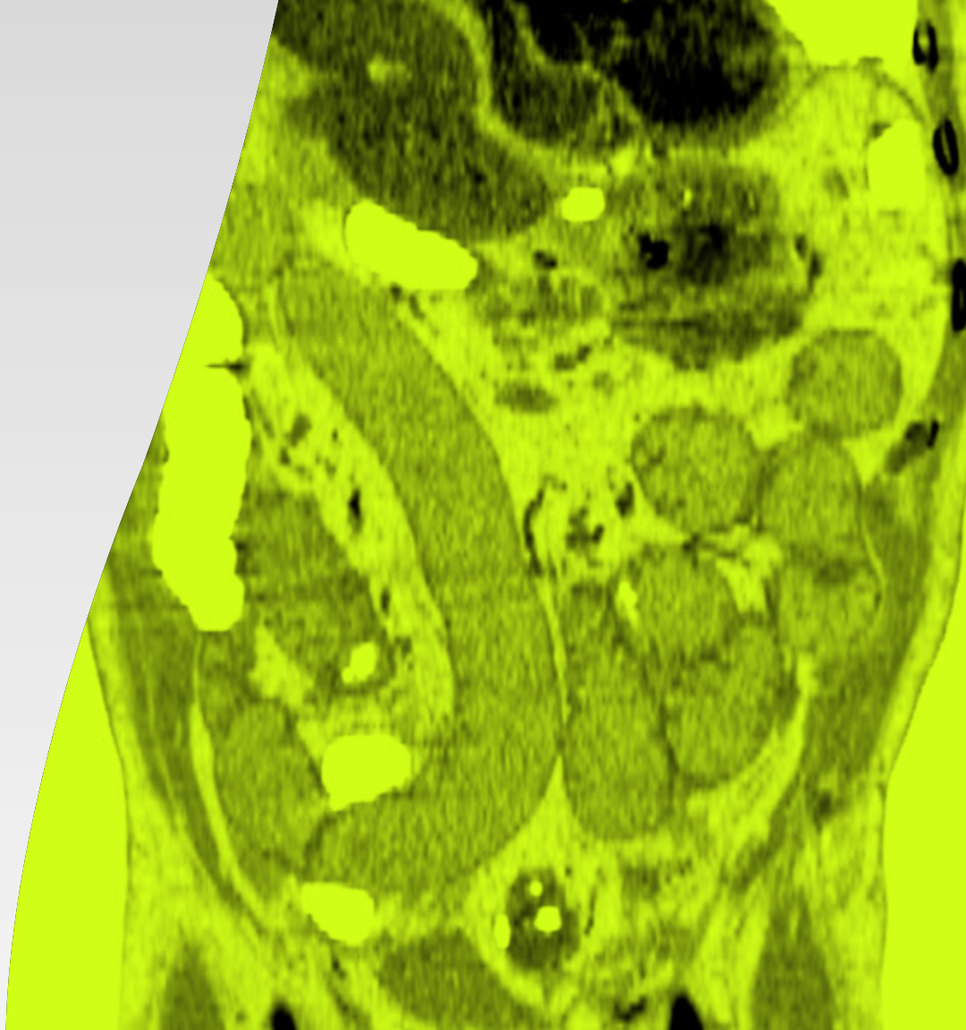
MODERN RADIOLOGY eBook

Small Bowel

小肠



EUROPEAN SOCIETY OF RADIOLOGY

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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章节大纲：

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
瑞士日内瓦大学放射学教授

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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。

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小肠

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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。

小肠

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<?> 问题

MODERN RADIOLOGY eBook

Based on the ESR Curriculum for Radiological Education

Small Bowel

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章节大纲：

基于 ESR 课程的放射学教育

小肠

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Chapter Outline

Relevant Anatomy for Small Bowel Imaging

- Parts of the Small Bowel
- Normal Ultrasonography, Computed Tomography and Magnetic Resonance Imaging Anatomy
- Blood Supply

Strengths, Weaknesses and Role of Imaging Modalities

- Plain Abdominal Radiograph
- Ultrasonography
- Computed Tomography
- Magnetic Resonance Imaging
- Interventional Radiology

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- Congenital
- Obstruction
- Perforation/Trauma
- Tumour
- Inflammatory/Infectious
- Ischaemia

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小肠影像学检查的相关解剖信息

- 小肠的组成部分
- 超声、计算机断层扫描和磁共振成像正常解剖
- 血供

影像学检查方法的优势、劣势和作用

- 腹平片
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按病因分类的小肠影像学检查主要适应证

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- 梗阻
- 穿孔/创伤
- 肿瘤
- 炎症/感染
- 缺血

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Relevant Anatomy for Small Bowel Imaging

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章节大纲：

小肠影像学检查的相关解剖信息

/ Parts of the Small Bowel

For general anatomical, histological and physiological information about the **small bowel** (duodenum, jejunum, ileum) please refer to your knowledge obtained during your studies in the previous years.

Here we provide you only with some imaging-specific additions to the subject. This primarily concerns **ultrasonography** (US), **computed tomography** (CT), **magnetic resonance imaging** (MRI) and **interventional radiology**.

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章节大纲：

有关**小肠**（十二指肠、空肠、回肠）的一般解剖学、组织学和生理学信息，请参考您在以往学习中获得的知识。

本书仅提供与本主题相关的影像学补充内容，主要涉及**超声** (US)、**计算机断层扫描** (CT)、**磁共振成像** (MRI) 和**介入放射学**。

/ The Normal Small Bowel on US

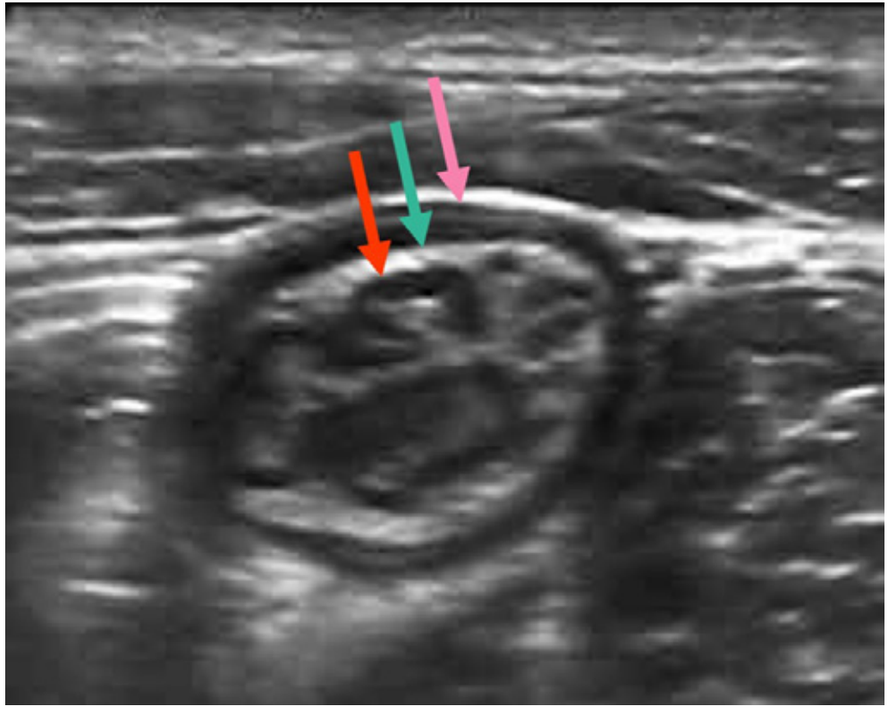

FIGURE 1

Ultrasonography of a normal small bowel loop in a transverse view. The different layers of the bowel wall can be distinguished, from inside out: lumen and superficial mucosal layer interface (echogenic, not pointed out), deep mucosa (hypoechoic, **red arrow**), submucosa (echogenic, **turquoise arrow**), muscularis propria (hypoechoic, **pink arrow**) and on the outside a thin layer of echogenic serosal surface (not pointed out because it is blended with the surrounding echogenic fat).

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/ 超声检查下的正常小肠

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图 1

一段正常小肠袢的超声横轴位图像。从内向外可以依次分辨肠壁的各层结构：管腔与黏膜表层交界处（高回声，未标注）、黏膜深层（低回声，**红色箭头**）、黏膜下层（高回声，**蓝绿色箭头**）、固有肌层（低回声，**粉色箭头**），最外层为菲薄的高回声浆膜面（未标注，因其与周围高回声脂肪组织融合）。

/ The Normal Small Bowel on CT

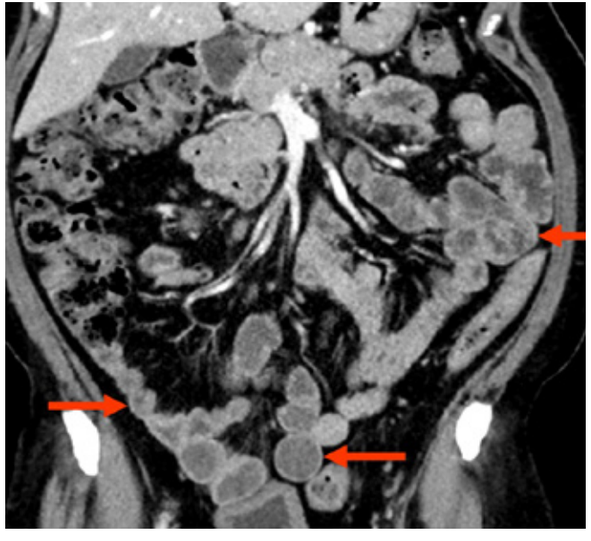

FIGURE 2

Normal small bowel loops on coronal CT after administration of an intravenous contrast medium. The bowel walls enhance normally and are relatively hyperintense compared to the lumen (red arrows).

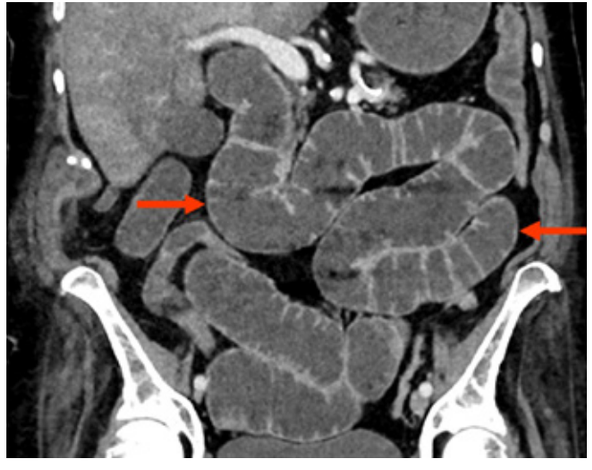

FIGURE 3

Coronal CT after intravenous contrast administration in a patient with dilated small bowel loops (arrows). The bowel loops have normal enhancement and normal thickness bowel walls. Also, the circular mucosal folds are well visualised in this patient due to the distended bowel loops.

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/ CT 检查下的正常小肠

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图 2

静脉注射对比剂后的冠状位 CT，显示正常小肠袢。肠壁正常强化，与肠腔相比呈相对高密度（红色箭头）。

图 3

一例小肠袢扩张患者，静脉注射对比剂后的冠状位 CT（箭头所示）。肠袢强化正常，肠壁厚度正常。此外，由于肠袢扩张，该患者的环状黏膜皱襞清晰可见。

/ The Normal Small Bowel on MRI

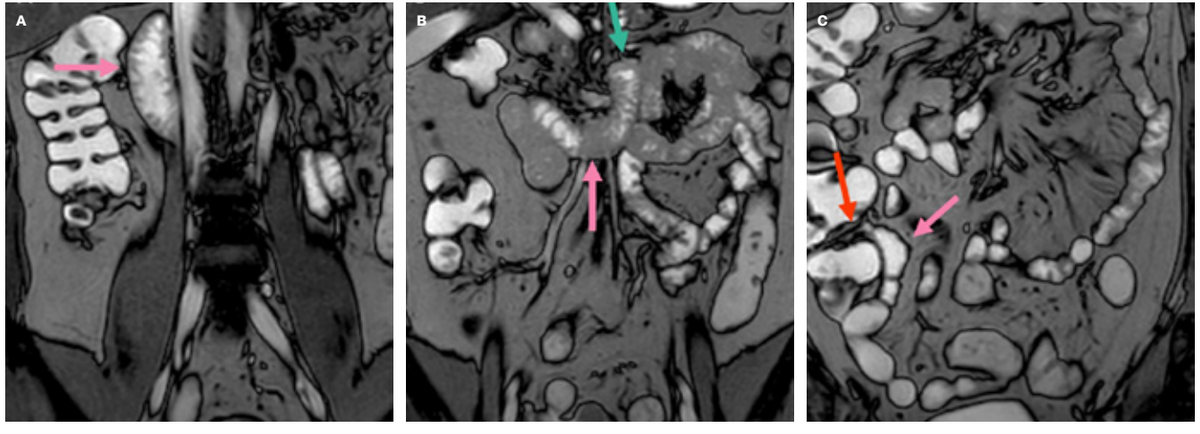

FIGURE 4 A–C

Normal small bowel on coronal MRI (T2-weighted sequences). Left to right: from posteriorly to anteriorly in the abdomen. On the left the descending part of the duodenum is pointed out (**pink arrow**), in the middle the transverse part of the duodenum (**pink arrow**) which continues (**turquoise arrow**) into the jejunum at the ligament of Treitz and on the right the terminal ileum (**pink arrow**) where it enters into the cecum (ileocecal valve, **red arrow**). The larger part of the small bowel (i.e., jejunum and ileum) lays in between the duodenum and terminal ileum. The lumen is variably filled in these images.

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图 4 A-C

正常小肠冠状位 MRI（T2 加权序列）。从左至右：腹部从后至前。左图为十二指肠降段（**粉色箭头**）；中图为十二指肠水平段（**粉色箭头**），其在十二指肠悬韧带处（**蓝绿色箭头**）续为空肠；右图为回肠末端（**粉色箭头**），进入盲肠（回盲瓣，**红色箭头**）。小肠的大部分（即空肠和回肠）位于十二指肠与回肠末端之间。在这些图片中，管腔的填充程度各不相同。

/ Anatomy for Small Bowel Imaging – **Blood Supply**

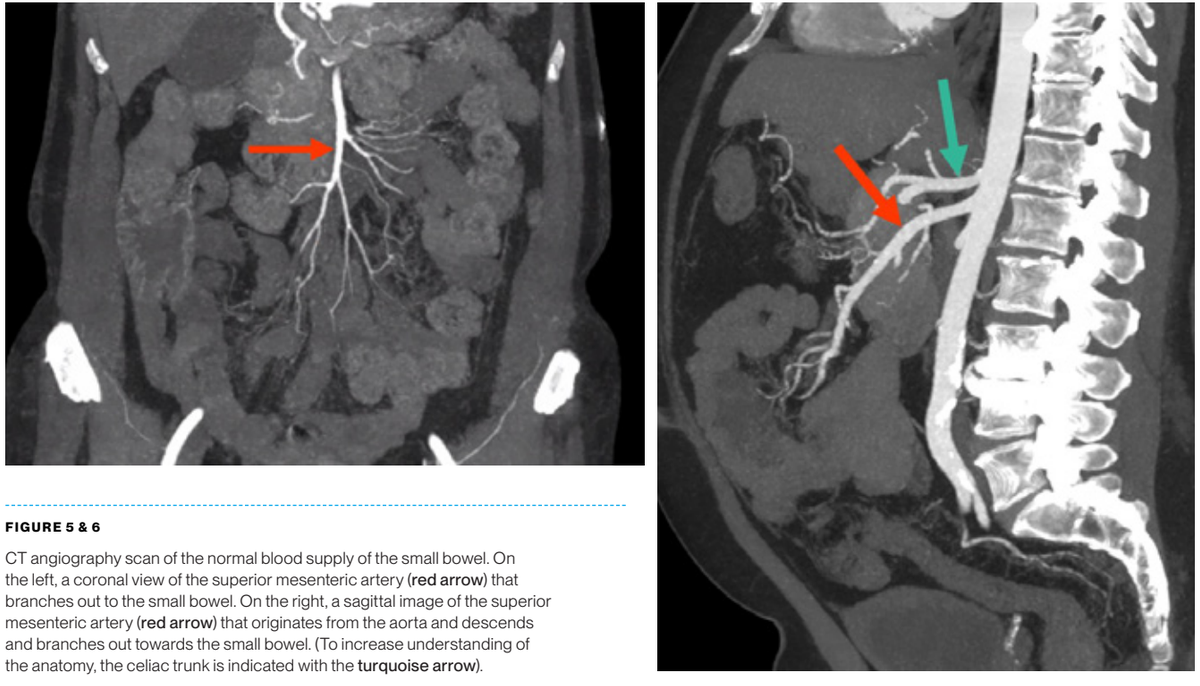

FIGURE 5 & 6

CT angiography scan of the normal blood supply of the small bowel. On the left, a coronal view of the superior mesenteric artery (**red arrow**) that branches out to the small bowel. On the right, a sagittal image of the superior mesenteric artery (**red arrow**) that originates from the aorta and descends and branches out towards the small bowel. (To increase understanding of the anatomy, the celiac trunk is indicated with the **turquoise arrow**).

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/ 小肠影像学解剖 - **血供**

/ 小 **肠**

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图 5 和 6

正常血供小肠的 CT 血管成像。左图为肠系膜上动脉（**红色箭头**）的冠状位图像，该动脉发出分支至小肠。右图为肠系膜上动脉（**红色箭头**）的矢状位图像，该动脉起自腹主动脉并下行，发出分支至小肠。（为更好理解腹腔干动脉的解剖，用**蓝绿色箭头**标示腹腔动脉）。

Strengths, Weaknesses and Role of Imaging Modalities

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章节大纲：

影像学检查方法的优势、劣势和作用

/ Strengths, Weaknesses and Role of Imaging Modalities – **Plain Abdominal Radiograph**

There is a very limited role, if any, for plain abdominal radiographs in visualising the small bowel. Bowel walls are generally not visible on plain X-rays and bowel content is only visualised when there is enough contrast with its surroundings, mostly due to gas. Furthermore, complications are not shown.

One of the abnormalities that can be visualised on plain X-rays are dilated bowel loops that are filled with gas, however, the cause of the dilation will need further evaluation using a different imaging modality. Also, free gas below the diaphragm caused by a gastrointestinal perforation can be seen on upright plain radiographs. However, CT has a substantially higher sensitivity and specificity for free peritoneal gas, it can show the cause of the perforation and possible complications.

>|< COMPARE

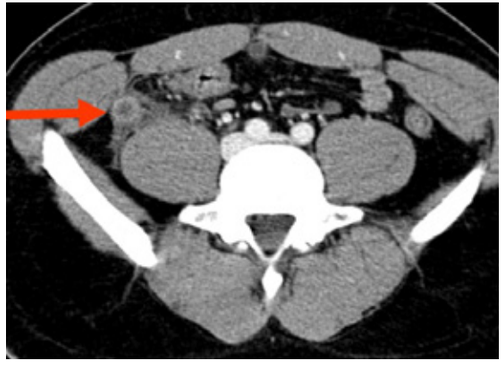

FIGURE 7

Normal plain abdominal radiograph in a patient with acute abdominal pain at the right lower quadrant. This patient had an appendicitis which was visualised on a CT-scan (distended appendix, periappendiceal infiltrate mesoappendix at red arrow).

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章节大纲：

/ 影像学检查方法的优势、劣势和作用 - **腹平片**

腹平片对显示小肠的作用非常有限。肠壁在 X 线平片上通常不可见，只有在与周围环境有足够的对比度时才能看到肠内容物，主要由于气体衬托。而且，平片无法显示并发症。

X 线平片上可见的异常之一是充盈气体的扩张肠袢，但需要其他影像检查方法才能进一步评估扩张的原因。此外，直立位 X 线平片可见消化道穿孔导致的膈下游离气体。然而，CT 对检出腹腔内游离气体的敏感性和特异性明显更高，可显示穿孔的原因和可能的并发症。

>|< 比较

图 7

一例急性右下腹痛患者，腹平片正常。CT 扫描显示该患者有阑尾炎（阑尾扩张，阑尾周围系膜浸润，如**红色箭头**所示）。

/ Strengths, Weaknesses and Role of Imaging Modalities – **Ultrasonography**

Ultrasonography is often used in abdominal imaging including acute abdomen, inflammatory bowel diseases and in paediatric cases. One of the advantages of ultrasonography is the high resolution which makes it possible to visualise the different layers of the bowel wall. Motility can be assessed, which can be increased in bowel loops upstream of an obstruction or decreased such as in paralytic ileus. Compression can be applied which gives information on the compressibility of the small bowel which may be decreased (e.g., in Crohn's disease). Moreover, this modality is available in an outpatient clinic setting and the investigation is interactive with the patient, which may result in additional anamnestic information. Disadvantages are often the inability to give an overview of the entire small bowel, field of view can be limited by (bowel) gas and visualisation can be limited in obese patients.

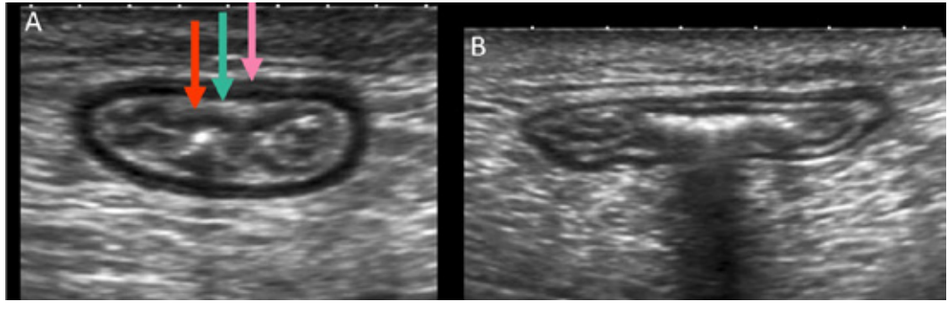

FIGURE 8 A&B

Normal small bowel ultrasonography. On the left, a transverse view of a normal small bowel loop. On the right, the same small bowel loop when it is compressed by the transducer. The **red arrow** shows the deep mucosa, the **turquoise arrow** the submucosa & the **pink arrow** the muscularis propria.

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/ 影像学检查方法的优势、劣势和作用 - **超声**

超声检查常用于腹部，包括急腹症、炎性肠病和儿科病例。超声检查的优势之一是高分辨率，这有助于显示肠壁的不同层次。超声检查可以评估肠蠕动，梗阻近端的肠袢蠕动可能增加，在麻痹性肠梗阻时减少。可施加压迫，用以提供有关小肠可压缩性的信息，压缩性可能降低（例如在克罗恩病中）。此外，这种方式可在门诊进行，通过与患者互动可能获得额外的病史信息。缺点是通常无法对小肠进行全方位观察，视野可能受到（肠道）气体的限制，在肥胖患者中的可视化可能受限。

图 8 A 和 B

正常小肠的超声。左图为正常小肠袢横轴位图像。右图为同一小肠袢被探头压迫时的情况。**红色箭头**所示为深层黏膜，**蓝绿色箭头**所示为黏膜下层，**粉色箭头**所示为固有肌层。

/ Strengths, Weaknesses and Role of Imaging Modalities – **CT**

CT is a widely and frequently used imaging modality to visualise the small bowel. Different protocols can be used, dependent on the indication.

The most important disadvantage is the use of ionising radiation, especially in children and (young) patients that need repeated imaging. State of the art CT-scanners have substantially decreased ionising radiation burden than earlier scanners, but the radiation dose of abdominal CT is not negligible.

/ CT Protocols

Intravenous contrast medium is routinely administered in CT of the bowel, as it improves visualisation of the bowel wall layers and facilitates detection of ischaemia or haemorrhage. A routine CT of the abdomen comprises a single phase CT obtained in the portal venous phase. For indications where there is a special interest in the vascularisation of the small bowel, biphasic CT can be performed in which intravenous contrast is administered in the arterial phase and venous phase.

Oral contrast medium or water can be used to distend the bowel loops and to highlight the contrast between bowel lumen and bowel wall in CT. Oral contrast media can be administered orally (CT enterography) or via a nasojejunal tube (CT enteroclysis). In acute situations no oral contrast medium is used routinely as it leads to time delay. In case of ischaemia or haemorrhage, oral contrast medium will decrease the conspicuity of bowel wall enhancement while intraluminal haemorrhage will be completely obscured by oral contrast medium. Therefore in these patients certainly no oral contrast medium should be used.

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章节大纲：

/ 影像学检查方法的优势、劣势和作用 - **CT**

CT 是广泛且常用的小肠影像检查方法。根据不同的适应证，可以采用不同的扫描方案。

其最主要的缺点是有电离辐射，尤其对于需要反复多次行影像学检查的儿童和（年轻）患者。与早期扫描仪相比，现在的 CT 扫描仪已显著降低了电离辐射剂量，但腹部 CT 的辐射负担仍不容忽视。

/ CT 扫描方案

肠道 CT检查中常规给予**静脉对比剂**，因其可以更好显示肠壁，并提高缺血或出血的检出。常规腹部 CT 检查包括单期的门静脉期。在需要特别关注小肠血供的情况下，可行双时相 CT 扫描，即静脉注入对比剂后的动脉期和静脉期。

口服对比剂或水可用于扩张肠袢，并提高 CT图像中肠腔与肠壁之间的对比度。口服对比剂可经口（CT 小肠造影）或经鼻空肠管（CT 小肠灌肠双对比造影）给予。在紧急情况下，不常规使用口服对比剂，因会延误时间。在缺血或出血情况下，口服对比剂会降低肠壁强化程度的显示，而且肠腔内的出血会被口服对比剂完全掩盖。因此，此类患者不应使用口服对比剂。

>|< COMPARE

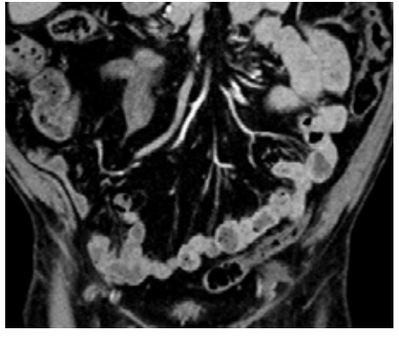

FIGURE 9

Normal coronal CT scan of a patient that received intravenous contrast in the portal venous phase but no oral contrast. A difference in contrast between the bowel wall and lumen can be visualised.

This protocol is used in most settings, indications are various but can for example consist of oncologic follow up, suspected small bowel obstruction or haemorrhage.

FIGURE 10

Normal coronal CT scan of a patient that received oral and intravenous contrast. The bowel lumen is filled with oral contrast so there is a large contrast difference between lumen and bowel wall.

Indications for this protocol consist mainly of disorders where there is an interest in bowel wall lesions, such tumours or Crohn's disease. Potential drawback is obscuring bowel wall or lesion enhancement.

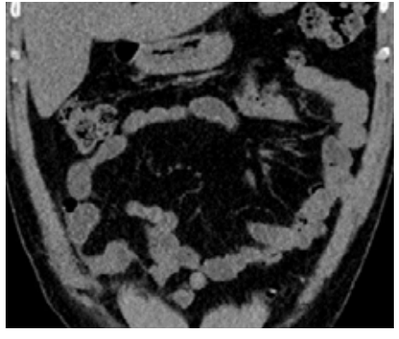

FIGURE 11

Normal coronal CT scan of a patient that did not receive oral preparation and no intravenous contrast. In some bowel loops there is a slight contrast between the bowel wall and lumen but circulation cannot be properly evaluated.

There are rare indications for this protocol, but for example ingested foreign bodies or in patients with an absolute contra indication for contrast medium.

Small Bowel

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小肠

章节大纲：

>|< 比较

图 9

一例接受了静脉对比剂但未口服对比剂患者的正常冠状位门静脉期 CT。可观察到肠壁和肠腔之间的对比度差异。

该方案适用于大多数情况，适应证各不相同，但可包括例如肿瘤随访、疑似小肠梗阻或出血等。

图 10

一例同时接受口服和静脉注射对比剂患者的正常冠状位 CT。肠腔内充盈口服对比剂，因此肠腔与肠壁对比差异显著。

该方案的适应证主要包括肠壁病变，例如肿瘤或克罗恩病。潜在缺点是使肠壁或病变强化变得模糊。

图 11

一例未接受口服及静脉对比剂患者的正常冠状位 CT。部分肠袢的肠壁与肠腔间存在轻微对比差异，但无法良好评估肠壁血供。

该方案的适应证极少，但可以适用于吞食异物或患者有对比剂使用绝对禁忌症的情况。

/ Strengths, Weaknesses and Role of Imaging Modalities – **MRI**

>|< COMPARE

MRI is another often used imaging modality for the small bowel, mostly in an elective setting.

A MRI examination comprises several sequences in different planes which will be optimised for certain diseases and/or areas in the abdomen. Indications for small bowel MRI mostly consist of an interest in lesions of the bowel wall; in daily practice Crohn's disease is a common indication.

Its major advantages over CT are the inherent high contrast resolution, its versatility and lack of ionising radiation. The latter makes it especially suitable for a population that is young and/or needs repeated imaging. Disadvantage are that it is less widely available and takes more time than CT.

/ MRI Protocols

As with CT, different protocols including oral and intravenous contrast can be used.

Intravenous contrast is routinely administered for small bowel evaluation on MRI since it gives information on bowel wall layers, vascularisation of the bowel wall and of bowel lesions. Diffusion weighted imaging (based on differences in MRI-probed Brownian motion differences between tissue structures) can make intravenous contrast medium superfluous in some settings.

Oral contrast medium with a large volume, that is not well absorbed in the small bowel, is also routinely used in MRI of the small bowel (MR enterography or MR enteroclysis). This results in distended bowels and an increased contrast difference between lumen and bowel wall which enables adequate visualisation of the bowel wall and bowel wall lesions.

/ 影像学检查方法的优势、劣势和作用 - **MRI**

>|< 比较

MRI 是小肠的另一种常用影像学检查方法，多为择期检查。

MRI 检查包括不同切面的若干序列，这些序列可以根据腹部某些特定疾病和/或区域进行优化。小肠 MRI 的适应证主要包括肠壁病变；在日常实践中，克罗恩病是常见适应证。

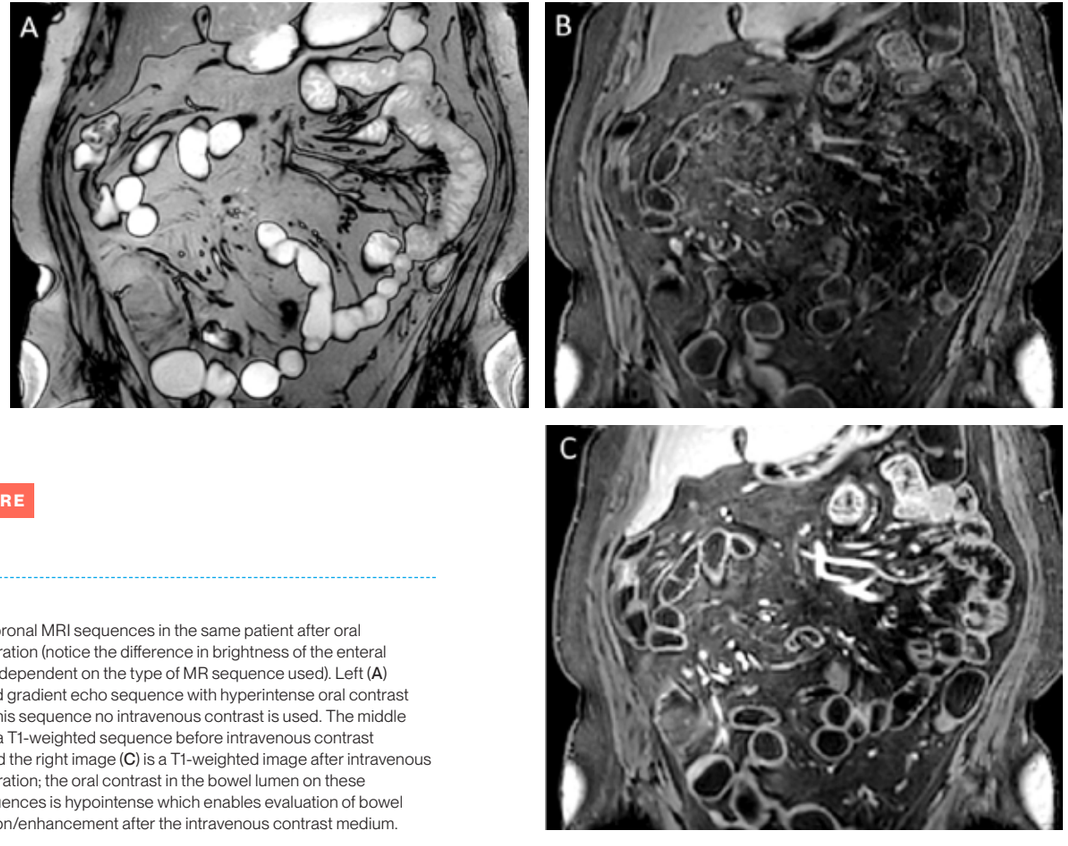
与 CT 相比，MRI 的主要优点是对比分辨率高、适用情况广和无电离辐射。尤其后者使其特别适合年轻和/或需要多次影像检查的人群。缺点是设备普及度较低，且花费时间比 CT 长。

/ MRI 扫描方案

与 CT 一样，可使用不同的扫描方案，包括口服和静脉对比剂。

静脉对比剂通常用于 MRI 小肠评估，因其可提供有关肠壁层次、肠壁血供情况和肠病变的信息。扩散加权成像（基于 MRI 检测的不同组织结构之间布朗运动差异）在某些情况下可使静脉对比剂变得多余。

量大且在小肠中吸收不佳的**口服对比剂**也常用于小肠 MRI（MR 小肠造影或 MR 小肠灌肠双对比造影）。这会使肠管扩张，增加肠腔与肠壁间的对比度差异，从而可充分显示肠壁和肠壁病变。



>|< COMPARE

FIGURE 12 A–C

Three different coronal MRI sequences in the same patient after oral contrast administration (notice the difference in brightness of the enteral contrast medium dependent on the type of MR sequence used). Left (**A**) shows a balanced gradient echo sequence with hyperintense oral contrast in the lumen, for this sequence no intravenous contrast is used. The middle image (**B**) shows a T1-weighted sequence before intravenous contrast administration and the right image (**C**) is a T1-weighted image after intravenous contrast administration; the oral contrast in the bowel lumen on these T1-weighted sequences is hypointense which enables evaluation of bowel wall vascularisation/enhancement after the intravenous contrast medium.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

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>|< 比较

图 12 A-C

同一患者，口服对比剂后三个不同的冠状位 MRI 序列（注意肠内对比剂的亮度差异取决于采用的不同序列）。左图 (**A**) 为平衡梯度回波序列，肠腔内有高信号的口服对比剂，该序列未使用静脉对比剂。中图 (**B**) 为静脉注射对比剂前的 T1 加权序列，右图 (**C**) 为静脉注射对比剂后的 T1 加权序列；肠腔内的口服对比剂均呈低信号，因此这些 T1 序列可用于评价静脉注射对比剂后的肠壁血供/强化。

/ Strengths, Weaknesses and Role of Imaging Modalities – **Interventional Radiology**

Interventional radiology is used for the treatment of some small bowel diseases. In active gastrointestinal bleeding, an intravascular radiological intervention can be performed to block the vessel that is bleeding. Also, image-guided percutaneous drainage can be performed for fluid collections and abscesses.

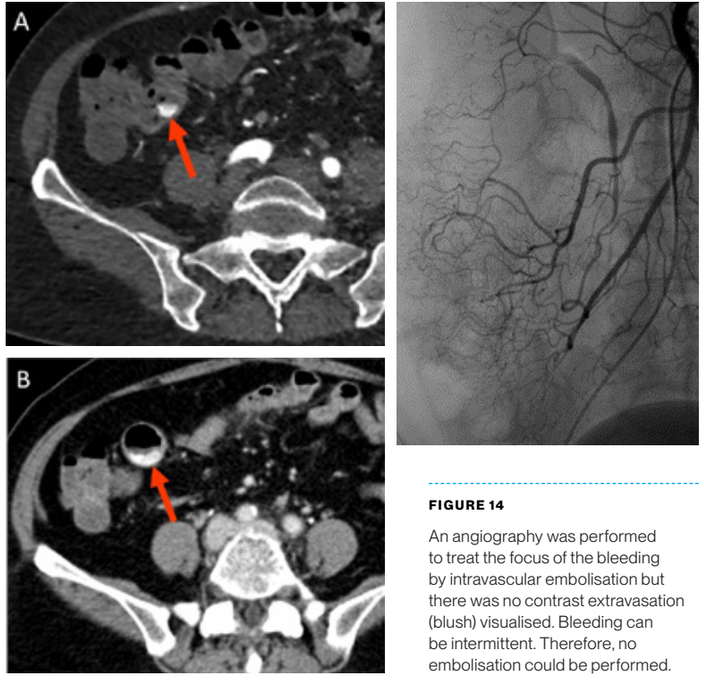


FIGURE 14

An angiography was performed to treat the focus of the bleeding by intravascular embolisation but there was no contrast extravasation (blush) visualised. Bleeding can be intermittent. Therefore, no embolisation could be performed.

FIGURE 13

Transverse CT in the arterial phase (**A**) and portal venous phase (**B**) of a patient with arterial bleeding in the terminal ileum. The presence of contrast extravasation in the bowel lumen of the terminal ileum that increases in the portal venous phase indicates an active bleeding (**red arrow**).

/ Small **Bowel**

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 影像学检查方法的优势、劣势和作用 - **介入放射学**

介入放射学用于某些小肠疾病的治疗。在活动性胃肠道出血中，可行血管内放射介入以堵住出血血管。此外，还可对积液和脓肿进行影像学引导下经皮引流。

图 13

一例回肠末端动脉出血患者的动脉期 (A) 和门静脉期 (B) 的横轴位 CT。若末端回肠肠腔内出现对比剂外溢，并在门静脉期增多，则提示有活动性出血（**红色箭头**）。

图 14

行血管成像以通过血管内栓塞治疗出血灶，但未见对比剂外溢（外渗）显示。出血可以是间歇性的。因此无法进行栓塞。

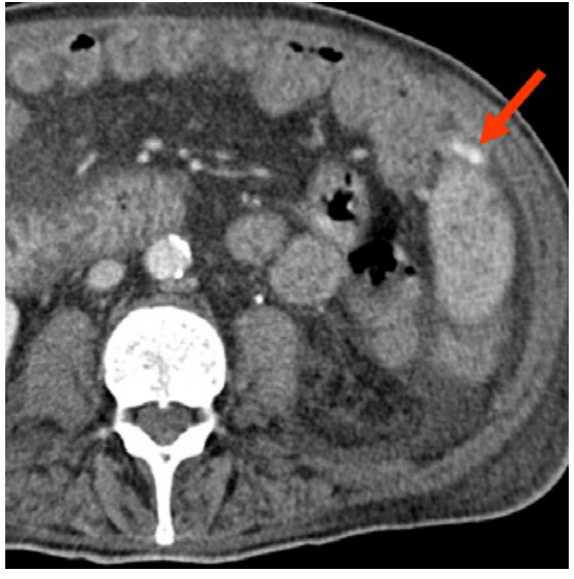
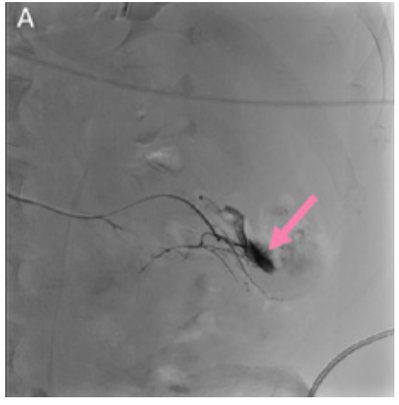


FIGURE 15

Transverse CT in the portal venous phase of a patient with an arterial bleeding in the jejunum. Contrast extravasation is present in the jejunum (**red arrow**) showing an active bleeding.



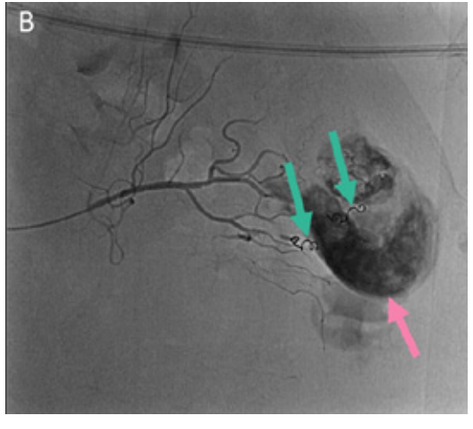


FIGURE 16 A&B

At angiography, contrast extravasation (blush, **pink arrow**) was seen indicating an active bleeding (**A**). The vessels were coiled (**turquoise arrows**) to stop the bleeding (**B**). There is still some contrast present in the bowel lumen from before the coiling, this will disappear due to peristalsis within minutes.

/ Small **Bowel**

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/ 小肠

章节大纲：

图 15

一例空肠动脉出血患者的门静脉期横轴位 CT。空肠出现对比剂外渗（**红色箭头**），表明有活动性出血。

图 16 A 和 B

血管成像见对比剂外溢（外渗，**粉色箭头**），提示活动性出血 (**A**)，遂行弹簧圈栓塞（**蓝绿色箭头**）止血 (**B**)。仍可见栓塞术前滞留于肠腔内的部分对比剂，肠蠕动将在数分钟内使其排空。

Main Indications to Small Bowel Imaging by Pathology

Small Bowel

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小肠

章节大纲：

按病因分类的小肠影像学检查主要适应证

/ Main Imaging Indications by Pathology

- / Congenital
- / Obstruction
- / Perforation/Trauma
- / Tumour
- / Inflammatory/Infectious
- / Ischaemia

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 按病因分类的小肠影像学检查主要适应证

- / 先天性疾病
- / 肿瘤
- / 梗阻
- / 炎症/感染
- / 穿孔/创伤
- / 缺血

/ Main Imaging Indications by Pathology – **Congenital**

- / Malrotation and volvulus
- / **Meckel's diverticulum:** see inflammation/infectious Perforation/trauma

/ Congenital: Malrotation & Volvulus

Intestinal malrotation is a congenital anomaly in which the intestines and its mesentery are rotated abnormally in the abdomen. In the abnormal situation, often the cecum lies in the right upper quadrant instead of the lower quadrant and the small bowel is localised mostly on the right side of the abdomen instead of the left side. The abnormal localisation can result in bowel twisting around itself leading to an obstruction of the blood flow and the bowel becoming ischaemic, which is called a volvulus. For a schematic overview please see (1).

Ultrasound is the recommended imaging modality for suspected volvulus in children.

<∞> REFERENCE

(1) https://radiologyassistant.nl/pediatrics/abdominal-masses/acute-abdomen-in-neonates#congenital-high-obstruction

/ Small **Bowel**

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 按病因分类的小肠影像学检查主要适应证 - **先天性疾病**

- / **肠旋转不良和肠扭转**
- / **梅克尔憩室：**见“炎症/感染”和“穿孔/创伤”

/ 先天性疾病：肠旋转不良和肠扭转

肠旋转不良是一种先天性异常，指肠管及其系膜在腹腔内发生旋转异常。盲肠通常位于右上腹而不是右下腹，小肠主要位于腹部右侧而不是左侧。这种位置的异常可能导致肠管自身扭转，进而导致血流受阻、肠缺血，这种情况被称为肠扭转。示意图见 (1)。

推荐用超声对疑似肠扭转的患儿进行影像学检查。

<∞> 参考文献

(1) https://radiologyassistant.nl/pediatrics/abdominal-masses/acute-abdomen-in-neonates#congenital-high-obstruction

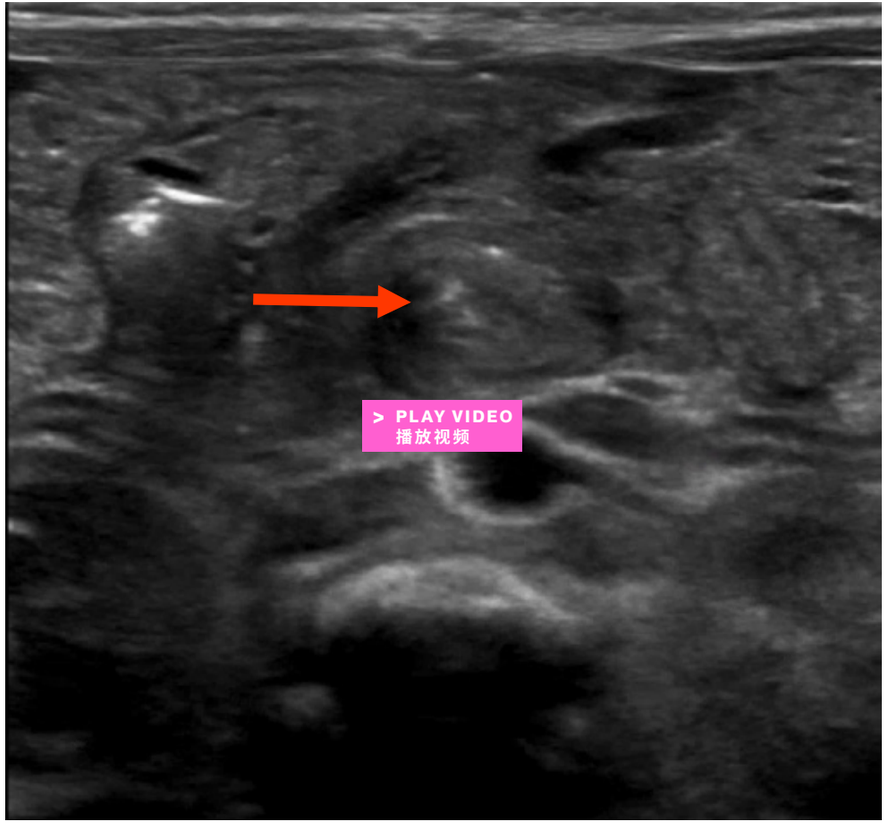

FIGURE 17

Ultrasonography of a child with a volvulus. The movie shows a transverse view with a circular, layered structure which is the small bowel with its mesentery, that twists around the superior mesenteric artery (**whirl sign, red arrow**).

/ Small Bowel

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/ 小肠

章节大纲：

图 17

肠扭转患儿的超声检查。视频展示的横轴位图像中可见一类圆形、分层状结构，这是小肠及其肠系膜围绕着肠系膜上动脉扭转（**漩涡状，红色箭头**）。

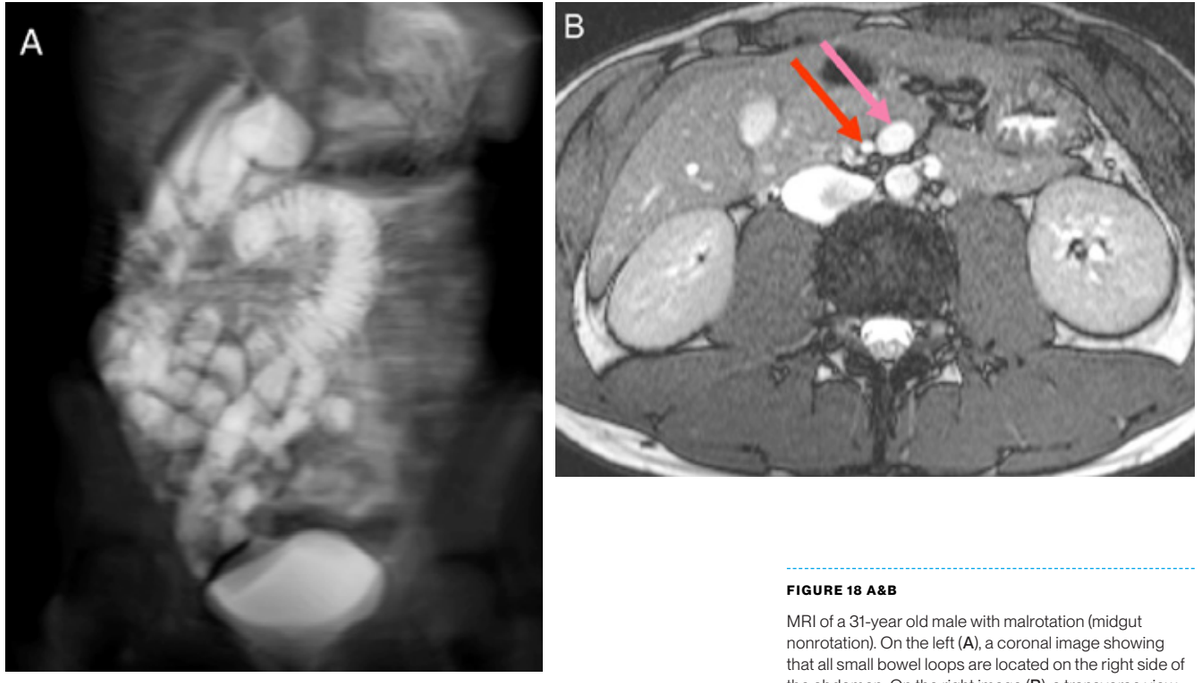


FIGURE 18 A&B

MRI of a 31-year old male with malrotation (midgut nonrotation). On the left (**A**), a coronal image showing that all small bowel loops are located on the right side of the abdomen. On the right image (**B**), a transverse view demonstrating reversed superior mesenteric artery (SMA) and superior mesenteric vein (SMV) relationships: SMV (**pink arrow**) on the left of the SMA (**red arrow**). It was an unexpected finding in this patient, MRI is usually not performed for this indication at this age. Images from Kavaliauskiene et al. Insights Imaging.2011;2:501–513.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

图 18 A 和 B

31 岁肠旋转不良（中肠未旋转）男性患者的 MRI。左图 (**A**) 为冠状位图像，显示所有小肠袢位于右侧腹部。右图 (**B**) 为横轴位图像，显示肠系膜上动脉 (SMA) 和肠系膜上静脉 (SMV) 位置反转。肠系膜上静脉（**粉色箭头**）位于肠系膜上动脉（**红色箭头**）左侧。该患者属于意外发现，通常不会在这个年龄针对该适应证进行 MRI 检查。图像来自 Kavaliauskiene et al. Insights Imaging.2011;2:501–513.

/ Main Imaging Indications by Pathology – **Obstruction**

- / Intussusception
- / Adhesions and internal herniation

<!> ATTENTION

/ Obstruction: Intussusception

Intussusception is a condition primarily occurring in children, in which a proximal small bowel loop is pulled into a more distal bowel loop. In some **cases** a lead point causing the invagination can be identified, such as a lymph node or a tumour. In most paediatric cases **however** there is no lead point identifiable, but in the small number of adults with an intussusception, there is almost always a lead point identified. It is an acute **diagnosis** and the bowel needs repositioning because it can lead to bowel ischaemia.

Ultrasonography is the first choice of imaging in paediatric cases. In young children often hydrostatic reposition will be attempted (i.e., the invaginated bowel is 'pushed back' by a fluid column introduced in the rectum) using ultrasound and/or fluoroscopic guidance before surgery will be considered.

<∞> REFERENCES

Del-Pozo G et al. Radiographics 1999. 19:299-319
Kim Y et a. Radiographics 2006. 26:733-744
Silva A et al. Radiographcs 2009. 29:423-439

/ Small **Bowel**

CHAPTER OUTLINE:

/ 小**肠**

章节大纲：

/ 按病因分类的小肠影像学检查主要适应证 - **肠梗阻**

- / 肠套叠
- / 肠粘连和腹内疝

<!> 注意

/ 肠梗阻：肠套叠

肠套叠是近端肠管套入远端管腔，主要发生于儿童。在一些病例中，可以发现引发肠套叠的诱因，如淋巴结或肿瘤。然而，在大多数儿科病例中，通常无法发现诱因；成年肠套叠患者较少，但几乎总能发现诱因。肠套叠需要尽快做出诊断并复位，否则可能导致肠缺血。

超声是儿科患者首选的影像学检查方式。对于儿童，在考虑手术之前，通常会尝试在超声和/或透视引导下进行水压灌肠复位（即通过直肠注入液体将套叠的肠管"推回"）。

<∞> 参考文献

Del-Pozo G et al. Radiographics 1999. 19:299-319
Kim Y et a. Radiographics 2006. 26:733-744
Silva A et al. Radiographcs 2009. 29:423-439

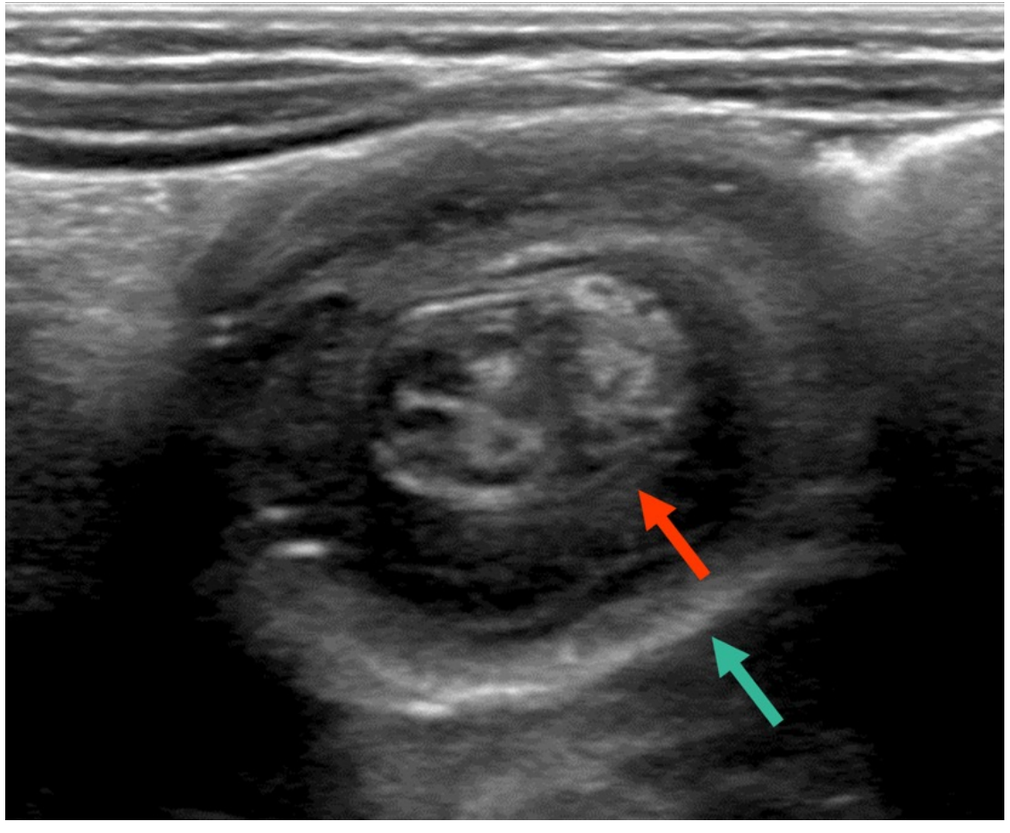


FIGURE 19

Ultrasonography in transverse view of a 22-month old child with an ileocecal intussusception. The **red arrow** points at the ileum that is inside the cecum (**turquoise arrow**) (doughnut sign).

/ Small Bowel

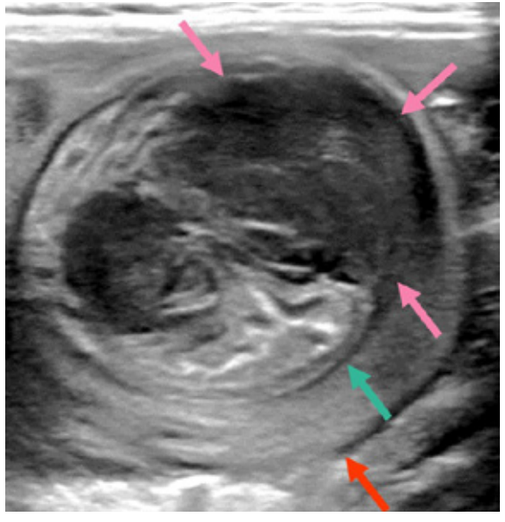
CHAPTER OUTLINE:

/ 小肠

章节大纲：

图 19

22 月龄回-盲型肠套叠患儿的超声横轴位图像。**红色箭头**所指的回肠套入盲肠内（**蓝绿色箭头**）（甜甜圈征）。



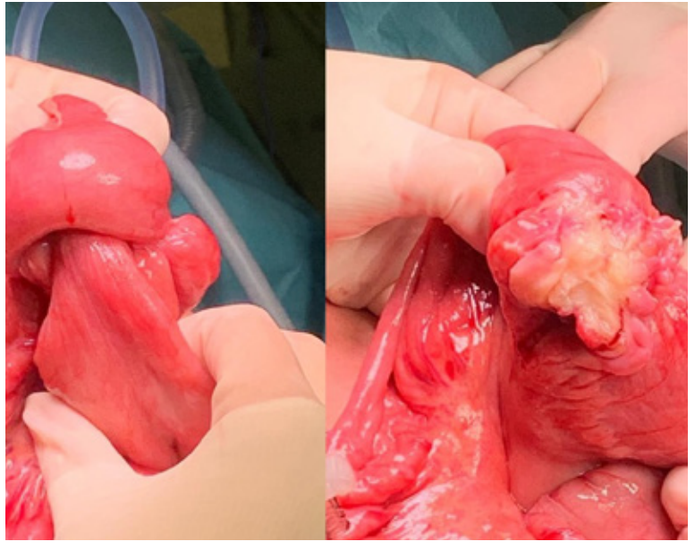


FIGURE 20 & 21

Ultrasonography in transverse view of a more rare case of a 5-year old child with an ileo-ileal intussusception due to a tumour. The **turquoise arrow** points at the ileum with mesentery that is invaginated inside another ileal loop, shown by the **red arrow**. The **pink arrows** point at the hypoechoic tumour that is the lead point in this case. On the right, the pictures at surgery with at the left the intussusception and at the right the tumour that had caused the intussusception (lead point) cut open. At histopathology a Burkitt lymphoma was found. Images from surgery, courtesy of C. de Raaff, MD.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

图 20 和 21

一例罕见病例的超声横轴位图像：5 岁儿童因肿瘤引发回肠-回肠型肠套叠。**蓝绿色箭头**指向套入的近端回肠及肠系膜，**红色箭头**指向被套入的远端回肠。**粉色箭头**所指的低回声肿瘤是此例的诱因。右图是术中照片，左边展示了肠套叠，右边是导致肠套叠的肿瘤切开照片。病理结果提示 Burkitt 淋巴瘤。手术供图来自 C. de Raaff 医学博士。

<!> ATTENTION

/ Obstruction: Adhesions, Internal Herniation and Closed Loop Obstruction

Small bowel obstruction is a relatively common diagnosis in adults and is often caused by adhesions. These fibrous bands in the abdominal cavity occur regularly in patients that underwent surgery or radiotherapy in the past and can cause blockage of the small bowel.

Another cause of small bowel obstruction is internal herniation, in which small bowel loops protrude through an entry point of the peritoneum or mesentery leading to obstruction.

A more serious complication that can be caused by adhesions and/or internal herniation is a closed loop obstruction. In this disorder, the small bowel is herniated and closed off at two separate bowel loops. This causes obstruction of the blood flow to the bowel loop in between, which can become ischaemic and necrotic, resulting in high mortality when not treated in time (for a schematic overview, see*).

In adult cases suspected of small bowel obstruction, CT with intravenous contrast administration is therefore recommended.

<∞> REFERENCES

* https://radiologyassistant.nl/abdomen/bowel/closed-loop-in-small-bowel-obstruction

Del-Pozo G et al. Radiographics 1999. 19:299-319
Kim Y et a. Radiographics 2006. 26:733-744
Silva A et al. Radiographcs 2009. 29:423-439

<!> 注意

/ 肠梗阻：肠粘连、腹内疝和闭袢型肠梗阻

小肠梗阻在成人中相对常见，通常由粘连引起。腹腔内的粘连带经常在接受过手术或放疗的患者中出现，可能导致小肠梗阻。

小肠梗阻的另一病因是腹内疝，即小肠肠袢经腹膜或肠系膜的孔道或裂隙突出，从而引起梗阻。

粘连和/或腹内疝可引起更严重的并发症，即闭袢型肠梗阻。这是指小肠疝出，一段肠袢的两端均被阻塞引起的梗阻。这会导致梗阻点间的肠袢血流受阻，可能发生缺血和坏死，若不及时治疗死亡率很高（示意图见*）。

因此，对于疑似小肠梗阻的成人患者，推荐行增强 CT 检查。

<∞> 参考文献

* https://radiologyassistant.nl/abdomen/bowel/closed-loop-in-small-bowel-obstruction

Del-Pozo G et al.Radiographics 1999.19:299-319
Kim Y et a. Radiographics 2006.26:733-744
Silva A et al.Radiographcs 2009.29:423-439

/ Obstruction: Adhesion

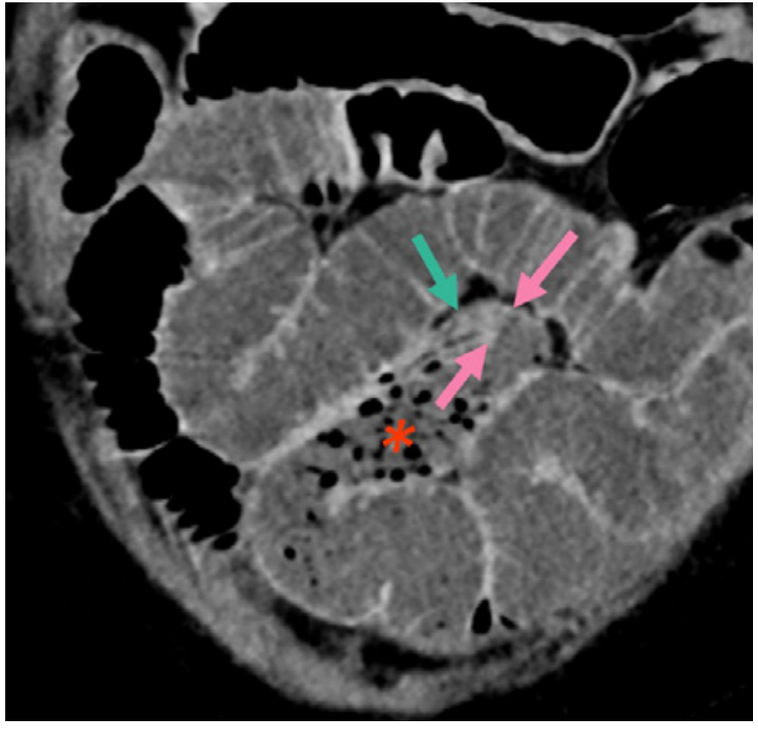


FIGURE 22

Coronal CT scan after intravenous contrast administration of a patient with a small bowel obstruction due to an adhesion. Several dilated small bowel loops are seen upstream of the obstruction, here a calibre change in the small bowel is seen indicating the adhesion (**pink arrows**). Proximal of the obstruction there is stasis leading to gas bubbles (faecal-like material in the small bowel, known as 'small bowel faeces sign' *) and distally to the obstruction the small bowel loop is collapsed (**turquoise arrow**). There is normal bowel wall enhancement.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 肠梗阻：肠粘连

图 22

1 例因粘连引起小肠梗阻的增强 CT 冠状位图像。在梗阻部位近端可见数个扩张的小肠肠袢，此处可见小肠管径变窄，表明存在粘连（**粉色箭头**）。在梗阻的近端，肠内容物淤滞导致气体积聚（小肠中有粪便样物质，称为“小肠粪便征”*），梗阻远端小肠肠管塌陷（**蓝绿色箭头**）。肠壁强化正常。

/ Obstruction: Closed Loop Obstruction

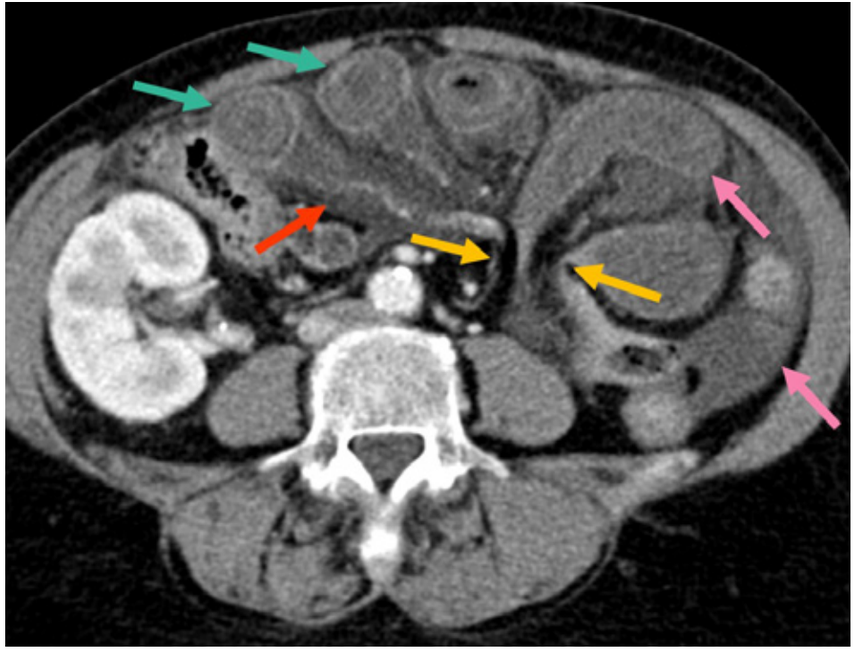


FIGURE 23

Transverse CT image after intravenous contrast administration in a patient with internal herniation of small bowel loops through a peritoneal or mesenteric orifice. The small bowel loops distend because of bowel obstruction leading the bowel to be trapped beyond the orifice, i.e. 'closed loop obstruction'.

The increased intraluminal pressure first will decrease venous outflow which will increase the pressure in the bowel wall and subsequently decrease arterial inflow, leading to bowel ischaemia and bowel necrosis.

At CT, the bowel loops have a thickened wall due to venous congestion in which you can see a layered pattern (water target sign, **turquoise arrows**), decreased enhancement and thinned walls due to arterial ischaemia (**pink arrows**) and there is mesenteric oedema (**red arrow**). Between the yellow arrows is the point of herniation.

This patient was operated on acutely. A necrotic small bowel loop of 60 cm was resected after which the patient had a good recovery.

/ Small Bowel

CHAPTER OUTLINE:

/ 肠梗阻：闭袢型肠梗阻

/ 小肠

章节大纲：

图 23

横轴位增强 CT 图像，显示小肠经腹膜或肠系膜孔疝出形成腹内疝。由于腹内疝导致肠管嵌顿，疝囊外的肠管扩张，形成闭袢性肠梗阻。

肠腔内压力升高首先导致静脉血回流减少，从而增加肠壁压力，随后动脉血供减少，最终引发肠缺血与肠坏死。

在 CT 图像中，可以看到静脉淤血引起的肠壁增厚及分层强化模式（靶征，**蓝绿色箭头**），由于动脉缺血引起的强化减弱、肠壁变薄（**粉色箭头**），以及肠系膜水肿（**红色箭头**）。黄色箭头之间是疝囊颈。

该患者紧急接受了手术。切除 60 cm 的坏死小肠袢后，患者恢复良好。

/ Obstruction: Closed Loop Obstruction

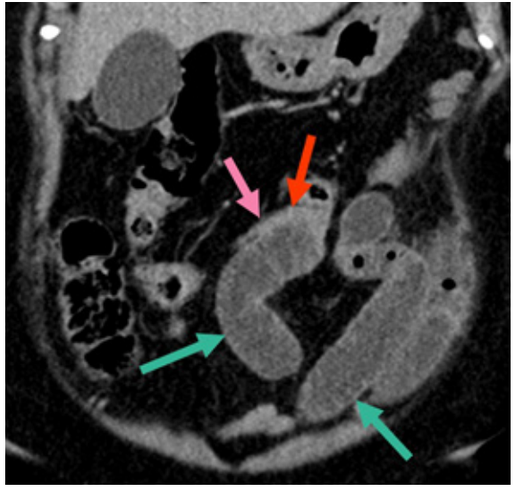


FIGURE 24

Coronal CT scan after intravenous contrast administration in a patient with a closed loop obstruction due an omental adhesion to the sigmoid. As in the previous case, the small bowel loops are distended (**turquoise arrows**). The bowel walls enhance showing that there is still arterial inflow. One point of internal herniation is shown by the **red arrow**, the **pink arrow** points at the collapsed small bowel loop before the distended bowel loop.

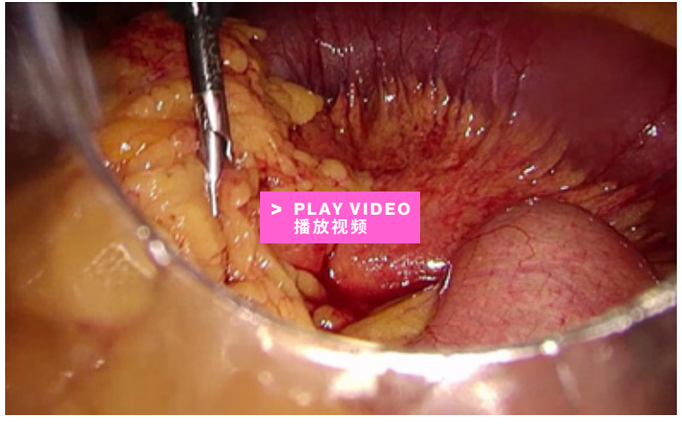


FIGURE 25

This patient was operated on acutely, a movie of the surgery is shown here. A discoloured, ischaemic bowel loop can be seen at the back and a vital bowel loop in front. The adhesion is cut, after which the bowel starts to gain back its normal colour. The patient had a full recovery after surgery. Video from surgery: courtesy of R.J. Swijnenburg, MD.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 肠梗阻：闭袢型肠梗阻

图 24

冠状位增强 CT 图像，显示网膜与乙状结肠粘连所致闭袢性肠梗阻。与前例相同，**蓝绿色箭头**所指为扩张的小肠肠管。肠壁强化表明仍有动脉血供。**红色箭头**所指提示腹内疝，**粉色箭头**指向扩张肠管前的塌陷肠管。

图 25

该患者接受了紧急手术，手术录像如此处所示。后方可见一段颜色异常的缺血肠袢，前方则为血供正常的肠袢。切除粘连带后，肠壁恢复正常颜色。患者术后完全康复。手术视频来源：R.J.Swijnenburg 医学博士.

/ Main Imaging Indications by Pathology – **Perforation**

Perforation of the small bowel mostly occurs in the duodenum due to an ulcer. Other causes of small bowel perforation are sharp trauma, foreign body or perforation due to bowel ischaemia. In case of a suspected gastrointestinal perforation, a CT with intravenous contrast medium is indicated as it is the most accurate technique for detection of contained or free air, the location of the perforation and possible complications (e.g. abscess). Free intraperitoneal air and perforations can be identified at ultrasonography, but less readily and less accurate than at CT. Abdominal radiography (either supine or upright) have been surpassed by CT for the detection of a small bowel perforation while radiography does not give information on the site of the perforation or possible complications.

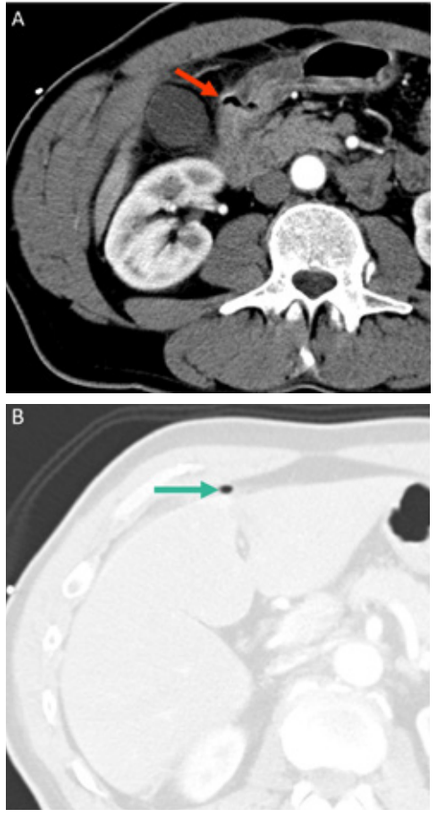


FIGURE 26 A&B

Transverse CT scan of a patient with a duodenal perforation. A perforated duodenal ulcer (**A**) is shown (**red arrow**). On the same CT scan, a small air bubble (**turquoise arrow**) corresponding to intraperitoneal free gas is seen on the lung window setting obtained at the level of the liver (**B**).

/ Small **Bowel**

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 按病因分类的小肠影像学检查主要适应证 - **穿孔**

小肠穿孔多发生于十二指肠，常由溃疡引起。小肠穿孔的其他原因包括锐器伤、异物所致或由肠道缺血导致的穿孔。怀疑胃肠穿孔时，推荐进行增强CT检查，可较为精准地检测包裹性或游离性气体、穿孔部位以及可能的并发症（如脓肿）。超声检查可发现腹腔游离气体和穿孔，但其便利性和准确性均不及 CT。CT 检测小肠穿孔的能力已经超过腹部 X 线摄影（立卧位），X 线摄影不能提供穿孔部位或潜在并发症的信息。

图 26 A 和 B

十二指肠穿孔患者的 CT 横轴位图像。**A**图显示了十二指肠溃疡穿孔（**红色箭头**）。**B**图为同一次 CT 扫描的肺窗图像，肝脏水平可见一小气泡（**蓝绿色箭头**），提示腹腔游离气体。

/ Duodenal Perforation

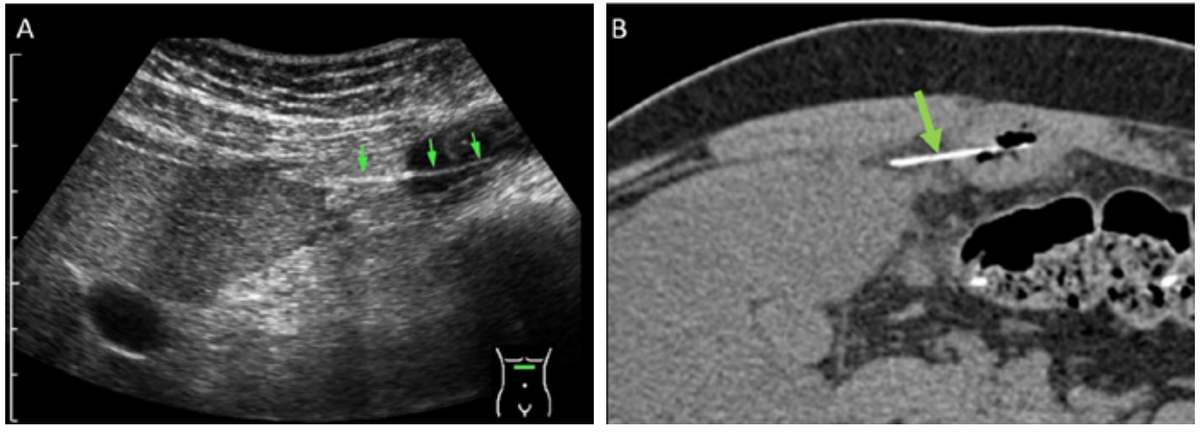


FIGURE 27 A&B

Ultrasonography and CT scan of a patient with a perforation due to a fishbone. On the left the ultrasonography in longitudinal view on which the fishbone is indicated with **green arrows**. On the right, the CT scan in transverse view reveals similar findings with the fishbone pointed out by the **green arrow**.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 十二指肠穿孔

图 27 A 和 B

鱼骨所致穿孔患者的超声和 CT 检查图像。左图为超声纵切面图像，**绿色箭头**所示位置为鱼骨。右图 CT 横轴位图像，与超声类似，**绿色箭头**所指为鱼骨。

/ Main Imaging Indications by Pathology – **Tumour**

- / Polyps
- / Tumours

/ Tumour: Polyps

There is a limited indication to visualise polyps with radiological imaging; mostly endoscopy is used to diagnose and treat polyps. However, in syndromes with multiple polyps, such as Peutz-Jeghers syndrome, regular surveillance with video capsule enteroscopy or MR enterography is recommended.

/ Small **Bowel**

CHAPTER OUTLINE:

/ 按病因分类的小肠影像学检查主要适应证 - **肿瘤**

/ 小**肠**

章节大纲：

- / 息肉
- / 肿瘤

/ 肿瘤：息肉

用影像学检查观察息肉的临床指征有限；息肉的诊断与治疗多通过内镜检查。但对于多发性息肉综合征，如色素沉着-息肉综合征（Peutz-Jeghers 综合征），推荐采用胶囊内镜检查或 MR 小肠造影进行定期监测。

/ Tumour: Polyps

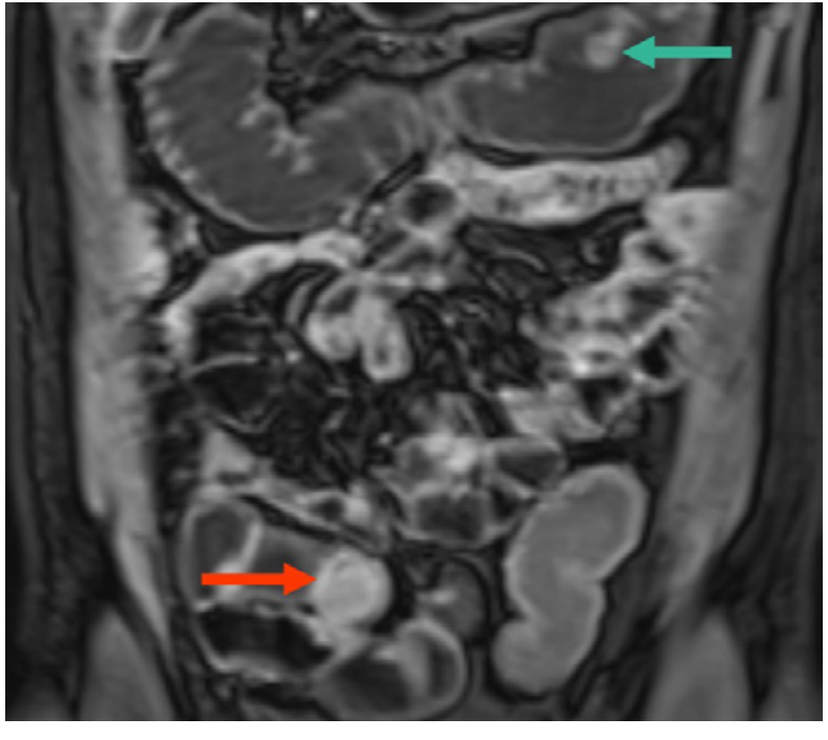


FIGURE 28

Coronal MR enterography after intravenous contrast administration in a patient with multiple polyps due to Peutz-Jeghers syndrome. The enhanced round lesion in the lumen of the ileum (**red arrow**) is a polyp and another polyp is present in the transverse colon (**turquoise arrow**).

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 肿瘤：息肉

图 28

Peutz-Jeghers 综合征所致多发性息肉患者的 MR 小肠造影冠状位增强图像。回肠息肉（**红色箭头**）表现为肠腔内强化的类圆形结节，横结肠中可见另一枚息肉（**蓝绿色箭头**）。

/ Main Imaging Indicationy by Pathology – **Tumour**

Tumours rarely occur in the small bowel. Different subtypes can develop of which the most prevalent is adenocarcinoma, followed by neuroendocrine tumours, lymphomas and sarcomas.

CT or MR enterography with intravenous contrast media are indicated to visualise tumours of the bowel wall.

/ Small **Bowel**

CHAPTER OUTLINE:

/ 小**肠**

章节大纲：

/ 按病因分类的小肠影像学检查主要适应证 - **肿瘤**

小肠的肿瘤相对少见。肿瘤有多种病理类型，其中最常见的是腺癌，其次是神经内分泌肿瘤、淋巴瘤和肉瘤。

CT 或 MR 增强小肠造影检查可用于观察肠壁肿瘤。

/ Tumour: Lymphoma

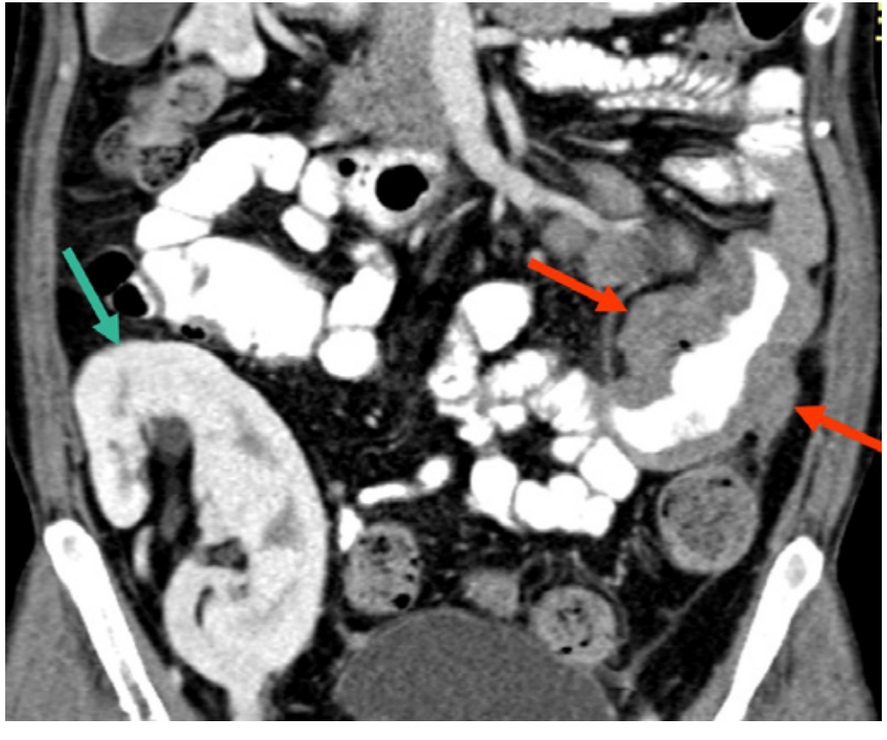


FIGURE 29

Coronal CT scan after oral and intravenous contrast administration of a patient with lymphoma (**red arrows**). Typical of lymphomas is that the tumour despite its size does not obstruct the bowel, the bowel wall is thickened but there is still patent lumen present. The cause of the lymphoma in this case is most likely immunosuppressant therapy after a kidney transplant (abnormal kidney localisation in the right iliac fossa; **turquoise arrow**).

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 肿瘤：淋巴瘤

图 29

淋巴瘤患者口服和静脉注射对比剂后的冠状位 CT 图像（**红色箭头**）。淋巴瘤的典型特征是尽管肿瘤体积很大，但不会引起肠梗阻；肠壁增厚，但肠腔仍保持通畅。该病例的淋巴瘤很可能是肾移植后的免疫抑制剂治疗引起（右髂窝可见异常位置的肾；**蓝绿色箭头**）。

/ Tumour: Neuroendocrine Tumour

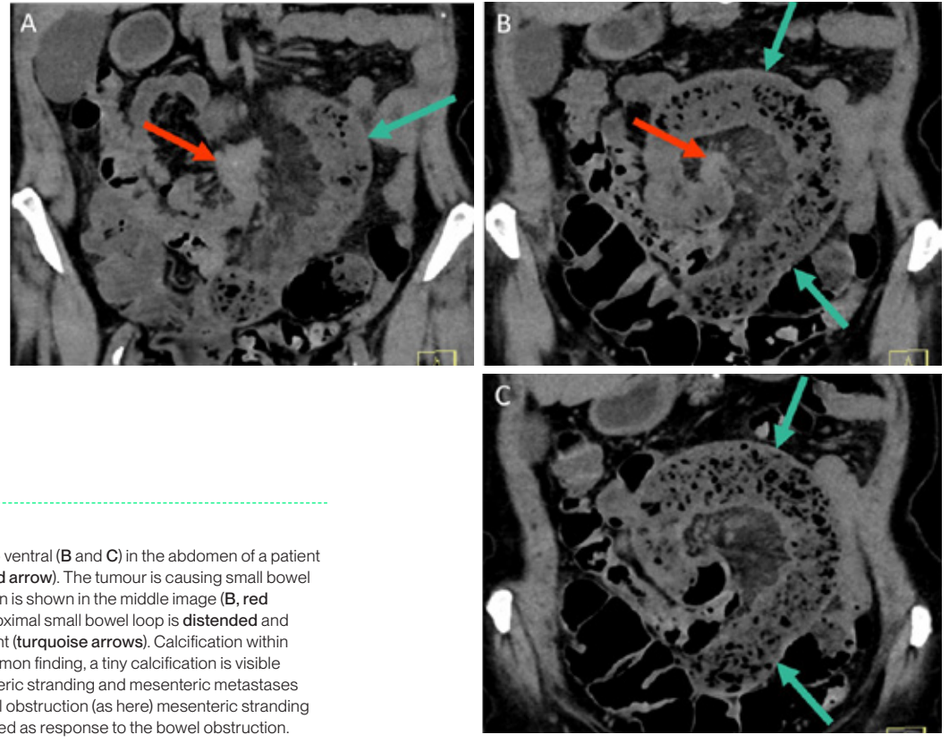


FIGURE 30

Coronal CT scan from dorsal (**A**) to ventral (**B** and **C**) in the abdomen of a patient with a neuroendocrine tumour (**red arrow**). The tumour is causing small bowel obstruction, the point of obstruction is shown in the middle image (**B**, **red arrow**). Due the obstruction the proximal small bowel loop is **distended** and a small bowel faeces sign is present (**turquoise arrows**). Calcification within a neuroendocrine tumour is a common finding, a tiny calcification is visible centrally in the tumour (**A**). Mesenteric stranding and mesenteric metastases can be seen, but in a case of bowel obstruction (as here) mesenteric stranding and small nodules ca also be caused as response to the bowel obstruction.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 肿瘤：神经内分泌肿瘤

图 30

神经内分泌肿瘤（**红色箭头**）患者的腹部冠状位 CT 图像（从背侧 (**A**) 到腹侧（**B** 和 **C**））。肿瘤导致小肠梗阻，梗阻点如图 B 所示（**B，红色箭头**）。梗阻点近端小肠扩张，可见小肠粪便征（**蓝绿色箭头**）。神经内分泌肿瘤内常见钙化，如图所示，在肿瘤中心可见到微小钙化 (**A**)。肠系膜可见条索状和结节状转移灶，但在肠梗阻的情况下（如此处），肠梗阻也可引起肠系膜条索影和小结节表现。

/ Main Imaging Indications by Pathology – **Inflammation/Infection**

- / Meckel's Diverticulum
- / Crohn's disease

/ Inflammation/ Infection: Meckel's Diverticulum

Meckel's diverticulum is a congenital remnant resulting from failed closure of the embryological connection between the umbilicus and the small bowel. It is visible as a bulge in the ileum of the small bowel at the anti-mesenterial site. It is a true diverticulum (i.e., has all bowel wall layers) and the most common congenital defect of the gastrointestinal tract (about 2-3% of the general population). The diverticulum can get inflamed (diverticulitis) which requires treatment; it can also bleed.

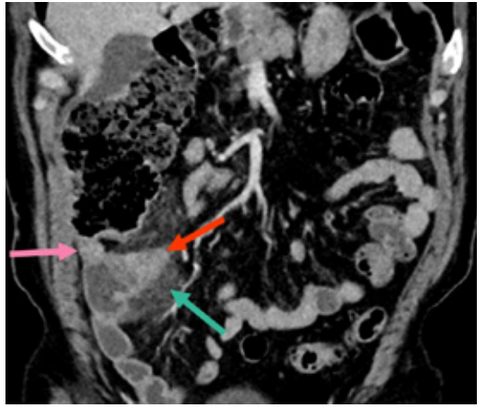


FIGURE 31

Coronal CT scan after intravenous contrast administration of a patient with an inflamed Meckel's diverticulum, seen as a bulge in the ileum (**red arrow**); the ileum continues at the **pink arrow**. Induration in the surrounding tissue is seen due to inflammation (**turquoise arrow**).

/ Small **Bowel**

CHAPTER OUTLINE:

/ 按病因分类的小肠影像学检查主要适应证 - **炎症/感染**

- / 梅克尔憩室
- / 克罗恩病

/ 炎症/感染：梅克尔憩室

梅克尔憩室是一种先天性残余结构，由胚胎时期脐与小肠之间的连接结构未闭合所致。可在回肠的系膜侧对侧见一凸起。这是一种真性憩室（即包含肠壁全层结构），是最常见的胃肠道先天性异常（约占一般人群的 2%～3%）。该憩室可能发炎（憩室炎），需进行治疗，此外也可能会发生出血。

/ 小**肠**

章节大纲：

图 31

梅克尔憩室炎患者的冠状位 CT增强图像，可以看到回肠有一凸起（**红色箭头**）；回肠在**粉色箭头**处延续。周围组织因炎症反应而密度增高（**蓝绿色箭头**）。

/ Inflammation/Infection: Crohn's Disease

Crohn's disease is a chronic inflammatory bowel disease. Patients are of all ages but often are diagnosed at an adolescent age. Most patients require several therapies throughout their lives, including medication and surgery, and they often need repeated imaging. The disease presents with inflammation of the bowel wall, which is typically seen as bowel wall thickening and increased vascularisation on imaging. Over time, complications such as fistulas (connections from one bowel loop to another bowel loop, to adjacent organs or the skin), abscesses and strictures of the bowel can occur.

Ultrasound, CT and MR enterography can be used for these type of patients, MRI is preferred over CT in young patients since repeated imaging is often required. In an acute setting often US and CT are performed over MRI as they are more easily accessible and available.

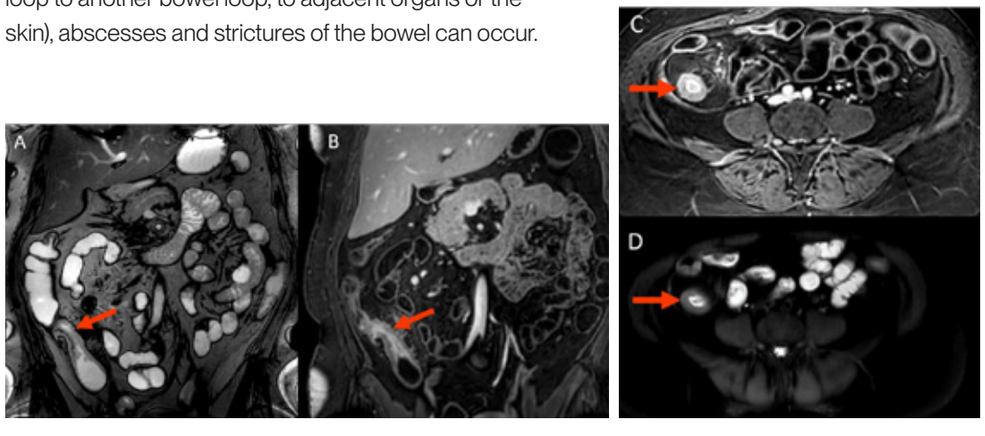


FIGURE 32

MR enterography of a patient with Crohn's disease. On the left, two different coronal sequences and on the right two different transverse sequences. The **red arrow** points at the terminal ileum with thickened bowel wall and stenosis, the area proximal to the thickened bowel wall is somewhat dilated (pre-stenotic dilation) because the downstream terminal ileum lumen is narrowed. B and C show increased enhancement after intravenous contrast administration due to increased vascularisation and D shows bowel wall oedema, caused by inflammation, on a T2-weighted sequence with fat suppression. There is a growing interest in differentiating between bowel wall inflammation and fibrosis (which develops over time), but at this time point imaging is not accurate in this differentiation yet.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 炎症/感染：克罗恩病

克罗恩病是一种慢性炎症性肠病。患者可在任何年龄发病，但常在青少年时期得到诊断。大多数患者一生中需要多种治疗，包括药物和手术，而且通常需要反复接受影像学检查。该病表现为肠壁炎症，影像学上通常表现为肠壁增厚和血管增多。随着时间的推移，可能会出现并发症，如肠瘘（肠管与肠管之间、肠管与邻近器官或皮肤之间形成的异常通道）、脓肿和肠道狭窄。

这类患者可采用超声、CT 和 MR小肠造影进行检查，由于通常需要反复进行影像学检查，因此MRI比 CT 更适合年轻患者。在紧急情况下，优先选择超声和 CT 而非 MRI 进行检查，因为超声和 CT 更方便、普及。

图 32

克罗恩病患者的 MR 小肠造影。左图是压脂 T2WI 及增强 T1WI 冠状位图像，右图是相应横轴位图像。**红色箭头**所指为病变的回肠末段，表现为肠壁增厚和肠腔狭窄，病变近端的肠管稍扩张（狭窄前扩张）。B 图和 C 图显示病变区域增强扫描强化增加，D 图（压脂 T2WI）显示由炎症引起的肠壁水肿。目前，区分肠壁炎症与肠壁纤维化（随时间进展）正成为临床关注的焦点，但目前的影像学检查手段尚不能实现二者的准确区分。

/ Inflammation/Infection: Crohn's Disease

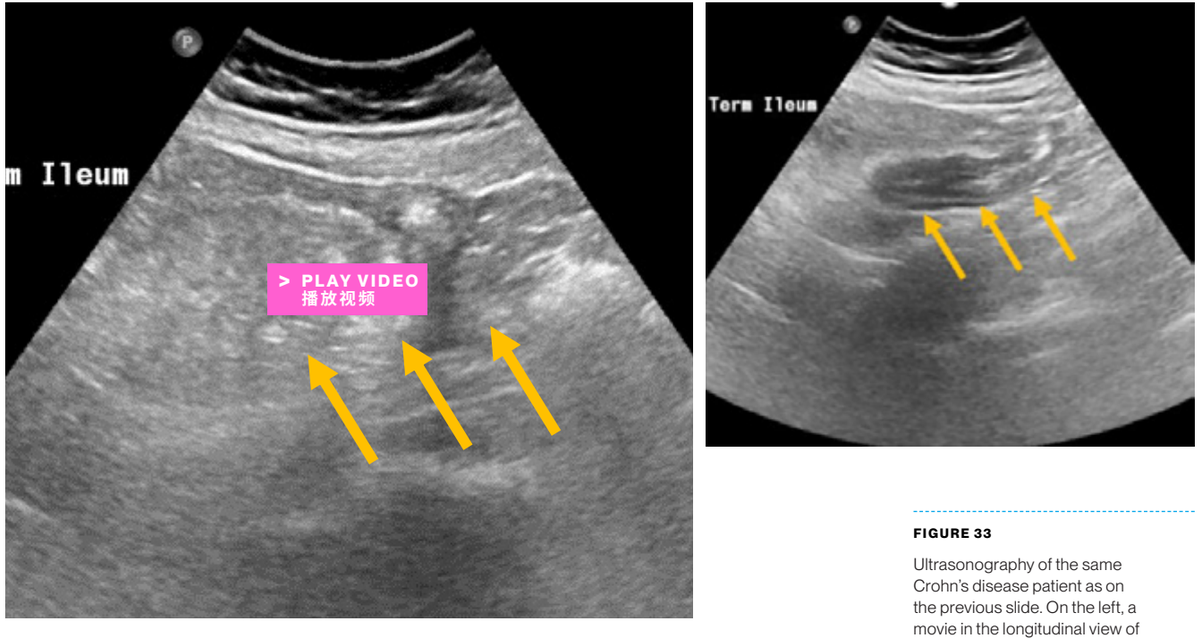


FIGURE 33

Ultrasonography of the same Crohn's disease patient as on the previous slide. On the left, a movie in the longitudinal view of the terminal ileum with a thickened wall at the ileocecal valve. On the right, a still frame of this movie with the terminal ileum pointed out.

/ Small Bowel

CHAPTER OUTLINE:

/ 炎症/感染：克罗恩病

/ 小肠

章节大纲：

图 33

与前一张幻灯片为同一克罗恩病患者，这是他的超声检查图像。左图为回肠末段纵切面图像，回盲瓣处肠壁增厚。右图为视频截图，所指结构为回肠末段。

/ Inflammation/Infection: Crohn's Disease

>|< COMPARE

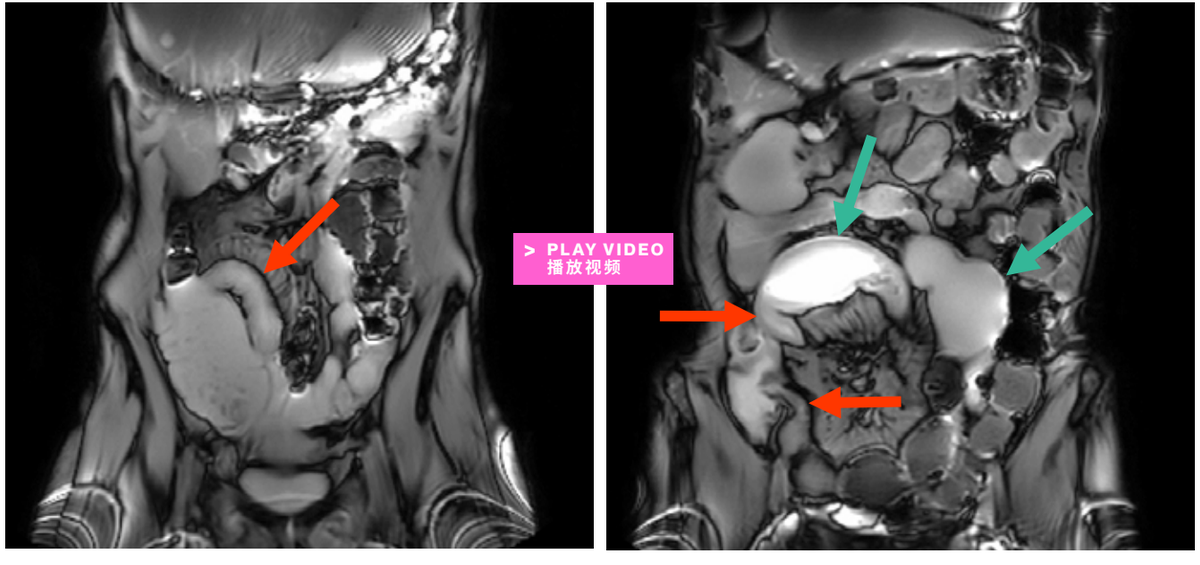


FIGURE 34 & 35

Movies of coronal cine-MRI scans of two patients with Crohn's disease. This sequence can be performed to obtain information about the functionality of the small bowel. In Crohn's disease, motility is decreased in the diseased segment (**red arrows**). In some patients, due to stenosis, the prestenotic segment is dilated and can have increased motility, shown in two separate bowel loops in the right image (**turquoise arrows**).

/ Small Bowel

CHAPTER OUTLINE:

/ 炎症/感染：克罗恩病

>|< 比较

/ 小肠

章节大纲：

图 34 和 35

2 名克罗恩病患者的冠状位动态磁共振电影序列。这一序列可用于获取小肠功能的相关信息。在克罗恩病中，病变肠段的蠕动减少（**红色箭头**）。在一些患者中，由于病变肠段狭窄，狭窄前段肠管扩张并且蠕动增加，如右图所示（**蓝绿色箭头**）。

/ Inflammation/Infection: Crohn's Disease

FIGURE 36

Coronal CT scan after oral and intravenous contrast administration of a patient with fistulas and an abscess due to Crohn's disease. Complications of Crohn's disease include fistulas and abscesses (**red arrows**). This patient required abscess drainage.

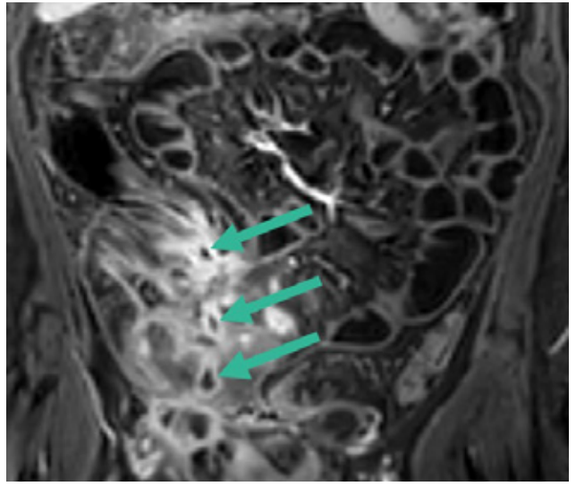


FIGURE 37

Coronal MRI scan after oral and intravenous contrast administration of the same patient. The patient required resection of the inflamed bowel segment and the fistula complex; the MRI scan was performed for surgical guidance. The **turquoise arrows** show different parts of the fistula tracts.

/ Small Bowel

CHAPTER OUTLINE:

/ 炎症/感染：克罗恩病

/ 小肠

章节大纲：

图 36

1 例合并肠瘘和脓肿的克罗恩病患者口服和静脉注射对比剂后的冠状位 CT 图像。克罗恩病的并发症包括肠瘘和脓肿（**红色箭头**）。该患者需要进行脓肿引流。

图 37

同一患者口服和静脉注射对比剂后的冠状位 MRI 扫描图像。该患者需要切除合并肠瘘的炎症肠段；通过 MRI 扫描结果引导手术。**蓝绿色箭头**显示了肠瘘的不同部分。

/ Inflammation/Infection: Crohn's Disease

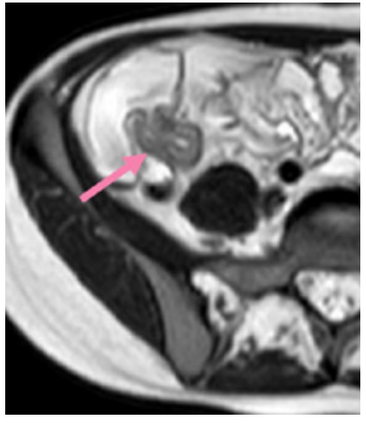


FIGURE 38

Transverse MRI scan of an inflamed terminal ileum (**pink arrow**) in a patient with Crohn's disease for which an ileocecal resection was performed.

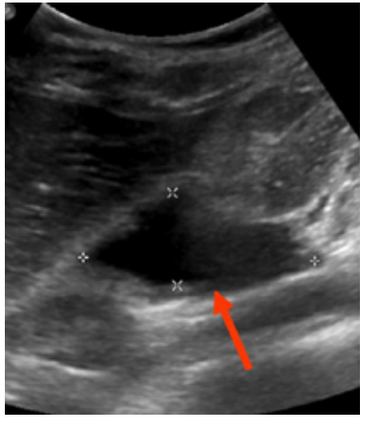


FIGURE 39

Ultrasound 10 days postoperatively at which a fluid collection is seen (**red arrow**), most likely due to an anastomotic leakage.

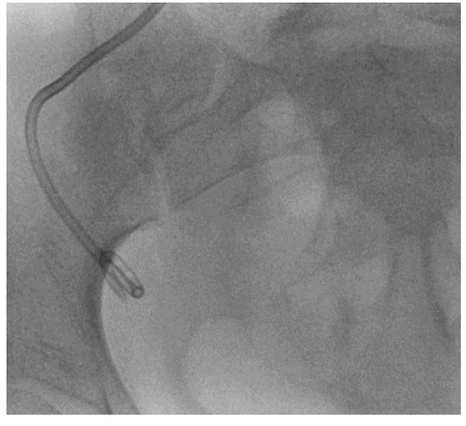


FIGURE 40

Using fluoroscopic guidance, a drain was inserted in the fluid collection in the pelvis after which the patient had a good recovery.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 炎症/感染：克罗恩病

图 38

这是一位克罗恩病患者的横轴位 MRI 图像，图像中回肠末段（**粉色箭头**）存在炎症；该患者已接受回盲部切除术。

图 39

术后 10 天行超声检查时发现积液（**红色箭头**），最有可能是由于吻合口瘘所致。

图 40

在透视引导下，将引流管置入积液中，之后患者恢复良好。

/ Main Imaging Indications by Pathology – **Ischaemia**

Ischaemia can be caused by an arterial obstruction due to thrombosis or an embolus resulting in a reduced or absent blood supply to the downstream small bowel. Also, a dissection can occur in the superior mesenteric artery (often as continuation of an aortic dissection) and results in a decreased or absent blood flow to the small bowel causing bowel ischaemia. Also, venous outflow obstruction can lead to bowel ischaemia.

Non-occlusive mesenteric ischaemia (NOMI) causes bowel ischaemia by a systemic hypoperfusion (e.g. shock due to sepsis or hypovolemia) which results in an inadequate blood supply to the bowel in the absence of an occlusion.

CT angiography can be performed in cases that have suspected abnormalities in vascularisation of the small bowel.

FIGURE 41

Coronal CT scan after intravenous contrast administration of a patient with bowel ischemia due to a dissection of the superior mesenteric artery. The **red arrow** points out the dissection at the point of transition from hyperintense (contrast medium) to hypointense (lack of contrast medium) in the vessel. A part of the small bowel enhances (**turquoise arrow**) where there is still patent vascularisation and a part of the small bowel shows no enhancement (**pink arrows**) which is a sign of ischemia.

/ Small **Bowel**

CHAPTER OUTLINE:

/ 小**肠**

章节大纲：

/ 按病因分类的小肠影像学检查主要适应证 - **缺血**

缺血可能是由于血栓栓塞引起的动脉阻塞，导致下游小肠的血供减少或中断。此外，肠系膜上动脉可发生夹层（通常是主动脉夹层的延续），并导致小肠血供减少或中断，从而引起肠缺血。此外，静脉回流受阻同样可导致肠缺血。

非闭塞性肠系膜缺血 (Non-Occlusive Mesenteric Ischemia, NOMI) 指全身性低灌注（例如脓毒症或血容量不足引起的休克）导致的肠缺血，虽然没有血管闭塞，仍会出现肠道供血不足。

对于怀疑存在小肠血供异常的病例，可进行 CT 血管成像检查。

图 41

肠系膜上动脉夹层导致肠缺血的患者增强后的冠状位 CT 扫描图像。**红色箭头**指向血管中从高密度（对比剂）向低密度（无对比剂）过渡处的夹层病变。部分小肠可见强化（**蓝绿色箭头**），提示该肠段仍有血供，另有部分小肠未见强化（**粉色箭头**），此为缺血的征象。

/ Ischaemia

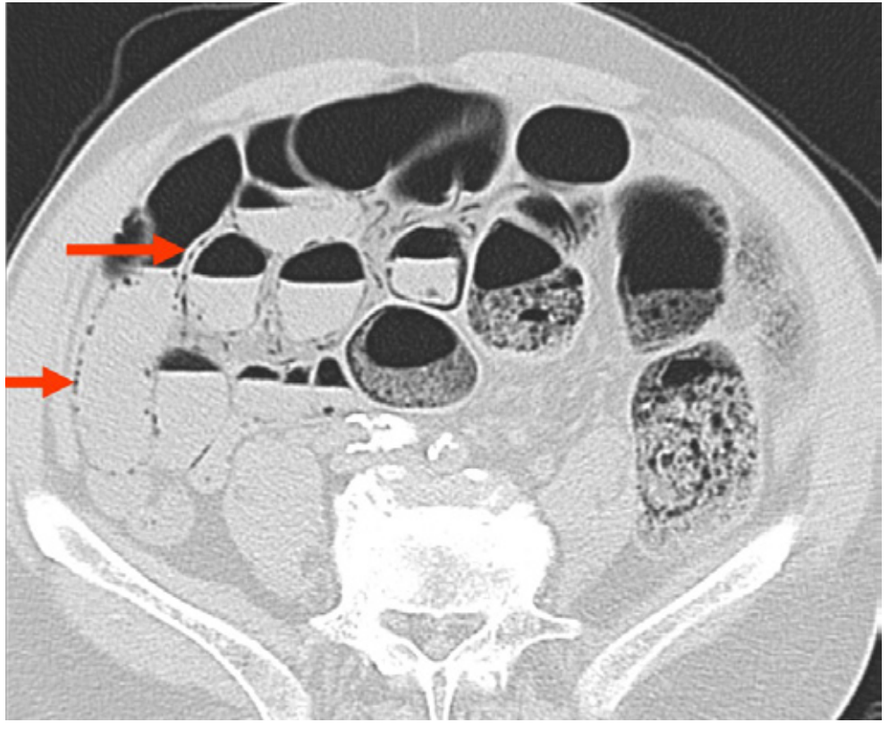


FIGURE 42

Transverse CT scan in lung window setting of a patient with bowel ischaemia. The bowel loops are distended and within the bowel wall there is gas present (pneumatosis intestinalis) which is seen as small hypodense spots (black spots) following the bowel wall (**red arrows**). Pneumatosis intestinalis can be caused by many conditions and is not a pathognomonic sign for bowel ischaemia.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 缺血

图 42

肠缺血患者的肺窗横轴位 CT 扫描图像。肠袢扩张，肠壁内可见气体密度影（即肠壁积气），表现为沿肠壁分布的小低密度灶（黑色斑点）（**红色箭头**）。肠壁积气可由多种疾病引起，并非肠缺血的特异性征象。

/ Take-Home Messages

- Plain abdominal radiographs has no role in visualising the small bowel.
- Ultrasonography is the first-line imaging technique of the small bowel in the paediatric population.
- CT is widely used for visualising the small bowel as it is a fast, readily available technique with a large field of view; the CT acquisition protocol is adapted to the clinical setting.
- Ionising radiation exposure is the main limitation of CT.
- MRI has inherent high contrast resolution, is versatile and lacks ionising radiation.
- For MRI availability/access are often limited and the examination takes more time than CT.
- Small bowel diseases are a common cause of acute abdominal pain and ultrasonography and CT play an important role in management of these diseases.
- The overview and better assessment of complications favours CT over ultrasonography in bowel obstruction; CT is crucial for the timely diagnosis of bowel ischaemia.
- MRI and ultrasonography are preferred for small bowel Crohn's disease, with MRI having the advantage of high inherent contrast resolution and a large field of view while ultrasonography is an easily assessable, interactive, high spatial resolution technique.

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 核心要点

- 腹平片无法用于显示小肠。
- 超声是儿科患者小肠检查的首选影像学方法。
- CT具备检查速度快、设备易获取、扫描范围广的优势，因此广泛用于小肠的显示；且 CT 的扫描方案可以根据临床具体情况进行调整。
- CT 的主要局限性是电离辐射暴露。
- MRI 具有高软组织分辨率，兼具多功能性，且无电离辐射。
- MRI 的可用性/可及性通常有限，且检查所需时间比 CT 更长。
- 小肠疾病是急性腹痛的常见病因，超声和 CT 在这类疾病的诊疗过程中发挥着重要作用。
- 在肠梗阻的诊断中，相较于超声检查，CT 在整体评估及精准判断并发症方面更具优势；此外，CT 对于肠缺血的及时诊断至关重要。
- 对于小肠克罗恩病，MRI和超声是首选的影像学检查。其中，MRI 具有高软组织分辨率和广视野的优势；而超声检查则是一种易实施、可互动且空间分辨率高的检查技术。

/ Take-Home Messages

- CT is most commonly used in patients with oncologic diseases of the small bowel; MRI (and in some cases ultrasonography) are alternatives.
- Imaging has a limited role in diagnosing intraluminal small bowel diseases (e.g., polyps); CT or MRI are mostly used, CT having higher spatial resolution and MRI lacking ionising radiation exposure (especially relevant when surveillance is needed, necessitating multiple examinations over time).

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 核心要点

- 对于患有小肠肿瘤性疾病的患者，CT 是最常用的检查方式；而 MRI 可作为替代选择（部分情况下还包括超声检查）。
- 影像学在小肠腔内疾病（如息肉）的诊断中作用有限，临床多采用 CT 或 MRI 检查，其中 CT 具有更高的空间分辨率，而 MRI 则无电离辐射暴露（这一点在需要进行随访监测时尤为重要，因为随访通常需要长期多次检查）。

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Test Your Knowledge

Small Bowel

CHAPTER OUTLINE:

小肠

章节大纲：

知识测试

Test Your Knowledge

<?> QUESTION

1 The CT protocol in small bowel obstruction includes

- ☐ Intravenous contrast medium
- ☐ Oral contrast medium
- ☐ Oral water
- ☐ Rectal contrast medium

Small Bowel

CHAPTER OUTLINE:

知识测试

小肠

章节大纲：

<?> 问题

1 小肠梗阻的 CT 扫描方案包括

- ☐ 静脉对比剂
- ☐ 口服对比剂
- ☐ 口服水
- ☐ 直肠对比剂

Test Your Knowledge

<?> ANSWER

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- ■ Intravenous contrast medium
- ☐ Oral contrast medium
- ☐ Oral water
- ☐ Rectal contrast medium

知识测试

<?> 回答

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- ☐ 口服水
- ☐ 直肠对比剂

Test Your Knowledge

<?> QUESTION

2 In intussusception

- ☐ A lead point can always be identified
- ☐ A lead point is almost always visible in children, but rarely in adults
- ☐ No rectal contrast medium is needed
- ☐ CT should be performed

Small Bowel

CHAPTER OUTLINE:

知识测试

小肠

章节大纲：

<?> 问题

2 肠套叠

- ☐ 始终能找到诱因
- ☐ 儿童几乎都能找到诱因，但成人罕见
- ☐ 无需直肠注入对比剂
- ☐ 应行 CT 检查

Test Your Knowledge

<?> ANSWER

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Small Bowel

CHAPTER OUTLINE:

知识测试

<?> 回答

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小肠

章节大纲：

Test Your Knowledge

<?> QUESTION

3 In closed loop obstruction

- ☐ The cause is mostly a large obstructive small bowel polyp
- ☐ The complete small bowel is dilated
- ☐ Ischaemia is a rare complication
- ☐ The bowel wall can be thickened or thinned

CHAPTER OUTLINE:

知识测试

章节大纲：

<?> 问题

3 闭袢型肠梗阻

- ☐ 病因多为较大的梗阻性小肠息肉
- ☐ 全组小肠扩张
- ☐ 缺血是一种罕见的并发症
- ☐ 肠壁可能增厚或变薄

/ Test Your Knowledge

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CHAPTER OUTLINE:

/ 知识测试

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章节大纲：

Test Your Knowledge

<?> QUESTION

4 Perforation of the small bowel

- ☐ Is mostly diagnosed by identifying contained or free intrabdominal gas
- ☐ Can often be diagnosed at supine plain radiography
- ☐ Can best be examined at CT as it outperforms ultrasonography for detecting small bowel perforation, the perforation site and possible complications
- ☐ Can be best examined by ultrasonography as it outperforms CT for detecting small bowel perforation, the perforation site and possible complications

Small Bowel

CHAPTER OUTLINE:

小肠

章节大纲：

知识测试

<?> 问题

4 小肠穿孔

- ☐ 主要通过识别局限性或游离的腹腔内气体来诊断
- ☐ 常可通过仰卧位 X 线平片诊断
- ☐ 最佳检查方式为 CT，因为其在检测是否小肠穿孔、穿孔部位和可能的并发症方面优于超声检查
- ☐ 最佳检查方式为超声检查，因其在检测是否小肠穿孔、穿孔部位及可能的并发症方面优于 CT

Test Your Knowledge

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Small Bowel

CHAPTER OUTLINE:

小肠

章节大纲：

知识测试

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/ Test Your Knowledge

<?> QUESTION

5 Small bowel polyps are

- ☐ A common cause of closed loop obstruction
- ☐ More common than colon polyps
- ☐ Possible incidental findings
- ☐ Often enhancing to a variable extent

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

<?> 问题

5 小肠息肉

- ☐ 是闭袢型肠梗阻的常见病因
- ☐ 比结肠息肉更常见
- ☐ 可能为偶然发现
- ☐ 通常表现为不同程度的强化

/ Test Your Knowledge

<?> ANSWER

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- ☐ A common cause of closed loop obstruction
- ☐ More common than colon polyps
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- ■ Often enhancing to a variable extent

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

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- ☐ 比结肠息肉更常见
- ■ 可能为偶然发现
- ■ 通常表现为不同程度的强化

/ Test Your Knowledge

<?> QUESTION

6 In small bowel tumours

- ☐ Small bowel adenocarcinoma, lymphoma and neuroendocrine tumours have certain differentiating features at CT
- ☐ Even when large, small bowel adenocarcinoma does not obstruct the bowel lumen
- ☐ Lymphoma are often more bulky than small bowel adenocarcinoma or neuroendocrine tumours
- ☐ Neuroendocrine tumours often have calcifications

/ 知识测试

<?> 问题

6 小肠肿瘤

- ☐ 小肠腺癌、淋巴瘤和神经内分泌肿瘤在 CT 上的特征有一定的鉴别诊断价值
- ☐ 即使体积较大，小肠腺癌也不会造成肠腔梗阻
- ☐ 淋巴瘤通常比小肠腺癌或神经内分泌肿瘤体积更大
- ☐ 神经内分泌肿瘤通常有钙化

/ Test Your Knowledge

<?> ANSWER

6 In small bowel tumours

- ■ Small bowel adenocarcinoma, lymphoma and neuroendocrine tumours have certain differentiating features at CT
- ☐ Even when large, small bowel adenocarcinoma does not obstruct the bowel lumen
- ■ Lymphoma are often more bulky than small bowel adenocarcinoma or neuroendocrine tumours
- ■ Neuroendocrine tumours often have calcifications

/ Small Bowel

CHAPTER OUTLINE:

/ 小肠

章节大纲：

/ 知识测试

<?> 回答

6 小肠肿瘤

- ■ 小肠腺癌、淋巴瘤和神经内分泌肿瘤在 CT 上的特征有一定的鉴别诊断价值
- ☐ 即使体积较大，小肠腺癌也不会造成肠腔梗阻
- ■ 淋巴瘤通常比小肠腺癌或神经内分泌肿瘤体积更大
- ■ 神经内分泌肿瘤通常有钙化

Test Your Knowledge

<?> QUESTION

7 In small bowel Crohn's disease

- ☐ Radiography is commonly used in acute situations
- ☐ The first presentation is with enteral fistulas
- ☐ Ultrasonography and CT are the preferred imaging techniques in daily practice
- ☐ Bowel wall enhancement at CT and MRI are common findings

Small Bowel

CHAPTER OUTLINE:

知识测试

小肠

章节大纲：

<?> 问题

7 小肠克罗恩病

- ☐ 急性期常采用 X 线平片检查
- ☐ 首发症状是肠瘘
- ☐ 超声和 CT 是日常实践中首选的成像方法
- ☐ 肠壁强化在 CT 和 MRI 检查中常见

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<?> QUESTION

8 In small bowel Crohn's disease

- ☐ Bowel wall thickening is a common finding
- ☐ Bowel wall oedema can be identified at CT
- ☐ Inflammation and fibrosis can be accurately differentiated at imaging
- ☐ Complications such as fistulas are often missed

Small Bowel

CHAPTER OUTLINE:

小肠

章节大纲：

知识测试

<?> 问题

8 小肠克罗恩病

- ☐ 肠壁增厚是常见表现
- ☐ 可通过 CT 识别肠壁水肿
- ☐ 影像学检查可准确区分炎症和纤维化
- ☐ 通常会漏诊肠瘘等并发症

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CHAPTER OUTLINE:

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章节大纲：

Test Your Knowledge

<?> QUESTION

9 A Meckel's diverticulum

- ☐ Originates from the embryological front gut.
- ☐ It is a false diverticulum
- ☐ Is visible at the mesenterial site of the ileum
- ☐ Can become inflamed or bleed

Small Bowel

CHAPTER OUTLINE:

知识测试

小肠

章节大纲：

<?> 问题

9 梅克尔憩室

- ☐ 起源于胚胎期的前肠
- ☐ 为假性憩室
- ☐ 可见于回肠的系膜侧
- ☐ 可能发生炎症或出血

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/ 小肠

章节大纲：

Test Your Knowledge

<?> QUESTION

10 In small bowel ischaemia

- ☐ Arterial or a venous occlusion can be present
- ☐ There can be no occlusive cause while ischaemia is present
- ☐ CT is the preferred imaging technique as radiation exposure is not important in these patients
- ☐ Pneumatosis intestinalis is a pathognomonic finding

CHAPTER OUTLINE:

章节大纲：

知识测试

<?> 问题

10 小肠缺血

- ☐ 可能出现动脉或静脉闭塞
- ☐ 可能出现无闭塞原因的缺血
- ☐ CT 是首选的影像学检查方法，因为辐射暴露对这些患者而言并不重要
- ☐ 肠壁积气是一种特异性征象

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