
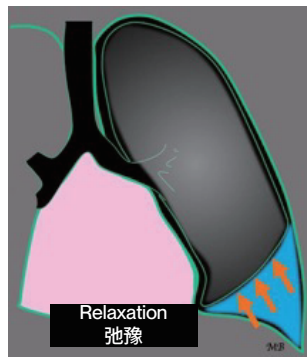
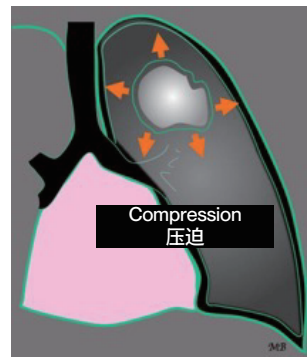
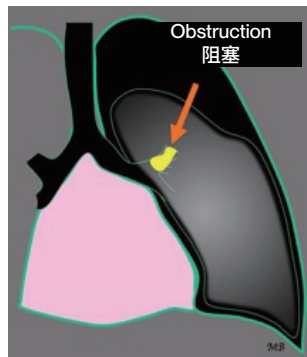
/ Atelectatic Opacification (Collapse)

Atelectasis = collapse of a complete lung or part of the lung (lobe, segment or specific subsegmental area) leading to an impaired O_2 and CO_2 exchange and, therefore, to an intrapulmonary shunt.

<!=> ATTENTION

The mechanisms by which atelectasis occurs include:

- / obstruction → the alveolar air is absorbed distal to an obstructive lesion → as the ventilation is impaired and the perfusion is maintained, all the gas in the area affected by obstruction is absorbed → because the visceral and parietal pleura do not separate, there is significant traction and volume loss – causes include bronchial obstruction due to tumour, foreign bodies or mucous plugs (e.g., in COPD, asthma and cystic fibrosis).
- / compression → a space occupying mass compresses the adjacent lung leading to alveolar collapse.
- / relaxation → loss of contact between the visceral and parietal pleura (e.g., due to pleural effusion or pneumothorax) leads to alveolar collapse.
- / contraction → scar tissue leads to lung contraction. Causes include destructive lung conditions, e.g., lung fibrosis, tuberculosis, after severe pneumonia forms, radiation pneumonitis.
- / adhesion → surfactant deficiency or dysfunction (e.g., in neonates and ARDS) leads to an increased alveolar surface tension → alveolar collapse.
- / gravity → gravity affects the distribution patterns of lung fluids and volume of alveoli – in the supine position, the dorsal lung alveoli physiologically display some partial atelectasis (dependent atelectasis).



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/ 肺不张性高密度影（萎陷）

肺不张 = 全肺或部分肺（肺叶、肺段或特定亚肺段区域）萎陷，导致 O_2 和 CO_2 交换受损，从而导致肺内分流。

<!=> 注意

肺不张的发生机制包括:

- / 阻塞性肺不张 → 阻塞性病变远端的肺泡内空气吸收 → 由于通气受损且灌注得以维持，阻塞区域内的气体被完全吸收 → 因为脏层胸膜和壁层胸膜未分离，所以存在显著的牵拉力和肺容积减少 — 原因包括由肿瘤、异物或粘液栓引起的支气管阻塞（例如，COPD、哮喘和囊性纤维化）。
- / 压迫性肺不张 → 邻近的占位性肿块压迫肺部，导致肺泡萎陷。
- / 松弛性肺不张 → 脏层胸膜与壁层胸膜失去接触（例如，由于胸腔积液或气胸）导致肺泡萎陷。
- / 瘢痕性肺不张 → 瘢痕组织导致肺收缩。病因包括破坏性肺部疾病，例如肺纤维化、肺结核、重症肺炎后改变以及放射性肺炎。
- / 粘连性肺不张 → 表面活性物质缺乏或功能障碍（例如，新生儿和 ARDS）导致肺泡表面张力增加 → 引发肺泡萎陷。
- / 重力性肺不张 → 重力影响肺液的分布模式和肺泡容积 — 在仰卧位时，背侧肺泡呈现生理学部分肺不张（依赖性肺不张）。

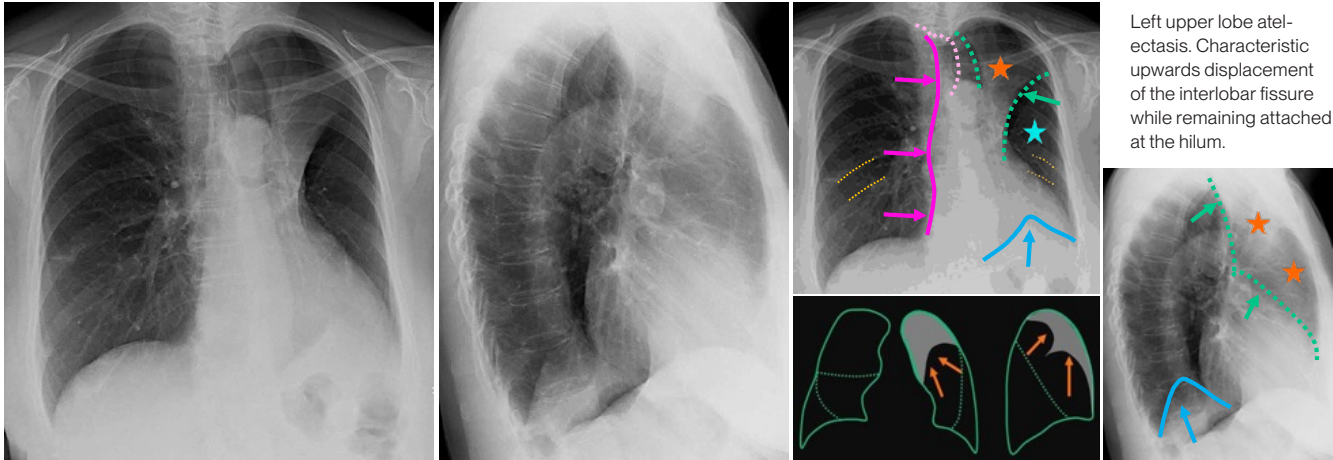
/ Radiologic Signs

Based on anatomical extent, atelectasis can be categorised as:

- / subsegmental → collapse of a part of a lung segment
- / segmental → collapse of a lung segment
- / lobar → collapse of an entire lobe
- / lung → complete lung collapses

Therefore, radiographic features will vary!

Signs of atelectasis on CXRs include homogeneous lung opacification (orange star), displacement of interlobar fissures (green)



towards the atelectasis, mediastinal shift (pink) towards the atelectasis (including displacement of mediastinal contents, e.g., trachea, heart) and hilum, ipsilateral hemidiaphragm elevation (blue) which can have a peaked appearance), compensatory hyperinflation of the unaffected ipsilateral lung (with increased radiolucency and oligemia (turquoise star)) or hyperinflation of the contralateral lung (light pink line) and ipsilateral ribs closer together than contralateral ribs (yellow lines). Mediastinal shift, diaphragmatic elevation and closeness of ribs are seen only in the presence of substantial atelectasis.

<!=> ATTENTION

Collapse of each individual lobe is associated with typical imaging features.

Left upper lobe atelectasis. Characteristic upwards displacement of the interlobar fissure while remaining attached at the hilum.

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根据解剖学范围，肺不张可分为以下几种：

- / 肺亚段不张 → 肺段部分萎陷
- / 肺段不张 → 肺段萎陷
- / 肺叶不张 → 整个肺叶萎陷
- / 全肺不张 → 整个肺萎陷

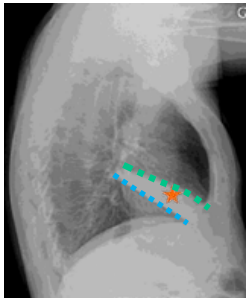
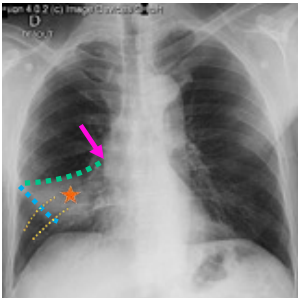
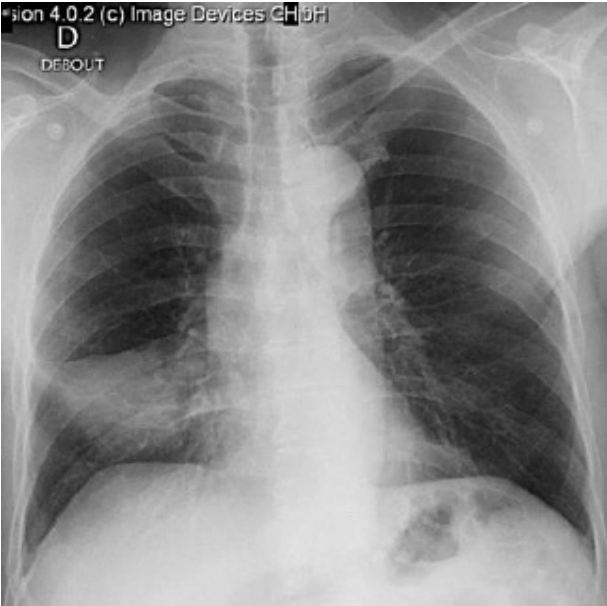
因此，其影像学表现存在差异！

CXR 显示的肺不张征象包括：均匀的肺部高密度影（橙色星号）、叶间裂（绿色）向肺不张区域移位、纵隔向肺不张区域移位（粉色）（包括纵隔内容物（如气管、心脏）和肺门移位）、同侧的偏侧膈抬高（蓝色，可呈尖峰状）、未受累同侧肺的代偿性过度充气（透亮度增加伴血流量减少（蓝绿色星号））或对侧肺过度充气（浅粉线）以及同侧肋骨较对侧狭窄（黄线）。纵隔移位、膈肌抬高和肋间隙变窄仅见于大范围肺不张时。

<!=> 注意

肺叶不张均具有特征性的影像学表现模式。

左肺上叶不张。叶间裂仍附着于肺门，呈典型的向上移位。



Classic signs of right middle lobe atelectasis as seen on CXR include homogeneous pulmonary opacification (orange stars), displacement of interlobar fissures towards the atelectasis (i.e., downwards displacement of the horizontal fissure (green lines) and upwards displacement of the oblique fissure (blue line)), displacement of the right hilum (pink arrow) towards the atelectasis, closeness of ipsilateral ribs (yellow lines). Compare with the normal position of the interlobar fissures shown on page 32!

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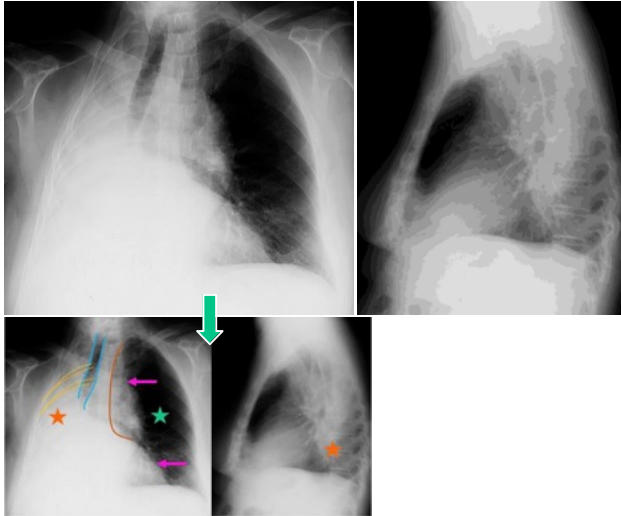
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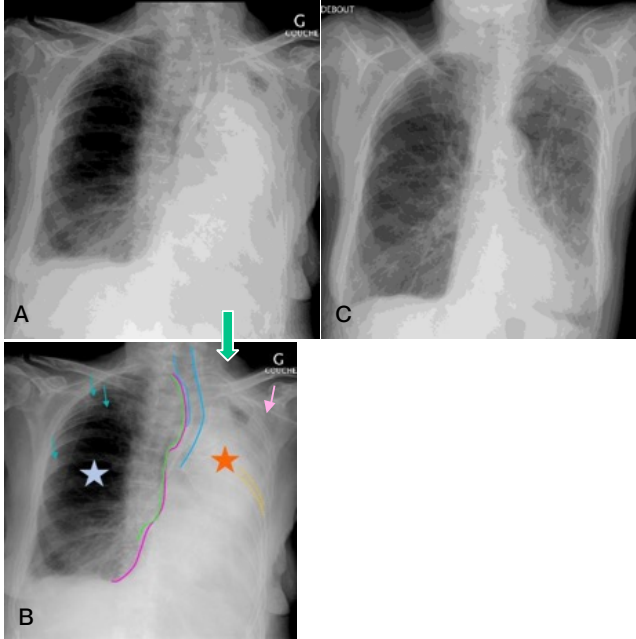
在 CXR 上观察到的右肺中叶不张的典型体征包括均匀的肺部高密度影（橙色星号）、叶间裂向肺不张移位（即水平裂向下移位（绿线）和斜裂向上移位（蓝线））、右肺门（粉色箭头）向肺不张移位、同侧肋间隙变窄（黄线）。请与第 32 页叶间裂正常位置进行对比。

<=> ATTENTION

Complete lung collapse should not be confounded with a large pleural effusion. The direction of the mediastinal shift is crucial to distinguish between the two entities: shift towards the pathology in the collapsed lung and in the opposite direction of pathology in a large effusion.



Right lung collapse caused by right main bronchus obstruction due to lung cancer. Homogeneous opacification (orange stars) of the right lung, displacement of the mediastinum (pink arrows) towards the right, deviation of the trachea to the right (blue lines), closeness of (yellow lines) ipsilateral ribs and compensatory hyperinflation of the left lung (radiolucency, oligemia (green star), herniation across the midline (brown line)). Retrocardiac opacity on the lateral CXR (orange star) corresponds to the collapsed lung (see normal lateral CXR on page 16).



Near total left lung collapse caused by left main bronchus obstruction due to a mucous plug in a patient with cystic fibrosis (A, B). Homogeneous opacification (orange star) of most of the left lung, displacement of the mediastinum (pink line) to the left, trachea displacement (blue lines) to the left, closeness of (yellow lines) ipsilateral ribs and compensatory hyperinflation of the right lung (radiolucency, oligemia (light blue star) and herniation across the midline (green line)). CXR obtained the same day after endoscopic removal of the mucous plug (C) shows collapse disappearance. Note that the patient equally has old rib fractures (turquoise arrows). Central venous catheter (light pink line).

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<=> 注意

全肺不张需与大量胸腔积液进行区分。鉴别要点在于纵隔移位的方向特征：肺不张时纵隔结构向患侧移位，而大量胸腔积液则表现为纵隔向对侧移位。

右主支气管肺癌阻塞导致右肺完全萎陷。右肺均匀高密度影（橙色星号），纵隔向右移位（粉色箭头），气管向右偏移（蓝线），同侧肋间隙变窄（黄线）和左肺代偿性过度充气（透亮度增高伴血流量减少（绿色星号）、纵隔疝形成（棕线））。侧位 CXR（橙色星号）上的心后高密度影代表萎陷的肺（见第 16 页的正常侧位 CXR）。

囊性纤维化（A、B）患者粘液栓引起左主支气管阻塞，导致几乎完全的左肺萎陷。左肺大部分呈均匀高密度影（八角星状），纵隔向左移位（粉线），气管向左移位（蓝线），同侧肋间隙变窄（黄线），右肺代偿性过度充气（透亮度增高伴血流量减少 [浅蓝星号] 和纵隔疝形成 [绿线]）。内镜清除粘液栓后当天进行的 CXR 显示萎陷消失 (C)。需注意，患者同时存在陈旧性肋骨骨折（蓝绿色箭头）。中心静脉导管置入（浅粉线）。

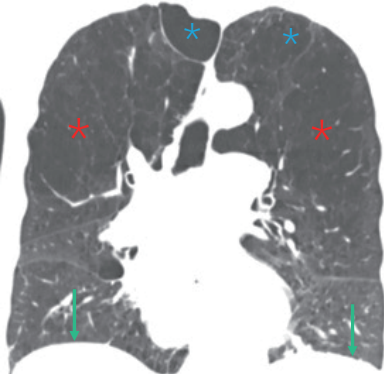
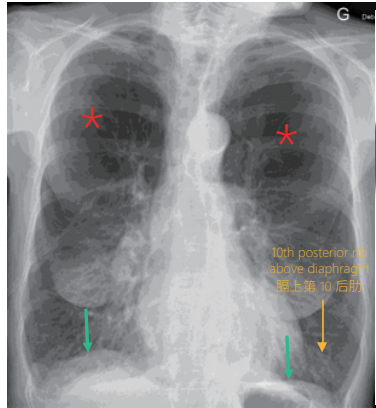
/ Increased Lucency (Hyperlucency)

/ Emphysema Definition and Types

Pulmonary emphysema = chronic lung condition characterised by enlargement of alveoli and destruction of alveolar wall without fibrosis, leading to air trapping and decreased lung function.

The imaging modality of choice is CT although CXR may reveal indirect signs of pulmonary emphysema.

On CXRs, pulmonary emphysema typically appears as hyperinflated lungs (yellow arrows) with flattened diaphragms (green arrows) and increased lung transparency (red asterisks) due to reduced



tissue density. On CT scans, emphysema presents as areas of low attenuation (red asterisks), indicating air trapping and destruction of lung tissue, often accompanied by bullae or enlarged air spaces (blue asterisks). These imaging findings help diagnose and assess the severity of emphysema.

Based on its distribution, emphysema can be classified into:

- / centrilobular > primarily affecting the central or proximal portions of the acinus, associated with cigarette smoking and commonly found in the upper lobes of the lungs.
- / panacinar (panlobular) > involving the entire acinus, often associated with alpha-1 antitrypsin deficiency and mainly affecting the lower lobes.
- / distal acinar (paraseptal) > predominantly affecting the distal portions of the acinus near the pleura and septa, commonly associated with smoking, bullae formation and pneumothorax, typically found in the lung periphery.

These different types may occur separately or coexist within an individual with emphysema and the distribution patterns can influence the clinical presentation and management of the condition.

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/ 透亮度增强（过度透亮）

/ 肺气肿的定义和类型

肺气肿 = 慢性肺病，其病理学特征是肺泡增大和肺泡壁破坏，但无纤维化，从而导致空气滞留和肺功能下降。

CT 是首选的肺气肿影像学检查，尽管 CXR 可显示其间接征象。

胸片上，肺气肿通常表现为肺过度充气（黄色箭头）伴横膈低平（绿色箭头），以及组织密度降低导致的肺透亮度增加（红色星号）。CT 上，肺气肿表现为低衰减区域（红色星号），提示空气滞留和肺组织破坏，常伴有肺大疱或气腔扩张（蓝色星号）。这些影像学表现有助于诊断和评估肺气肿的严重程度。

根据其分布，肺气肿可以分为：

- / 小叶中心型 > 主要影响腺泡的中央或近端部分，与吸烟有关，常见于肺上叶。
- / 全腺泡型（全小叶型）> 累及整个腺泡，常与 α -1 抗胰蛋白酶缺乏相关，主要累及下叶。
- / 腺泡远端（间隔旁型）> 主要累及靠近胸膜和间隔的腺泡远端部分，通常与吸烟、肺大疱形成和气胸（通常见于肺外围）有关。

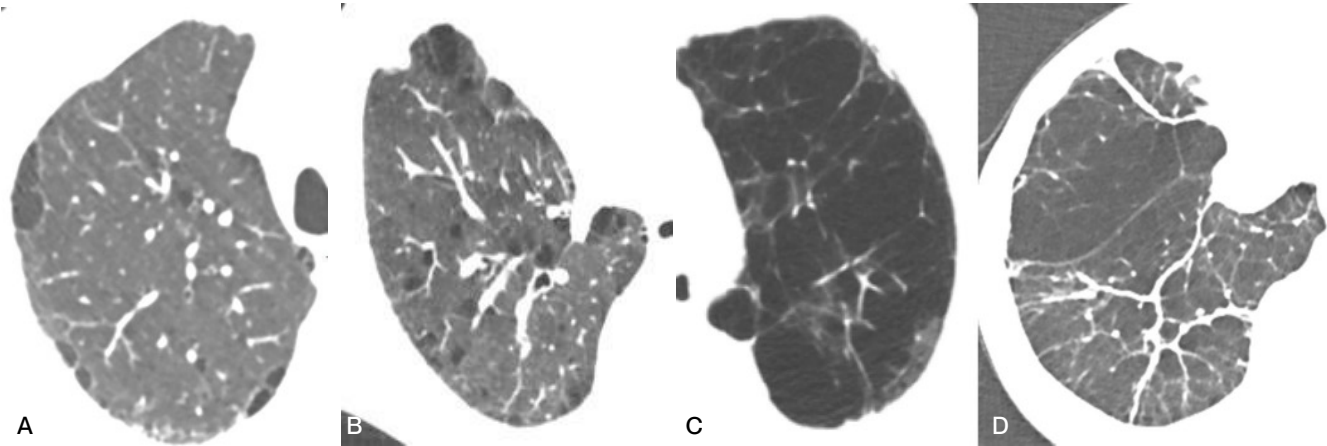
各型肺气肿可独立存在或混合出现，具体分布模式直接影响临床表现和治疗。

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/ Emphysema on CT



A. Mild paraseptal emphysema B. Mild centrilobular emphysema C. Advanced destructive centrilobular emphysema. D. Basal panlobular emphysema in a patients with Alpha-1-antitrypsin (A1AT) deficiency.

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A.轻度间隔旁肺气肿; B.轻度小叶中心型肺气肿; C.晚期破坏性小叶中心型肺气肿; D. α -1-抗胰蛋白酶 (A1AT) 缺陷患者的基底全小叶型肺气肿。

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/ 肺水肿

/ Left Heart Failure

Pulmonary oedema = abnormal accumulation of fluid in the extravascular lung compartment, i.e., in the interstitium ± alveoli.

The pathophysiologic mechanisms leading to pulmonary oedema include

- / increased pulmonary capillary hydrostatic pressure (left heart failure and fluid overload)
- / abnormal leakage of fluid into alveoli due to damage of type II pneumocytes and endothelial cells in the alveoli

The most common cause of cardiogenic pulmonary oedema is left heart failure, which results in decreased cardiac output and increased pulmonary venous pressure.

The most common cause of non-cardiogenic pulmonary oedema are renal failure and ARDS (Acute Respiratory Distress Syndrome = acute lung injury with diffuse alveolar damage).

The pulmonary capillary wedge pressure (PCWP) is an important parameter used to evaluate cardiac function and to diagnose left heart failure and pulmonary oedema. It reflects the pressure exerted on lung capillaries by the blood in the left atrium during diastole. It is measured by inserting a catheter into the pulmonary artery (PA) and advancing the catheter until it wedges into a small PA branch. The PCWP provides an estimate of the pressure in the left atrium. The normal PCWP = 8 - 12 mmHg, the normal left atrial pressure = 5 - 10 mmHg. On a PA CXR, the upper lobe veins are smaller than the lower lobe veins because in an erect position effects of gravity are superimposed on the low pressure, low resistance vascular bed.

<!=> ATTENTION

Features of left heart failure on CXRs include a continuum of imaging findings as follows:

- / an increase of the left atrial pressure to 10 – 15 mmHg (PCWP = 13 – 18 mmHg) results in upper lobe venous diversion (synonym = venous cephalisation, redistribution) – cephalisation of pulmonary veins is an early sign of pulmonary oedema > see images on the next page
- / an increase of the left atrial pressure to 16 – 22 mmHg (PCWP = 18 – 25 mmHg) results in interstitial pulmonary oedema with characteristic Kerley lines > see images on next pages
- / finally, an increase of the left atrial pressure > 23 mmHg (PCWP > 25 mmHg) results in alveolar pulmonary oedema with characteristic alveolar opacities > see next pages
- / pleural effusion and cardiomegaly are further features of left heart failure

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/ 左心衰竭

肺水肿 = 肺血管外间隙 (即间质 ± 肺泡) 液体异常积聚。

导致肺水肿的病理生理机制包括

- / 肺毛细血管流体静压升高 (左心衰竭和体液过多)
- / II 型肺泡细胞和肺泡内皮细胞损伤导致液体异常渗漏到肺泡

心源性肺水肿最常见的原因是左心衰, 可导致心输出量减少和肺静压升高。

非心源性肺水肿最常见的病因为肾衰竭和 ARDS (急性呼吸窘迫综合征 = 急性肺损伤伴弥漫性肺泡损伤)。

肺毛细血管楔压 (PCWP) 是用于评估心脏功能和诊断左心衰竭和肺水肿的重要参数。该指标反映了舒张期左心房血液对肺毛细血管的压力。测量方法为经肺动脉 (PA) 导管插入术, 将导管楔入肺动脉分支远端进行测量。PCWP 可提供左心房压力的估计值。正常 PCWP = 8-12 mmHg, 正常左心房压 = 5-10 mmHg。在后前位 CXR 上, 上叶静脉的血管径小于下叶静脉, 这是因为在直立位时, 重力作用会叠加在低压、低阻力的血管床上。

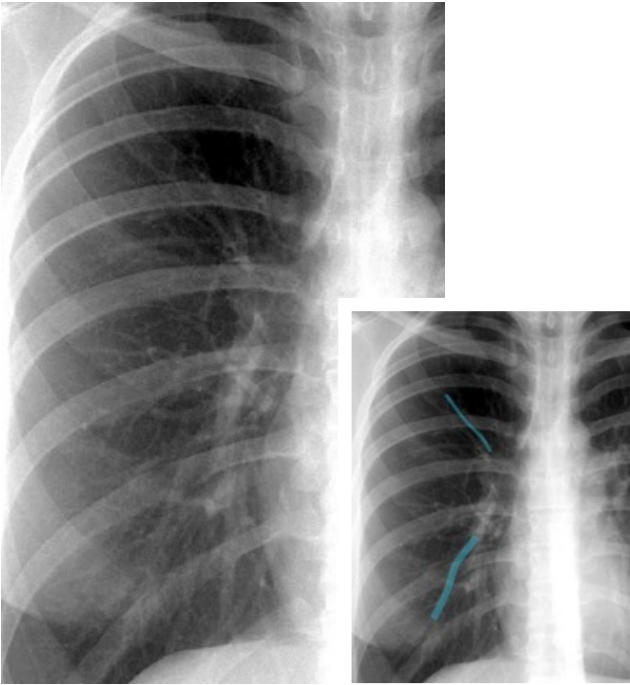
<!=> 注意

左心衰竭的 CXR 特征包括一系列连续影像学表现, 如下:

- / 左心房压力升高至 10-15 mmHg (PCWP = 13-18 mmHg) 导致上叶静脉分流 (同义词 = 静脉头侧化, 再分布) - 肺静脉头侧化是肺水肿的早期体征 > 见下页图片
- / 左心房压力升高至 16-22 mmHg (PCWP = 18-25 mmHg) 导致间质性肺水肿伴特征性 Kerley 线 > 见下页图片
- / 最后, 左心房压力升高 > 23 mmHg (PCWP > 25 mmHg) 导致肺泡性肺水肿伴特征性肺泡影 > 见下页
- / 胸腔积液和心脏扩大是左心衰竭的进一步特征

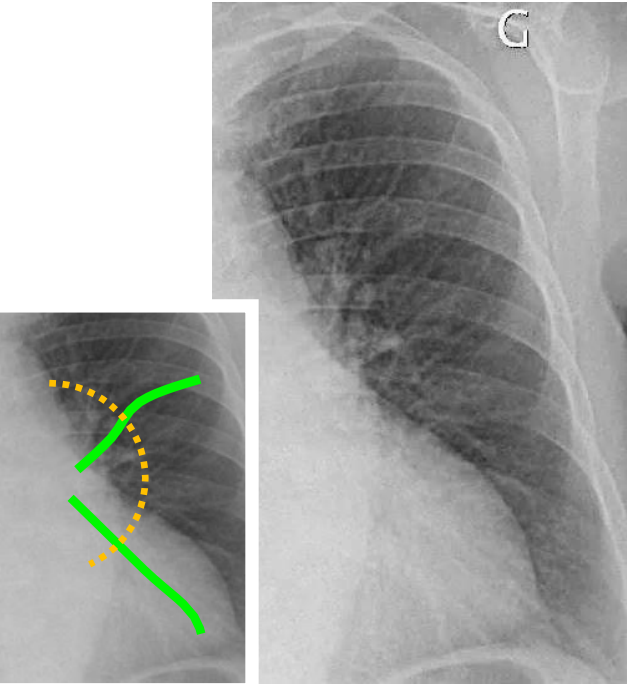
<!=> ATTENTION

Normal (PCWP = 8 - 12 mmHg) = Grade 0



In the erect position, the upper lobe pulmonary veins have a smaller diameter than the lower lung veins, measured equidistant to the hilum.

Cephalisation of the pulmonary veins
(PCWP = 13 – 18 mmHg) = Grade 1 oedema



Cephalisation = the upper lobe pulmonary veins appear dilated as they branch away from the hilum. If the upper lobe veins have a similar or larger diameter than the lower lung veins, measured equidistant to the hilum, there is cephalisation.

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<!=> 注意

正常 (PCWP = 8-12 mmHg) =0 级
肺静脉头侧化 (PCWP = 13-18 mmHg) = 1 级水肿

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直立位时，上叶肺静脉的直径小于下肺静脉，两者距肺门等距。

头侧化=上叶肺静脉离开肺门分支时呈扩张状态。若上叶静脉与下肺静脉在距肺门等距处测得的直径相近或更大，则存在头侧化现象。

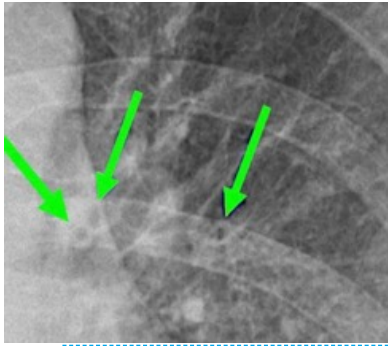
Interstitial lung oedema (PCWP = 19 – 25 mmHg) = Grade 2 oedema
> transudate in the interstitium



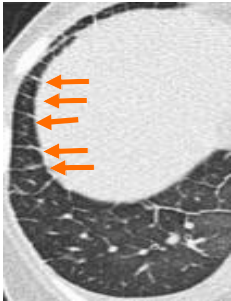
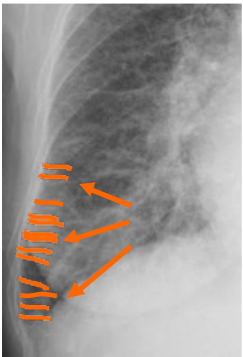
Kerley A lines
(central, 2 - 6 cm).



Kerley B lines (peripheral,
2 cm in length and perpen-
dicular to the pleura).



Peribronchovascular cuffing (green
arrows) = fluid accumulation in the
interstitial spaces around bronchi due
to increased hydrostatic pulmonary
circulation pressure > fluid leakage from
capillaries into surrounding tissues. As a
result, the bronchi appear surrounded by
a thickened cuff on CXRs.



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间质性肺水肿 (PCWP = 19-25 mmHg) = 2 级水肿
> 间质内漏出液

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支气管血管周围袖套征 (绿色箭头) = 由于肺循环流体静压升高 > 从毛细血管渗漏到周围组织中的液体, 导致支气管周围间质间隙积液。因此, CXR 显示, 支气管被增厚的支气管袖套所包围。

Kerley A 线 (中央, 2-6 cm)。

Kerley B 线 (外周, 长 2 cm, 垂直于胸膜)。

Grade 3 pulmonary oedema corresponds to alveolar oedema (PCWP > 25 mmHg).

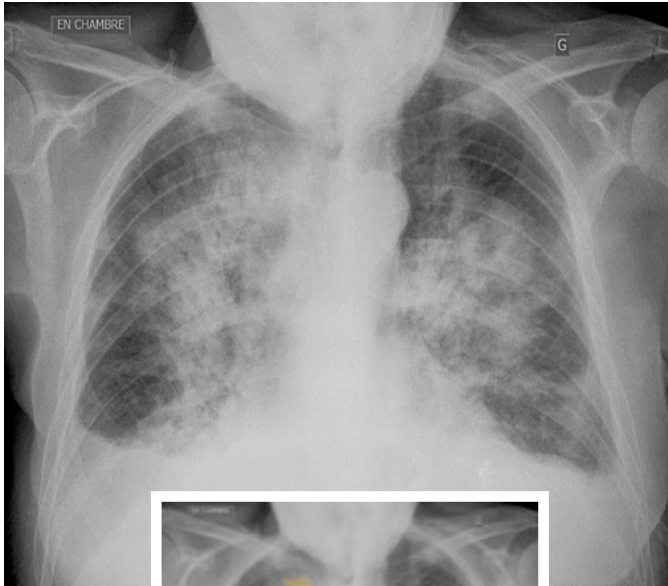
On CXRs, alveolar oedema is characterised by:

- / symmetrical distribution, i.e., both lungs are equally affected
- / central predominance, i.e., oedema is more pronounced near the hilar regions of the lungs than towards the periphery
- / gravity-dependent distribution, i.e., oedema tends to be more prominent in the lower half of the lungs, following the laws of gravity

These patterns can be explained by the mechanics of fluid pressure, with symmetrical distribution arising from pressure affecting both lungs, central predominance due to pressure starting from the heart and spreading outward and gravity dictating the distribution of blood volume and pressure within the lungs.

<!=> ATTENTION

The central distribution on PA and AP CXRs of grade 3 pulmonary oedema leads to the typical “bat wing” or “butterfly appearance”.



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3 级肺水肿为肺泡性肺水肿 (PCWP > 25 mmHg)。
在 CXR 上, 肺泡性肺水肿的特征性表现为:

- / 对称分布, 即双肺受累程度相同
- / 中央性分布, 肺门周围区域病变较外周更为显著
- / 重力依赖性分布, 水肿往往在肺的下半部更加明显, 符合重力规律

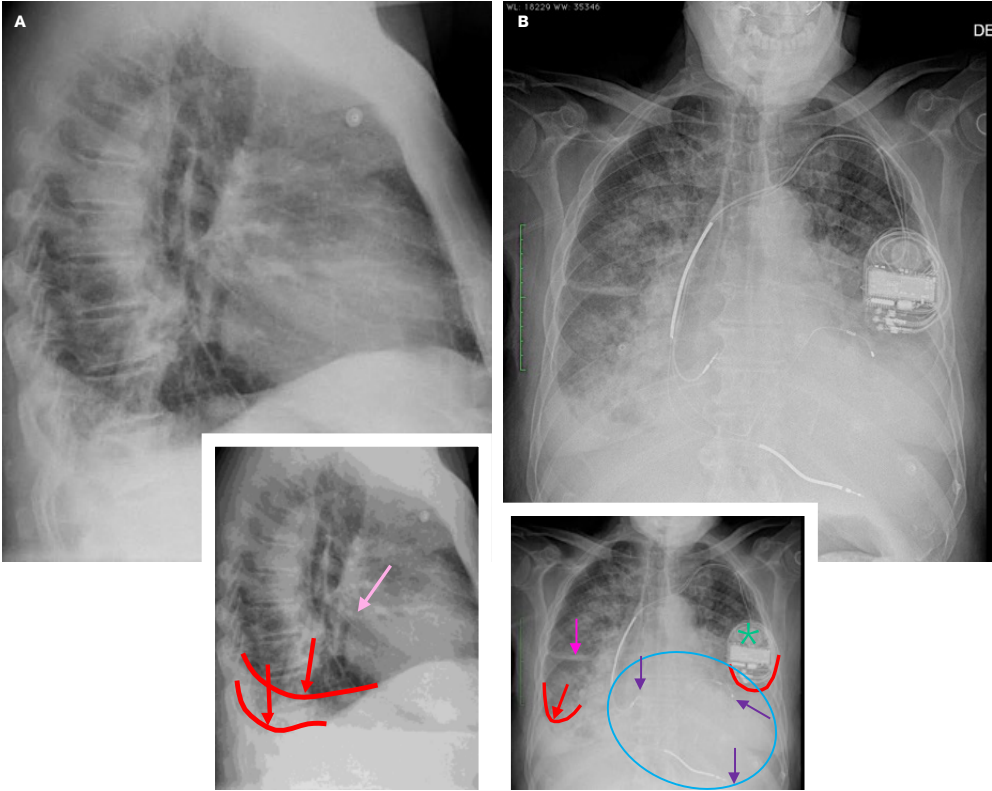
这些模式可以从液体压力的力学角度来解释, 对称分布源于压力同时作用于双肺, 中央性分布是因为压力从心脏开始向外扩散, 重力决定了肺内血容量及压力的分布模式。

<!=> 注意

3 级肺水肿在后前位和前后位 CXR 上呈中心分布, 形成典型的“蝙蝠翼”或“蝴蝶状”外观。

Increasing fluid pressure and volume in congestive heart failure, starting from the left atrium and progressing through the pulmonary vessels, interstitial and alveolar spaces results in pleural effusion.

Pleural effusions lead on CXRs to blunting of the costophrenic angles (red) and thickening of the oblique (light pink arrow) and horizontal (pink arrow) fissures.



Lateral erect and AP CXRs in two different patients (A and B) with left heart failure, pulmonary oedema and pleural effusions in the costophrenic angles (red). Cardiomegaly ((blue circle) based on the position of the electrode tips (purple arrows) of the pacemaker (green asterisk), the heart size can be estimated on the PA CXR in patient B despite massive alveolar oedema). The cardiothoracic ratio is well above 0.5.

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充血性心力衰竭时，液体压力和容量从左心房开始逐渐增加，依次影响肺血管、间质和肺泡腔，最终导致胸腔积液。

胸腔积液导致 CXR 显示肋膈角变钝（红色），斜裂（浅粉色箭头）和水平裂（粉色箭头）增厚。

2 例不同患者（A 和 B）的侧向直立和前后位 CXR，显示左心衰竭、肺水肿和肋膈角胸腔积液（红色）。心脏扩大（蓝色圆圈）可通过起搏器（绿色星号）和电极尖端（紫色箭头）的位置判断，尽管患者 B 存在严重肺泡性肺水肿，其后前位 CXR 仍可评估心脏大小。心胸比明显超过 0.5。

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/ Pulmonary Hypertension (PH)

Pulmonary hypertension (PH) is characterised by increased pulmonary arterial pressure, structural changes in pulmonary circulation and the appearance of vaso-occlusive lesions.

PH is defined as mean pulmonary artery pressure > 20 mmHg. PH is called pre-capillary when the pressure in the left atrium (LA) is ≤ 20 mm Hg and pulmonary vascular resistance (PVR) is ≥ 3 Wood Units (WU, 1 Wood unit = 80 dynes × sec/cm⁵). Otherwise (LA pressure > 20 mmHg and PVR < 3 WU), it is described as post-capillary.

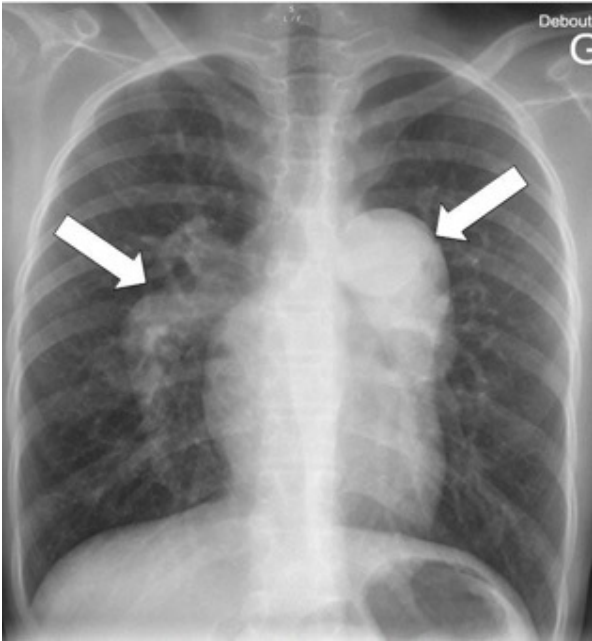
There are 5 groups of PH depending on the aetiology:

- / idiopathic or pulmonary artery disease (group 1)
- / left heart disease (group 2)
- / pulmonary parenchyma disease (group 3)
- / chronic thromboembolic disease (group 4)
- / various causes (group 5)

The clinical symptoms are nonspecific (dyspnoea, tiredness) and the diagnosis is often made late. The radiological assessment includes at least a CXR.

Depending on the clinical presentation cardiac ultrasound, chest CT, cardiac MRI and invasive pulmonary pressure measurement may be performed.

CXR may be normal or shows dilation of the pulmonary arteries (PA). It can also evidence right and/or left ventricular dilatation and parenchymal abnormalities suggesting a pulmonary cause of PH (group 3).



Significant dilation of the pulmonary arteries (arrows) on the PA CXR.

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/ 肺动脉高压 (PH)

肺动脉高压 (PH) 的特征包括肺动脉压升高、肺循环结构改变和血管闭塞性病变形成。

PH 定义为平均肺动脉压 > 20 mmHg。当左心房 (LA) 压力 ≤ 20mm Hg 并且肺血管阻力 (PVR) ≥3 Wood 单位 (WU, 1 Wood 单位=80 达因×秒/cm⁵) 时, 可归类为毛细血管前肺动脉高压。反之 (LA 压力 > 20 mmHg 且 PVR < 3 WU), 则称为毛细血管后肺动脉高压。

根据病因, PH 可分为以下 5 类:

- / 特发性或肺动脉疾病 (第 1 类)
- / 左心疾病 (第 2 类)
- / 肺实质疾病 (第 3 类)
- / 慢性血栓栓塞性疾病 (第 4 类)
- / 其他各种病因 (第 5 类)

该疾病临床表现缺乏特异性 (如呼吸困难、乏力等), 导致诊断往往被延误。该疾病的放射学评估应至少包括 CXR。

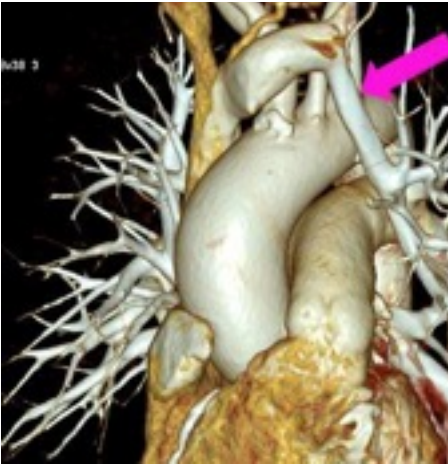
基于临床表现, 可进一步选择心脏超声、胸部 CT、心脏 MRI 及有创性肺压力检测等检查手段。

CXR 可表现为正常或显示肺动脉 (PA) 扩张。该检查还可发现右心室和/或左心室扩张和实质异常, 这些表肺实质异常提示肺动脉高压的肺源性病因 (第 3 类)。

后前位 CXR 显示肺动脉显著扩张 (箭头)。

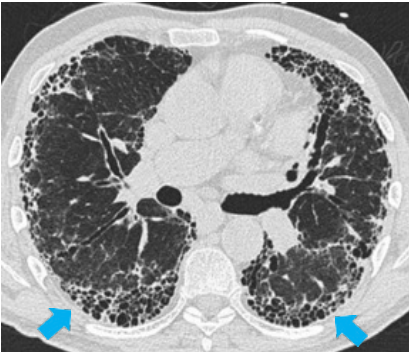
CT shows dilation of the right heart and PA. It may also detect the cause of PH, such as congenital heart malformations (group 1), lung parenchymal disease (group 3) or signs of chronic thromboembolic disease (CTED) (group 4).

Group 1
第 1 类



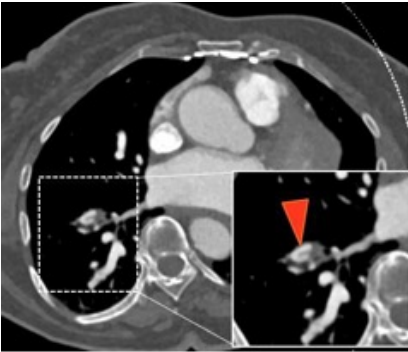
Abnormal pulmonary venous return of the left superior lobe (pink arrow).

Group 3
第 3 类



Pulmonary fibrosis with honeycomb lesions (blue arrows).

Group 4
第 4 类



Organised thrombus (web lesion) within PA in a CTED (red arrow).

Cardiac MRI can be useful to precisely analyse right ventricular function and may detect fibrosis at the insertion points of the right ventricle.

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CT 显示右心和肺动脉扩张。该检查还可用于识别肺动脉高压的病因，如先天性心脏畸形（第 1 类）、肺实质疾病（第 3 类）或慢性血栓栓塞性疾病 (CTED) 的征象（第 4 类）。

心脏 MRI 能够精确评估右心室功能，并可检测右心室附着点部位的纤维化改变。

左肺上叶肺静脉回流异常（粉红色箭头）。

肺纤维化伴蜂窝状病变（蓝色箭头）。

肺动脉内机化性血栓（网状病变）见于 CTED（红色箭头）。

/ Take-Home Messages

- / CXR is a quick, easily accessible and non-invasive exam enabling assessment of lung, mediastinal, pleural and chest wall diseases.
- / Understanding the technical principles of CXR and a standardised reading approach are essential to reach the correct diagnosis.
- / CT may overcome some of the limitations of CXR such as very subtle diseases and projection of other structures. It is primarily used:
 - / to confirm or give a more detailed assessment of CXR findings
 - / as a first line exam
 - / in the case of a normal CXR
 - / in the case of known limitations possibly false negatives of CXRs
 - / to perform biopsy of selected lesions
- / MRI is reserved to special cases, such as mediastinal diseases and is usually referred based on CT findings.
- / Thoracic US might provide a quick first assessment at bedside and is useful for guiding interventional procedures.

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- / CXR 是一种快速、易于获得的非侵入性检查，能够评估肺部、纵隔、胸膜和胸壁疾病。
- / 了解 CXR 的技术原理和标准化读片方法对于正确诊断至关重要。
- / CT 能够弥补 CXR 的一些局限性，例如能显示非常细微的病变以及其他结构的投射影。该检查的主要应用包括：
 - / 验证或进一步详细评估 CXR 的检查结果
 - / 首选的影像学检查方法
 - / CXR 检查结果正常时
 - / 存在已知诊断局限可能导致 CXR 假阴性时
 - / 对选定病灶进行活检
- / MRI 仅适用于特殊病例，如用于纵隔疾病，通常基于 CT 检查结果进行选择应用。
- / 胸部超声检查则可在床旁提供快速初步评估，并有助于指导介入性操作。

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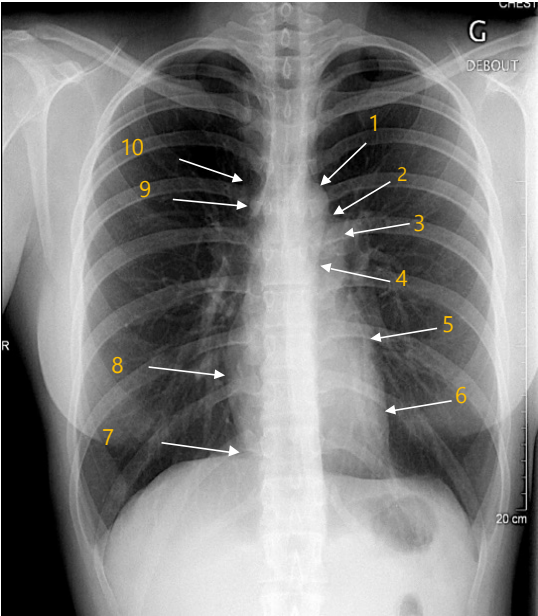
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<=> QUESTION

1

Annotate the following anatomic structures:



- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

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标注以下解剖结构:

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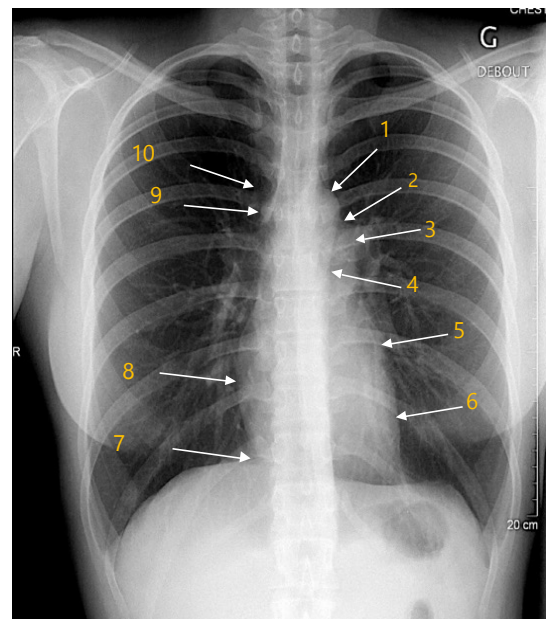
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
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- 10

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<=> ANSWER

1

Annotate the following anatomic structures:



- 1 aortic arch
- 2 aortopulmonary window
- 3 pulmonary artery
- 4 descending aorta
- 5 left atrium
- 6 left ventricle
- 7 inferior vena cava
- 8 right atrium
- 9 azygos vein
- 10 superior vena cava

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<=> 回答

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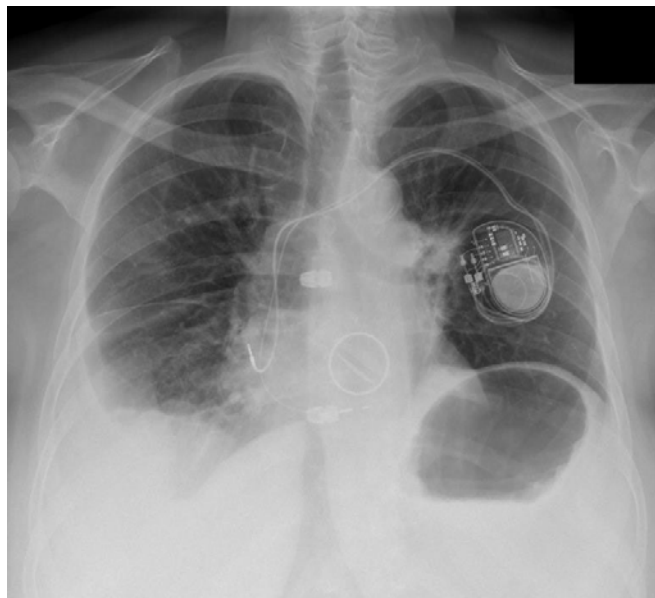
标注以下解剖结构:

- 1 主动脉弓
- 2 主动脉肺动脉窗
- 3 肺动脉
- 4 降主动脉
- 5 左心房
- 6 左心室
- 7 下腔静脉
- 8 右心房
- 9 奇静脉
- 10 上腔静脉

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<=> QUESTION

2 Which statement(s) is/are true concerning this CXR?



- ☐ This is an AP CXR
- ☐ The CXR is in maximum inspiration
- ☐ The CXR is in a strict anterior position
- ☐ The exposure is adequate

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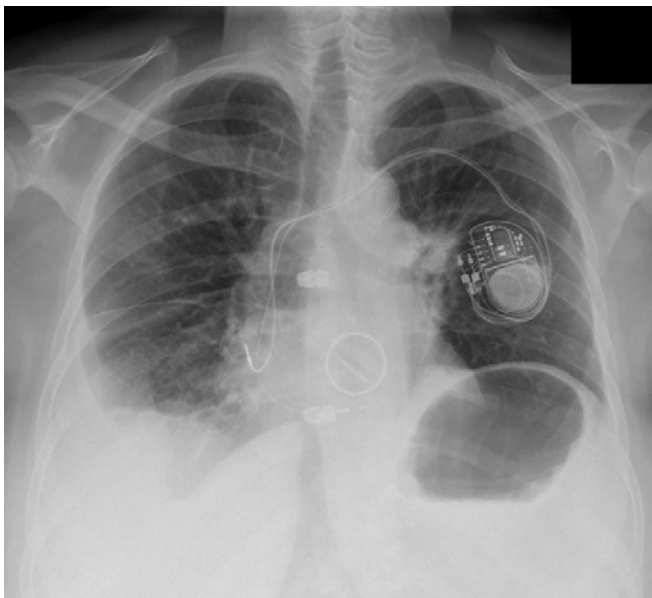
2 关于这张 CXR, 以下哪些陈述是正确的?

- ☐ 这是一张前后位 CXR
- ☐ 这张 CXR 拍摄于最大吸气相
- ☐ 这张 CXR 采用标准正位拍摄
- ☐ 曝光条件适当

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<?> ANSWER

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<?> QUESTION

3 Among the following entities, which tumours typically occur in the anterior mediastinum? (several answers are possible)

- ☐ Thyroid cancer
- ☐ Lymphoma
- ☐ Neurogenic tumours
- ☐ Seminoma

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<?> 问题

3 在下列疾病中，哪些肿瘤通常发生在前纵隔？(可能有多个正确答案)

- ☐ 甲状腺癌
- ☐ 淋巴瘤
- ☐ 神经源性肿瘤
- ☐ 精原细胞瘤

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- ☒ Lymphoma
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- CXR 上骨病变
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<?> 回答

3 在下列疾病中，哪些肿瘤通常发生在前纵隔？(可能有多个正确答案)

- ☒ 甲状腺癌
- ☒ 淋巴瘤
- ☐ 神经源性肿瘤
- ☒ 精原细胞瘤

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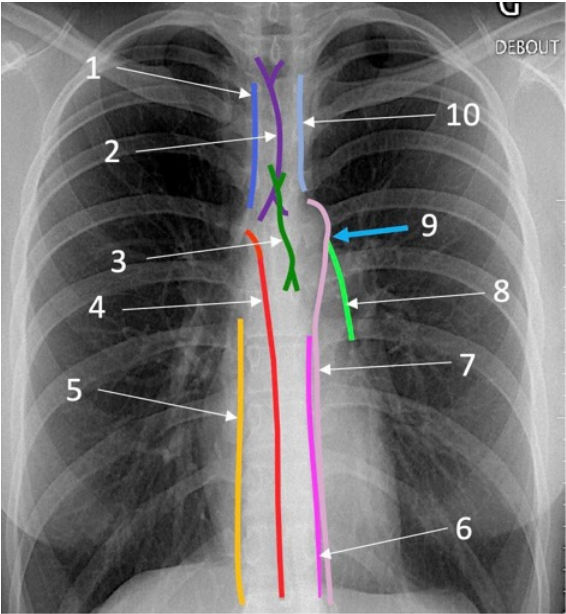
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<=> QUESTION

4 Annotate the following mediastinal lines, stripes and structures:



- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

<=> 问题

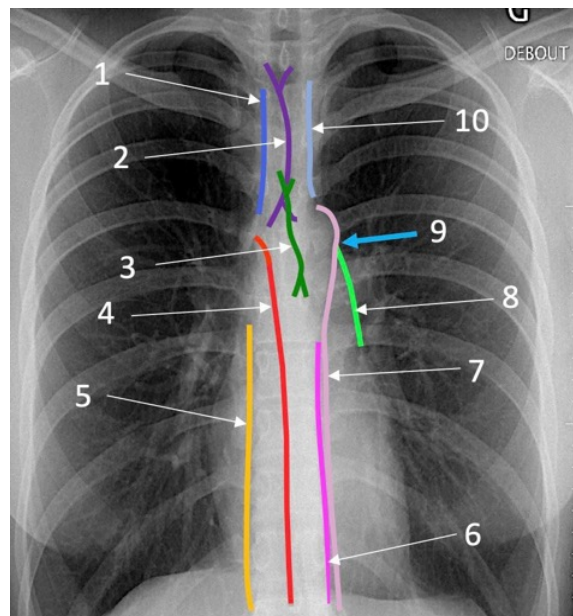
4 标注以下纵隔线、条纹和结构:

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

/ Test Your Knowledge

<=> ANSWER

4 Annotate the following mediastinal lines, stripes and structures:



- 1 Right paratracheal stripe
- 2 Posterior junction line
- 3 Anterior junction line
- 4 Azygos oesophageal line
- 5 Right paravertebral line
- 6 Left paravertebral line
- 7 Para-aortic line
- 8 Aortic pulmonary stripe
- 9 Aortopulmonary window
- 10 Left paratracheal stripe

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<=> 回答

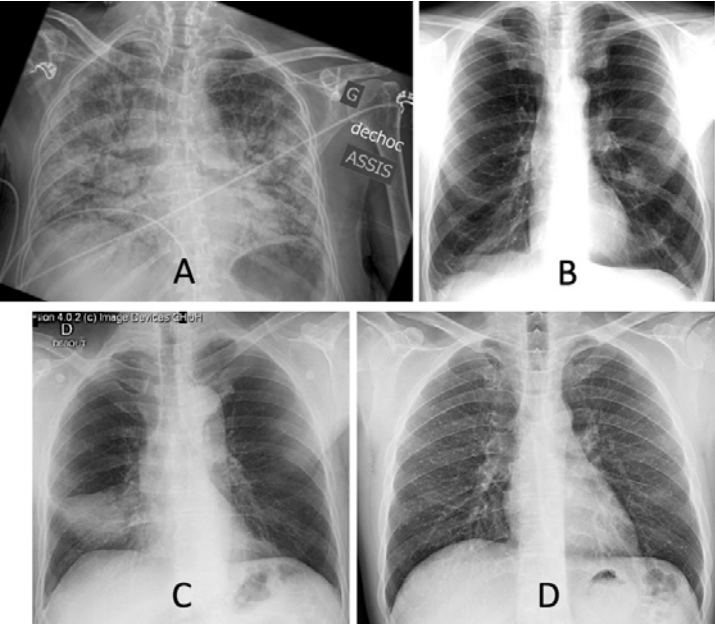
4 标注以下纵隔线、条纹和结构:

- 1 右气管旁线
- 2 后联合线
- 3 前联合线
- 4 奇静脉食管线
- 5 右椎旁线
- 6 左椎旁线
- 7 主动脉旁线
- 8 主动脉肺动脉带
- 9 主动脉肺动脉窗
- 10 左气管旁线

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<=> QUESTION

5 Which type of lung opacification pattern corresponds to images A-D?



- A
- B
- C
- D

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<=> 问题

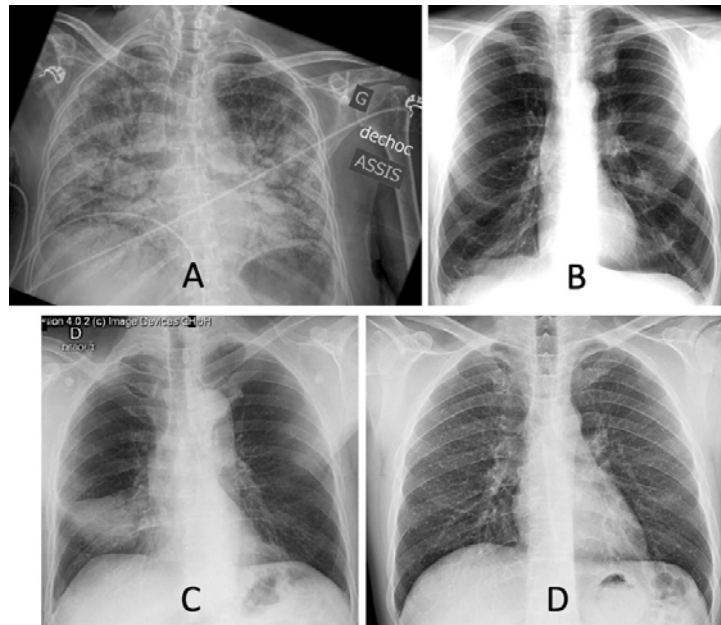
5 图 A-D 分别对应了哪种类型的肺部高密度影?

- A
- B
- C
- D

/ Test Your Knowledge

<=> ANSWER

5 Which type of lung opacification pattern corresponds to images A-D?



- A Alveolar
- B Nodule
- C Atelectasis
- D Interstitial (micronodular)

See pages 103-130 of this eBook chapter

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<=> 回答

5 图 A-D 分别对应了哪种类型的肺部高密度影?

- A 肺泡
- B 结节
- C 肺不张
- D 间质 (微结节)

见本电子书第 103-130 页

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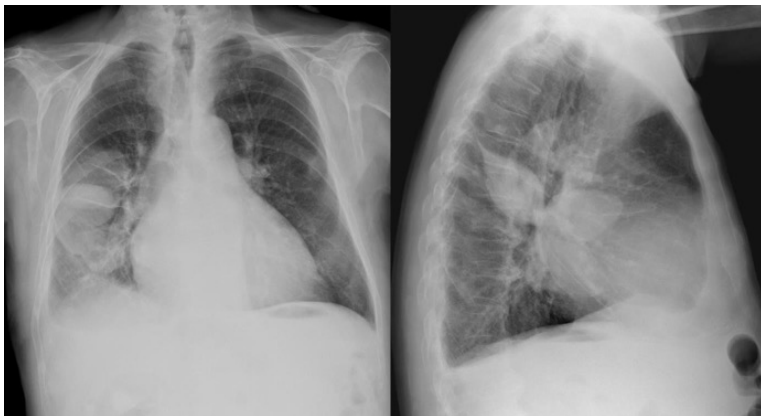
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<=> QUESTION

6 Which statement(s) is/are correct?
This patient has...

- ☐ Loculated pleural effusions
- ☐ Cardiomegaly
- ☐ Intrapulmonary masses
- ☐ Right lower lobe atelectasis

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<=> 问题

6 以下哪些陈述是正确的?
此患者患有...

- ☐ 包裹性胸腔积液
- ☐ 心脏扩大
- ☐ 肺内肿块
- ☐ 右下叶肺不张

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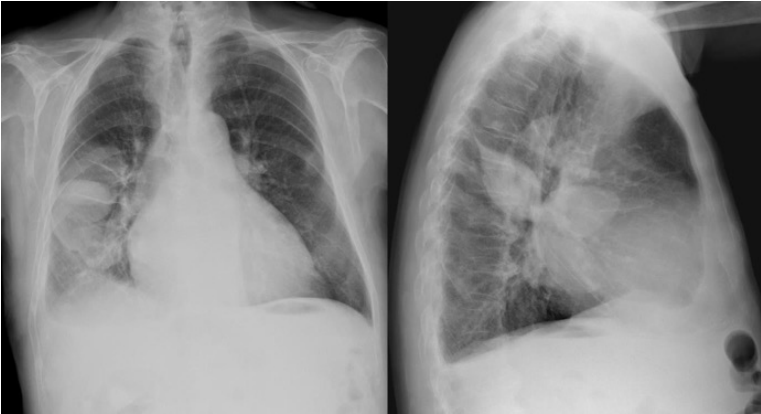
<?> ANSWER

6

Which statement(s) is/are correct?
This patient has...

- ☒ Loculated pleural effusions
- ☒ Cardiomegaly
- ☐ Intrapulmonary masses
- ☐ Right lower lobe atelectasis

See pages 36 and 66 of
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<?> 回答

6

以下哪些陈述是正确的?
此患者患有...

- ☒ 包裹性胸腔积液
- ☒ 心脏扩大
- ☐ 肺内肿块
- ☐ 右下叶肺不张

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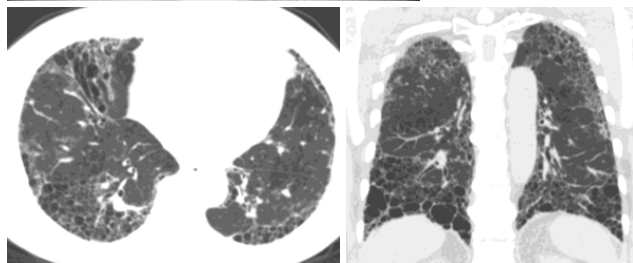
<=> QUESTION

7

Which statement(s) is/are true concerning this patient's imaging findings?



- ☐ The predominant pattern is nodular/micronodular
- ☐ The predominant pattern is honeycombing
- ☐ There are no signs of fibrosis/volume loss
- ☐ Connective-tissue disease related interstitial lung disease must be included in the differential diagnosis



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<=> 问题

7

关于该患者的影像学检查结果，以下哪些陈述是正确的？

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- ☐ 主要表现为结节状/微结节状
- ☐ 主要表现为蜂窝状
- ☐ 未见纤维化/肺容积减损征象
- ☐ 必须将结缔组织病相关的间质性肺病纳入鉴别诊断范围

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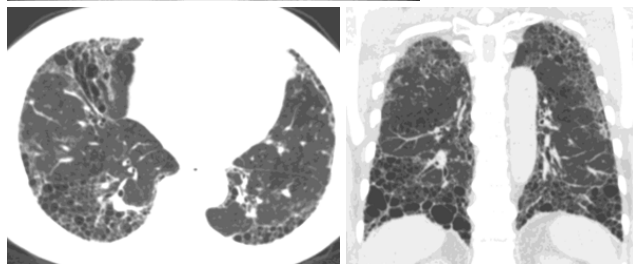
<=> ANSWER

7 Which statement(s) is/are true concerning this patient's imaging findings?



- ☐ The predominant pattern is nodular/micronodular
- ☒ The predominant pattern is honeycombing
- ☒ There are no signs of fibrosis/volume loss
- ☐ Connective-tissue disease related interstitial lung disease must be included in the differential diagnosis

See pages 109-112 of the eBook chapter



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<=> 回答

7 关于该患者的影像学检查结果，以下哪些陈述是正确的？

- ☐ 主要表现为结节状/微结节状
- ☒ 主要表现为蜂窝状
- ☒ 未见纤维化/肺容积减损征象
- ☐ 必须将结缔组织病相关的间质性肺病纳入鉴别诊断范围

见本电子书第 109-112 页

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<?> QUESTION

8 Indicate to what pathophysiologic mechanisms seen in left cardiac failure correspond the following findings on a PA CXR?

- ☐ Venous cephalisation
- ☐ Peribronchial cuffing
- ☐ Kerley B lines
- ☐ Kerley A lines
- ☐ Alveolar opacification

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<?> 问题

8 请指出左心力衰竭中观察到的哪些病理生理机制与后前位 CXR 的以下结果相对应?

- ☐ 静脉头侧化
- ☐ 支气管袖套征
- ☐ Kerley B 线
- ☐ Kerley A 线
- ☐ 肺泡性高密度影

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<?> ANSWER

8

Indicate to what pathophysiologic mechanisms seen in left cardiac failure correspond the following findings on a PA CXR?

- ☐ Venous cephalisation
- ☐ Peribronchial cuffing
- ☐ Kerley B lines
- ☐ Kerley A lines
- ☐ Alveolar opacification

See detailed explanations on pages 134 – 138 of this eBook chapter

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<?> 回答

8

请指出左心力衰竭中观察到的哪些病理生理机制与后前位 CXR 的以下结果相对应？

- ☐ 静脉头侧化
- ☐ 支气管袖套征
- ☐ Kerley B 线
- ☐ Kerley A 线
- ☐ 肺泡性高密度影

请参阅本电子书章节第 134-138 页的详细说明

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<?> QUESTION

9

Which statement(s) is/are correct?

- ☐ Solitary lung nodules are solid nodules without associated atelectasis, pneumonia or lymphadenopathy
- ☐ To evaluate nodule growth, volumetry rather than 2D measurement of lesion size is recommended
- ☐ The prevalence of lung cancer in solitary lung nodules larger than 10 mm in size is less than 10%
- ☐ A solitary lung nodule detected in a patient taking part in a lung screening programme should be followed according to the guidelines of the Fleischer Society

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<?> 问题

9

以下哪些陈述是正确的?

- ☐ 孤立性肺结节是指不伴有肺不张、肺炎或淋巴结肿大的实质性肺结节
- ☐ 评估结节生长时，建议采用体积测定法而非 2D 方法测量病灶大小
- ☐ 对于直径大于 10 mm 的孤立性肺结节，其肺癌发生率低于 10%
- ☐ 根据 Fleischer 学会的指南，对在参加肺癌筛查项目的患者中检测到的孤立性肺结节应进行随访

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<?> ANSWER

9

Which statement(s) is/are correct?

- Solitary lung nodules are solid nodules without associated atelectasis, pneumonia or lymphadenopathy
- To evaluate nodule growth, volumetry rather than 2D measurement of lesion size is recommended
- The prevalence of lung cancer in solitary lung nodules larger than 10 mm in size is less than 10%
- A solitary lung nodule detected in a patient taking part in a lung screening programme should be followed according to the guidelines of the Fleischer Society

See pages 114, 118 and 119 of the eBook chapter

<?> 回答

9

以下哪些陈述是正确的?

- 孤立性肺结节是指不伴有肺不张、肺炎或淋巴结肿大的实质性肺结节
- 评估结节生长时，建议采用体积测定法而非 2D 方法测量病灶大小
- 对于直径大于 10 mm 的孤立性肺结节，其肺癌发生率低于 10%
- 根据 Fleischer 学会的指南，对在参加肺癌筛查项目的患者中检测到的孤立性肺结节应进行随访

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<?> QUESTION

- 10 Which of the following statements regarding pathology of the pleura and pleural cavity is/are correct?
- ☐

Typical signs of tension pneumothorax are displacement of the mediastinum towards the pneumothorax, elevation of the diaphragm and decreased distance between the ribs
- ☐

Pleural plaques can be detected on CXRs and are related to asbestos exposure
- ☐

CXR is the preferred imaging modality to depict pleural pathology
- ☐

Malignant mesothelioma is more common than pleural metastases

/ Chest Imaging

CHAPTER OUTLINE:

- Introduction
- Diagnostic Imaging Techniques
- How to Read a Chest X-Ray (CXR)
- The Normal CXR
- The Silhouette Sign
- Soft Tissue Asymmetry on CXRs
- Medical Devices and Other Foreign Bodies on CXRs
- Bone Pathology on CXRs
- Pathology of the Pleura and Pleural Cavity
- The Abnormal Mediastinum
- Pathology of the Hilum
- Abnormal Lung Parenchyma
- Pulmonary Oedema
- Pulmonary Hypertension
- Take-Home Messages
- References
- Test Your Knowledge

/ 胸部影像学

/ 知识测试

章节大纲:

- 简介
- 影像诊断技术
- 如何判读胸部 X 线 (CXR)
- 检查结果
- 正常 CXR
- 剪影征
- CXR 见软组织不对称
- CXR 见医疗装置和其他异物
- CXR 上骨病变
- 胸膜和胸膜腔病变
- 纵隔异常
- 肺门病变
- 肺实质异常
- 肺水肿
- 肺动脉高压
- 核心要点
- 参考文献
- 知识测试

<?> 问题

- 10 以下哪些关于胸膜和胸膜腔病理学的陈述是正确的?
- ☐

张力性气胸的典型体征为纵隔向气胸移位、横膈抬高和肋骨间距缩短
- ☐

CXR 可检测到胸膜斑，与石棉暴露有关
- ☐

CXR 是显示胸膜病变的首选影像学检查
- ☐

恶性间皮瘤比胸膜转移更常见

/ Test Your Knowledge

<?> ANSWER

10 Which of the following statements regarding pathology of the pleura and pleural cavity is/are correct?

- ☐ Typical signs of tension pneumothorax are displacement of the mediastinum towards the pneumothorax, elevation of the diaphragm and decreased distance between the ribs
- ☒ Pleural plaques can be detected on CXRs and are related to asbestos exposure
- ☐ CXR is the preferred imaging modality to depict pleural pathology
- ☐ Malignant mesothelioma is more common than pleural metastases

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<?> 回答

10 以下哪些关于胸膜和胸膜腔病理学的陈述是正确的?

- ☐ 张力性气胸的典型体征为纵隔向气胸移位、横膈抬高和肋骨间距缩短
- ☒ CXR 可检测到胸膜斑, 与石棉暴露有关
- ☐ CXR 是显示胸膜病变的首选影像学检查
- ☐ 恶性间皮瘤比胸膜转移更常见

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/ 致谢

本电子书章节收录了日内瓦大学医学院“临床方法导论”课程（Unité d’Introduction à la Démarche Clinique, UIDC, 1ère année de master）的部分教学内容，以及“临床轮转学习：内科”课程（Apprentissage en milieu clinique rotation médecine interne）的相关影像资料。这一经过多年开发的课程模块获得了医学生和初级住院医师的广泛认可与好评。

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