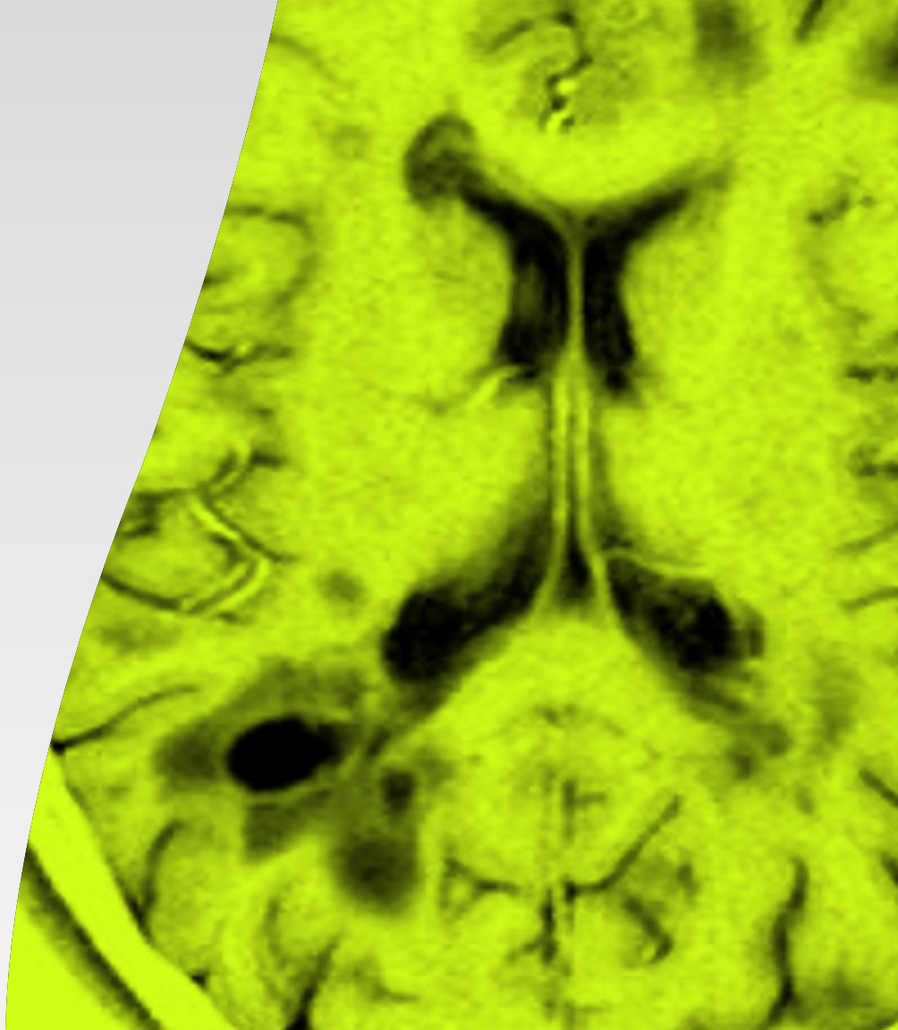
MODERN RADIOLOGY eBook

Central Nervous System

中枢神经系统

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
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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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Central Nervous System

CHAPTER OUTLINE:

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章节大纲：

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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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

<↑> HYPERLINKS

>▪< FURTHER KNOWLEDGE

>|< COMPARE

<∞> REFERENCES

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/ Central Nervous System

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/ 导示

<▪> 核心知识

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<↑> 超链接

>▪< 进阶知识

>|< 比较

<∞> 参考文献

<?> 问题

MODERN RADIOLOGY eBook

Based on the ESR Curriculum for Radiological Education

Central Nervous System

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中枢神经系统

章节大纲：

基于 **ESR** 课程的放射学教育

中枢神经系统

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- Anatomy
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  - Brain Stem
  - Cerebellum
  - Spine
  - Spinal Cord
- Strengths, Weaknesses and Role of Imaging Modalities
  - Ultrasound
  - Computed Tomography
  - Magnetic Resonance
  - Digital Subtraction Angiography
- Main Indications to Brain Imaging by Pathology
  - Congenital Lesions
  - Trauma
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- Take-Home Messages
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  - 脑干
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- 参考文献
- 知识测试

Anatomy

Central Nervous System

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章节大纲：

解剖结构

/ Anatomy

The **central nervous system (CNS)** consists of the brain and spinal cord. It is surrounded and protected by the skull, vertebrae and the three meningeal layers.

The brain can be divided into the cerebrum, brainstem and cerebellum.

The **cerebrum** is composed of the right and left hemispheres, with four lobes each: frontal, parietal, temporal and occipital. Its functions include: vision, hearing, speech, reasoning, emotions, learning and fine control of movement. Both lobes are connected by the connecting fibbers (corpus callosum, anterior commissure, inter-thalamic commissure, posterior commissure).

The brainstem **includes** the **midbrain**, the **pons** and the **medulla**. It connects the cerebrum and cerebellum to the spinal cord. It is responsible of different functions such as breathing, heart rate, body temperature, wake and sleep cycles, digestion, sneezing, coughing, vomiting and swallowing.

The **cerebellum** is located under the cerebrum. Its function is to coordinate muscle movements, posture and balance.

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/ 解剖结构

章节大纲：

中枢神经系统 (CNS) 由脑和脊髓组成。该结构由颅骨、椎骨及三层脑膜所包绕和保护。

脑可分为大脑、脑干和小脑。

大脑由左右两个半球组成，每个半球有四个脑叶：额叶、顶叶、颞叶和枕叶。其功能包括：视觉、听觉、言语、推理、情感、学习和精细动作控制。两侧大脑半球之间通过连合纤维（胼胝体、前连合、丘脑间连合、后连合）相连。

脑干**包括中脑、脑桥**和**延髓**。它连接大脑和小脑与脊髓。负责调节呼吸、心率、体温、觉醒和睡眠周期、消化、打喷嚏、咳嗽、呕吐和吞咽等功能。

小脑位于大脑下方。其功能是协调肌肉运动、维持姿势和平衡。

/ Cerebral Hemispheres

The cerebral hemispheres are divided into **six lobes**: frontal, parietal, temporal, occipital, insular and limbic (figure 1).

The frontal lobe is the largest and it is situated anteriorly and superiorly.

The temporal lobe lies below anteriorly and inferiorly.

The parietal lobe is posterior to the frontal lobe and superior to the occipital lobe.

The occipital lobe is the most posteriorly located inferior to the parietal lobe and posterior to the temporal lobe.

The insula lies deep to the Sylvian fissure, covered by the frontal, temporal and parietal opercula.

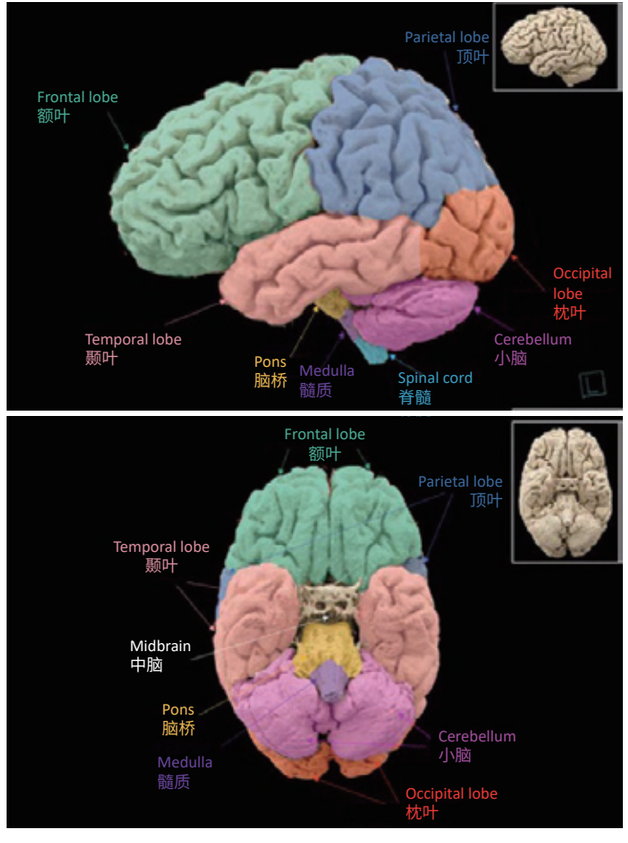

FIGURE 1

Annotated human brain surface rendering reconstruction from a 3- dimensional (3D) Magnetic Resonance Imaging (MRI) acquisition. Lateral view (A) and view from below (B). Courtesy Minerva Becker, MD and Jorge Remuinan, Geneva University Hospitals.

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章节大纲：

/ 大脑半球

大脑半球分为**六个脑叶**：额叶、顶叶、颞叶、枕叶、岛叶和边缘叶（图 1）。

额叶最大，位于前上方。

颞叶位于前下方。

顶叶位于额叶后方、枕叶上方。

枕叶位于最后方，在顶叶下方、颞叶后方。

岛叶位于外侧裂深处，被额叶、颞叶和顶叶所覆盖。

边缘系统包含海马体和扣带回。

图 1

本图展示基于三维 (3D) 磁共振成像 (MRI) 数据重建的人脑表面渲染图。侧视图 (A) 和仰视图 (B)。由日内瓦大学医院 Minerva Becker 医学博士和 Jorge Remuinan 提供。

/ Cerebral Fissures

The surface of the cerebral hemispheres of the brain has numerous sulci between the gyri and fissures separating the cerebral lobes (figure 2).

The **three main fissures** are the following:

The Rolandic fissure (central sulcus) separates the frontal and parietal lobes.

The Sylvian fissure (Sylvian sulcus) separates the frontal lobe from the temporal lobe.

The Parieto-occipital fissure (parieto-occipital sulcus) separates the parietal lobe from the occipital lobe.

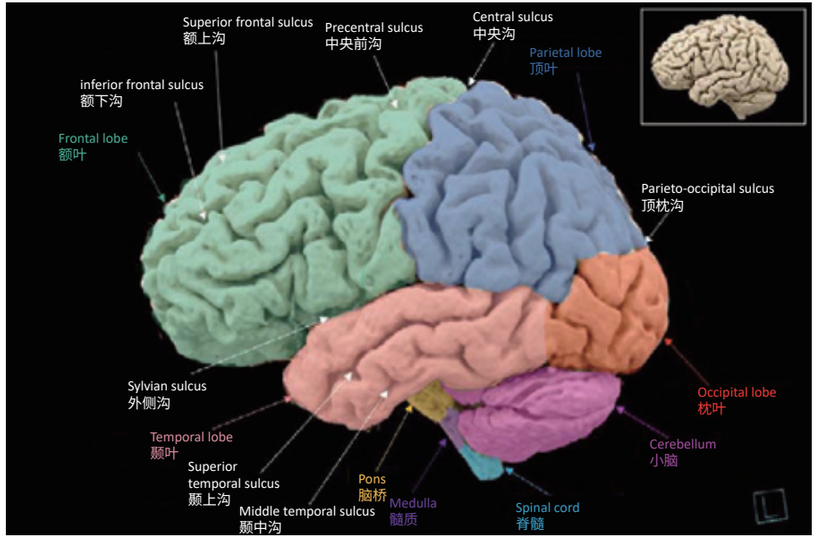

FIGURE 2

Annotated human brain surface rendering reconstruction from a 3D MRI acquisition. Lateral view. Courtesy Minerva Becker, MD and Jorge Remuinan, Geneva University Hospitals.

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/ 大脑裂

大脑半球表面脑回之间有很多脑沟和裂，这些沟裂将大脑各叶分隔开来（图 2）。

三条主要的裂包括：

Rolandic 裂（中央沟）分隔额叶与顶叶。

Sylvian 裂（外侧裂）分隔额叶与颞叶。

Parieto-occipital 裂（顶枕沟）分隔顶叶和枕叶。

章节大纲：

图 2

本图展示基于 3D MRI 重建的人脑表面渲染图。侧视图。由日内瓦大学医院 Minerva Becker 医学博士和 Jorge Remuinan 提供。

/ Rolandic Fissure (Central Sulcus)

The **central sulcus** (figure 3) is one of the most important landmarks in the convexity of the brain. It separates motor from sensory areas, and frontal from parietal lobes.

The **precentral gyrus** is located anterior to the central sulcus and contains the primary motor cortex. The central sulcus resembles an inverted Greek letter Omega. The knob of the omega corresponds to the hand motor cortex.

The **postcentral gyrus** is located posteriorly and contains the primary somatosensory cortex.

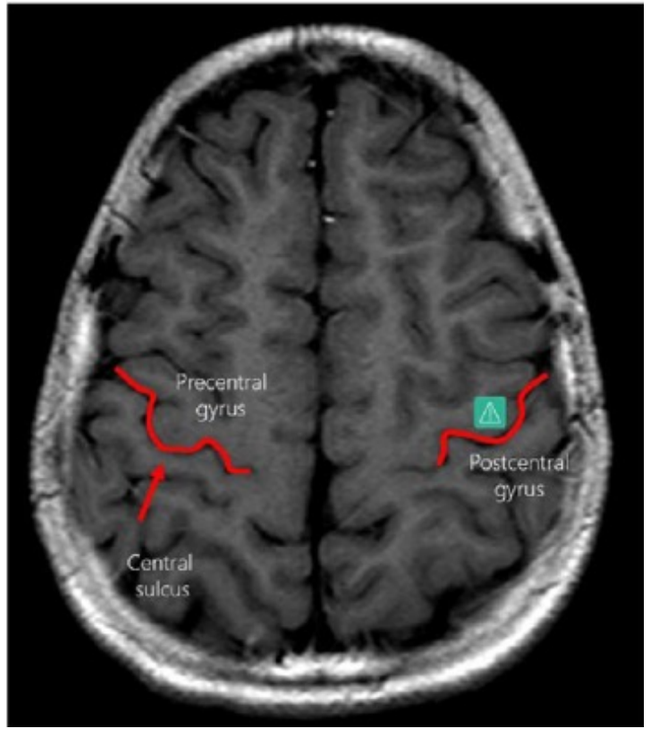

FIGURE 3

Axial T1-weighted MRI image showing the normal anatomy of the central sulcus, pre- and postcentral gyri .

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章节大纲：

/ Rolandic 裂（中央沟）

中央沟（图 3）是大脑凸面最重要的解剖标志之一。它将运动区与感觉区分开，并将额叶与顶叶分开。

中央前回位于中央沟前方，包含初级运动皮层。中央沟形似倒置的希腊字母“Ω”。“Ω”的隆起部分对应手部运动皮层。

中央后回位于后方，包含初级躯体感觉皮层。

图 3

轴位 T1 加权 MRI 图像显示中央沟、中央前回和中央后回的正常解剖结构。

/ The superior frontal sulcus intersects the precentral sulcus forming an upper case L sign (figure 4).

/ On the sagittal view the central sulcus is located immediately anterior to the marginal sulcus that is the continuation of the cingulate sulcus (figure 4).

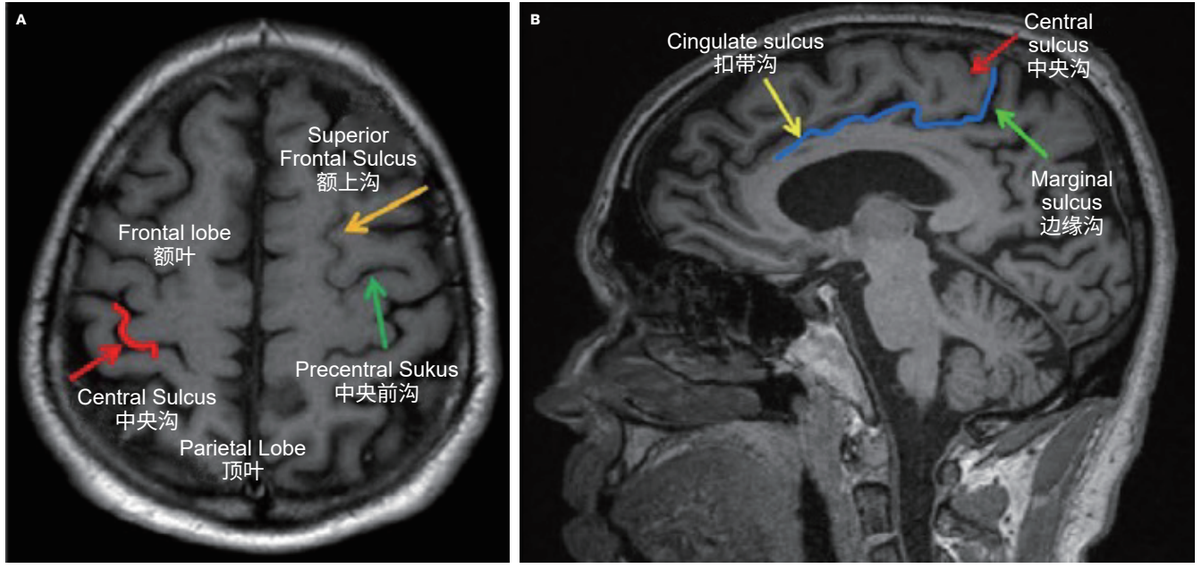

FIGURE 4

Axial (A) and sagittal (B) T1-weighted MRI image showing the normal anatomy of the sulci mentioned in the text.

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/ 额上沟与中央前沟相交，形成大写 L 形征（图 4）。

/ 在矢状位上，中央沟紧邻边缘沟前方，边缘沟是扣带沟的延续（图 4）。

图 4

轴位 (A) 和矢状位 (B) T1 加权 MRI 图像显示文中所述脑沟的正常解剖结构。

/ Sylvian Fissure

The Sylvian fissure separates the inferior frontal gyrus from the superior temporal gyrus (figure 5).

The inferior frontal gyrus (figure 5) contains three parts: pars orbitalis, pars triangularis and pars opercularis.

The motor speech area (Broca) is mainly located within pars opercularis.

Wernicke's area is a poorly defined sensory speech area. Its location may include parts of the supramarginal gyrus, angular gyrus and the posterior aspects of superior and middle temporal gyrus.

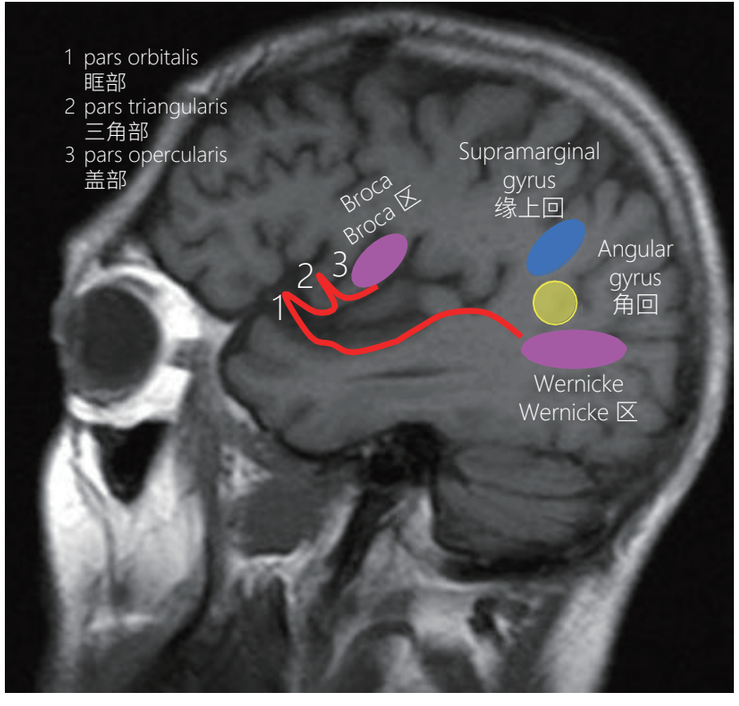

FIGURE 5

Parasagittal T1-weighted MRI image showing the Sylvian fissure and adjacent anatomic areas mentioned in the text.

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/ 外侧裂

外侧裂将额下回与颞上回分开（图 5）。

额下回（图 5）包括三个部分：眶部、三角部和盖部。

运动性语言区（Broca 区）主要位于盖部内。

Wernicke 区是一个界限不清的感觉性语言区。其位置可能包括缘上回、角回的部分区域以及颞上回和颞中回的后部。

图 5

旁矢状位 T1 加权 MRI 图像显示外侧裂和文中所述的邻近解剖区域。

/ Parieto-occipital Fissure

The Parieto-occipital fissure (figure 6) separates the parietal lobe from the occipital lobe.

The Calcarine fissure (figure 6) located on the medial surface of the occipital lobe separates the visual cortex into two.

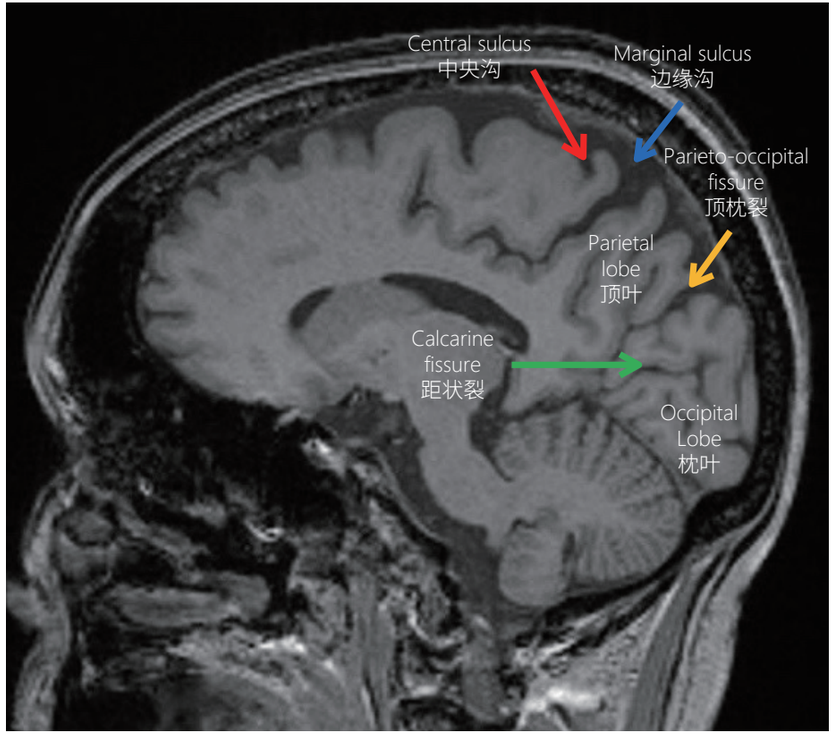

FIGURE 6

Parasagittal T1-weighted MRI image showing the parieto-occipital and calcarine fissure.

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/ 顶枕裂

顶枕裂（图 6）将顶叶和枕叶分开。

距状裂（图 6）位于枕叶内侧面，将视觉皮层分为两部分。

图 6

旁矢状位 T1 加权 MRI 图像显示顶枕裂和距状裂。

/ Insula

The insula (figure 7) is located in depth to the Sylvian fissure. It has two lobules: anterior and posterior (1).

The anterior insular lobule presents a triangular shape and is divided into anterior (a), middle (m) and posterior (p) insular gyri.

The posterior insular lobule is smaller with a rectangular shape, with two gyri anterior and posterior.

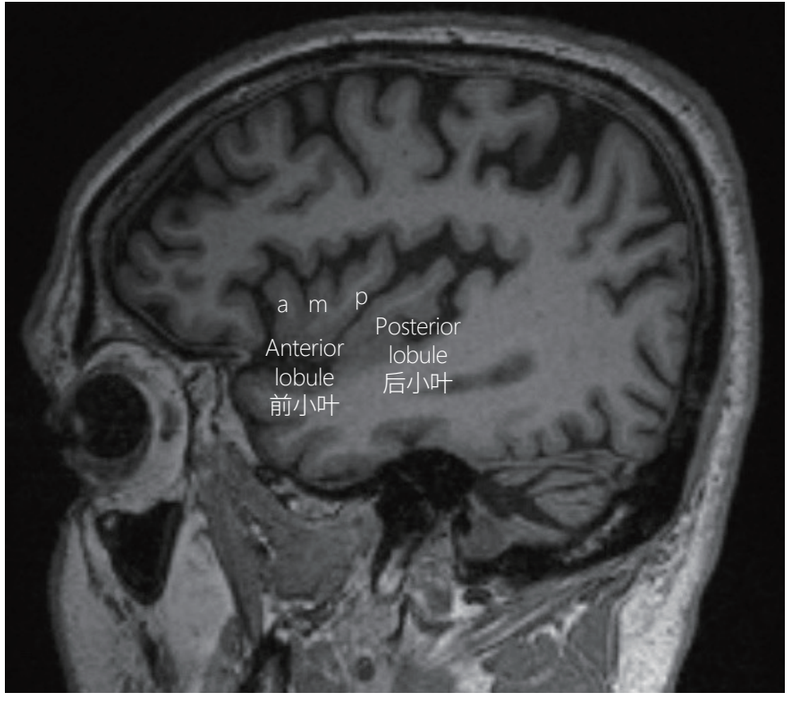

FIGURE 7

Parasagittal T1-weighted MRI image showing the anatomy of the insula.

<∞> REFERENCE

Naidich T.P., Kang E., Fatterpekar G.M., Delman B.N., Gultekin S.H., Wolfe D., Ortiz O., Yousry I., Weismann M., Yousry T.A. The insula: anatomic study and MR imaging display at 1.5 T. AJNR 2004; 25:222-32

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/ 岛叶

岛叶（图 7）位于外侧裂深部。它有两个小叶：前部和后部 (1)。

岛叶前部呈三角形，分为前 (a) 岛回、中 (m) 岛回和后 (p) 岛回。

岛叶后部较小，呈矩形，有前、后两个脑回。

<∞> 参考文献

Naidich T.P., Kang E., Fatterpekar G.M., Delman B.N., Gultekin S.H., Wolfe D., Ortiz O., Yousry I., Weismann M., Yousry T.A. The insula: anatomic study and MR imaging display at 1.5 T. AJNR 2004; 25:222-32

图 7

旁矢状位 T1 加权 MRI 图像显示岛叶的解剖结构。

/ Limbic Lobe

The limbic lobe (figure 8) is located in the medial surface of the cerebral hemispheres.

It includes the cingulate and parahippocampal gyri, the hippocampus, amygdala and the uncus.

The hippocampus is a bilaminar grey matter structure, occupying the medial surface on the floor of the temporal horn of the lateral ventricle. It consists of the dentate gyrus and Ammon's horn, together with the subiculum. Ammon's horn contains large pyramidal neurons arranged in three zones called CA1, CA2 and CA3 (2).

The fornix is also part of the limbic system. Formed by the efferent fibres of the hippocampus, it terminates in the mamillary body of the hypothalamus in the floor of the third ventricle.

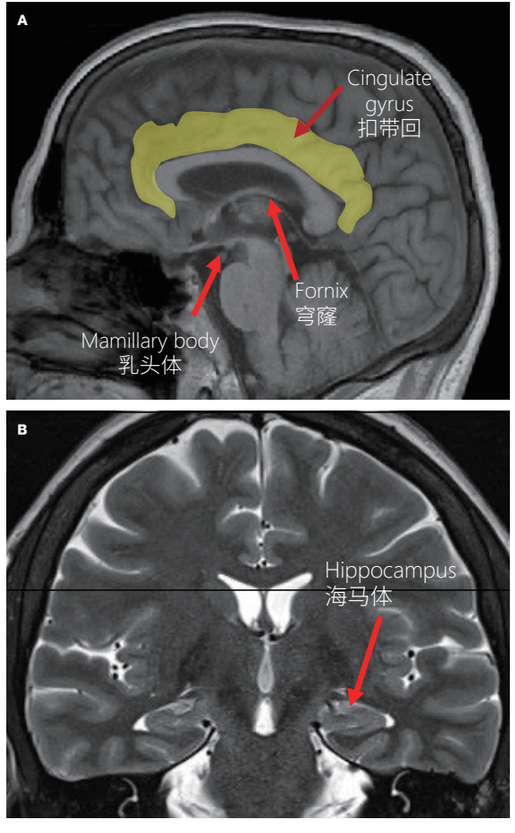


FIGURE 8

Midsagittal T1-weighted (A) and coronal T2-weighted (B) MR images showing the anatomy of the limbic lobe

CHAPTER OUTLINE:

章节大纲：

/ 边缘叶

边缘叶（图 8）位于大脑半球内侧面。

它包括扣带回、海马旁回、海马体、杏仁核和钩回。

海马体是一个双层灰质结构，位于侧脑室颞角底部的内侧面。它由齿状回、阿蒙氏角以及下托组成。阿蒙氏角包含排列在三个区域（称为 CA1、CA2 和 CA3 区）的大型锥体神经元 (2)。

穹窿也是边缘系统的一部分。其由海马体的传出纤维形成，止于第三脑室底部的下丘脑乳头体。

图 8

正中矢状位 T1 加权 (A) 和冠状位 T2 加权 (B) MR 图像显示边缘叶的解剖结构

/ Deep Grey Matter Nuclei

The main deep grey matter nuclei (figure 9) are the caudate (c), putamen (p), globus pallidus (gp) and the thalami (th).

The term basal ganglia refers to the caudate nucleus, lentiform nucleus (globus pallidus and putamen), subthalamic nuclei, and the substantia nigra (sn).

The red nucleus (rn) is one of the brainstem nuclei.

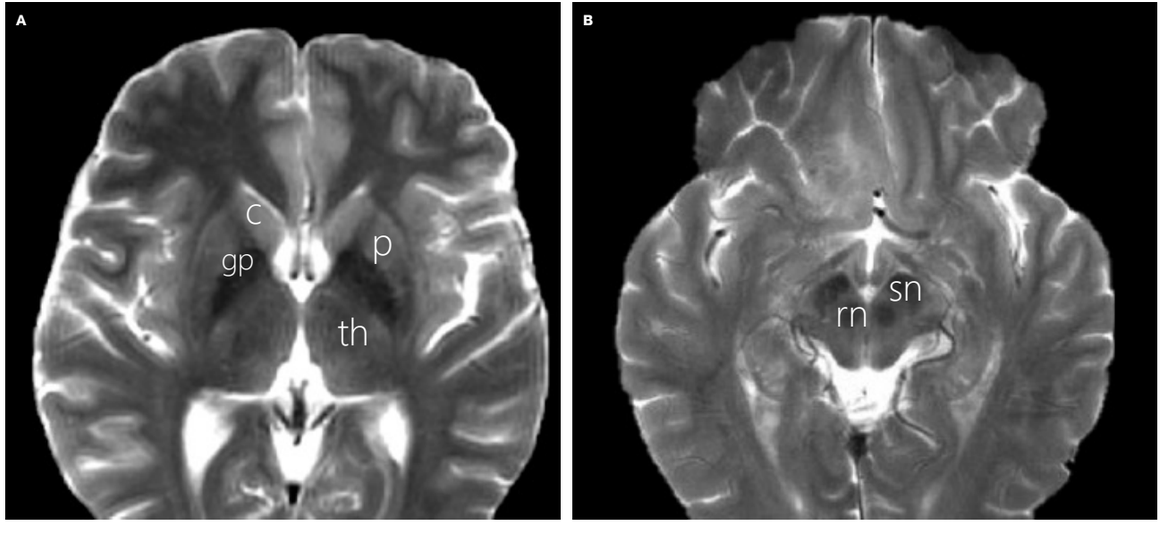


FIGURE 9

Deep grey matter nuclei as seen on T2-weighted axial MR images.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 深部灰质核团

主要的深部灰质核团（图 9）包括尾状核 (c)、壳核 (p)、苍白球 (gp) 和丘脑 (th)。

基底节是指尾状核、豆状核（苍白球和壳核）、底丘脑核和黑质 (sn)。

红核 (rn) 是脑干核团之一。

图 9

轴位 T2 加权 MR 图像显示的深部灰质核团。

/ White Matter

The white matter is formed by the axons surrounded by myelin sheaths. There are three groups of white matter sheaths: the commissural, projections and association fibbers (figure 10) .

The commissural fibres (red) cross the midline to link the two cerebral hemispheres. The three main commissures are the corpus callosum, the anterior commissure (ac), and the posterior commissure (pc). The corpus callosum is the largest of the white matter bundles, which is divided into different regions: rostrum (r), genu (g), body (b), isthmus and splenium (s).

The projection fibres (blue) connect the cortex with the brain stem, cerebellum, and spinal cord. The internal capsule with the anterior (al) and posterior limb (pl) is the major projection fibre bundle.

The association fibres (green) connect different regions of the same hemisphere. There are three groups: long association tracts, intralobar association tracts and U-shaped association tracts.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 白质

白质由髓鞘包裹的轴突构成。白质纤维束可分为三类：连合纤维、投射纤维和联络纤维（图 10）。

连合纤维（红色）跨越中线连接两侧大脑半球。三个主要的连合是胼胝体、前连合 (ac) 和后连合 (pc)。胼胝体是最大的白质纤维束，可分为不同区域：嘴部 (r)、膝部 (g)、体部 (b)、峡部和压部 (s)。

投射纤维（蓝色）连接大脑皮层与脑干、小脑和脊髓。包含前肢 (al) 和后肢 (pl) 的内囊是主要的投射纤维束。

联络纤维（绿色）连接同侧大脑半球的不同区域。包括长联络束、叶内联络束和 U 状联络束。

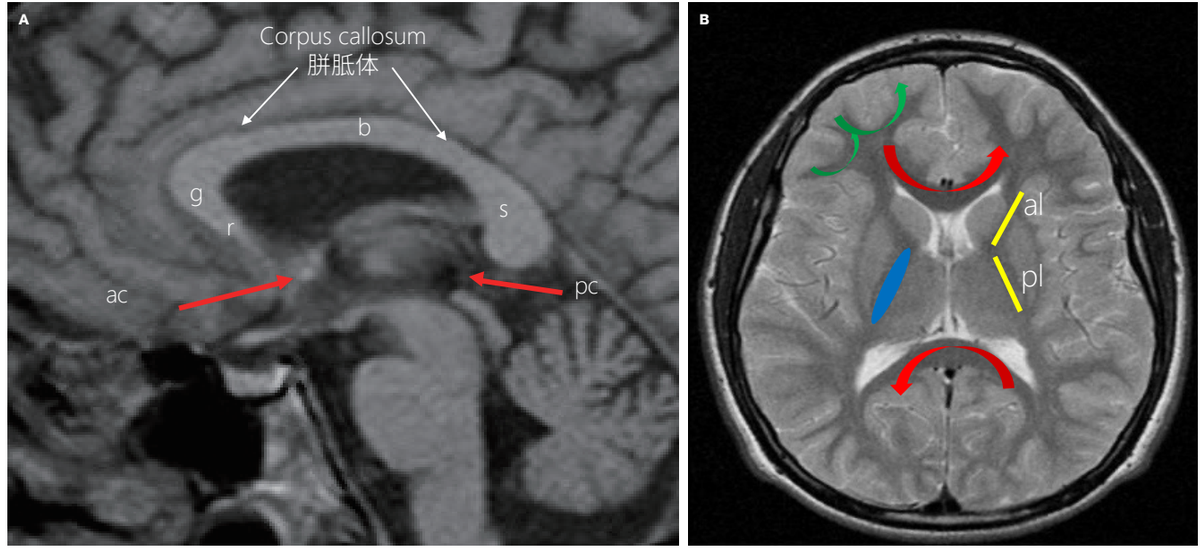


FIGURE 10

White matter commissural, projection and association fibres as seen on sagittal T1-weighted (A) and axial T2-weighted (B) images.

Central Nervous System

CHAPTER OUTLINE:

中枢神经系统

章节大纲：

图 10

矢状位 T1 加权 (A) 与轴位 T2 加权 (B) 图像显示的白质连合纤维、投射纤维及联络纤维。

/ Brain Stem

The brainstem connects the cerebrum to the cerebellum and the spinal cord (figure 11). There are three distinctive regions: the mesencephalon (ms), pons (p) and medulla (md).

The nuclei included in the brainstem are the cranial nerve nuclei, red nucleus and substantia nigra.

Cranial nerve nuclei:

Midbrain: Oculomotor nerve (CN III), trochlear nerve (CN IV)

Pons: Trigeminal nerve (CN V), abducens (CN VI), facial nerve (CN VII), vestibulocochlear nerve (CN VIII)

Medulla: Glossopharyngeal nerve (CN IX), vagus nerve (CN X), accessory nerve (CN XI), hypoglossal nerve (CN XII)

FIGURE 11

Basic brain stem anatomy on a sagittal T1-weighted MR image.

CHAPTER OUTLINE:

章节大纲：

/ 脑干

脑干将大脑与小脑和脊髓相连（图 11）。包含三个部分：中脑 (ms)、脑桥 (p) 和延髓 (md)。

脑干中包含的核团是颅神经核、红核和黑质。

颅神经核：

中脑：动眼神经 (CN III)、滑车神经 (CN IV)

脑桥：三叉神经 (CN V)、外展神经 (CN VI)、面神经 (CN VII)、前庭蜗神经 (CN VIII)

髓质：舌咽神经 (CN IX)、迷走神经 (CN X)、副神经 (CN XI)、舌下神经 (CN XII)

图 11

矢状位 T1 加权 MR 图像显示的脑干基本解剖结构。

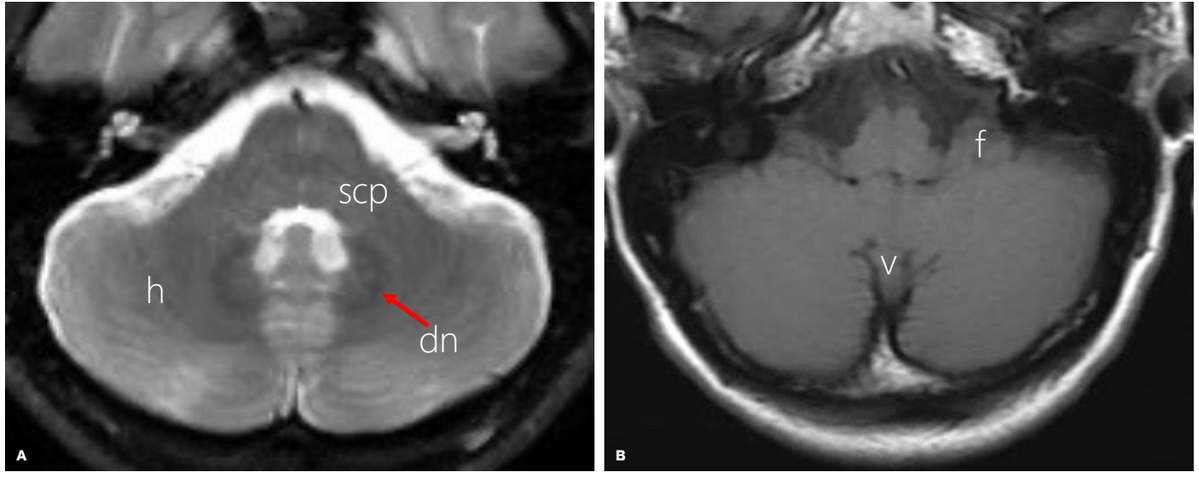
/ Cerebellum

The cerebellum (figure 12) has two hemispheres (h) and a midline vermis (v). Each hemisphere is divided into three lobes (anterior, posterior and flocculonodular (f)). There are four groups of cerebellar nuclei; fastigial, globose, emboliform and dentate nuclei (dn), the dentate nuclei being the largest cerebellar nuclei.

The cerebellum is attached to the brainstem through the peduncles, the superior (scp), middle and inferior cerebellar peduncles.

FIGURE 12

Anatomy of the cerebellum as seen on axial T2-weighted (A) and I T1-weighted (B) images.



CHAPTER OUTLINE:

/ 小脑

章节大纲：

小脑（图 12）由两个半球 (h) 和位于中线的小脑蚓 (v) 组成。每个小脑半球分为三个叶（前叶、后叶和绒球小结叶 (f)）。小脑核团分为四组：顶核、球状核、栓状核和齿状核 (dn)，其中齿状核是小脑最大的核团。

小脑通过小脑脚与脑干相连，包括上小脑脚 (scp)、中小脑脚和下小脑脚。

图 12

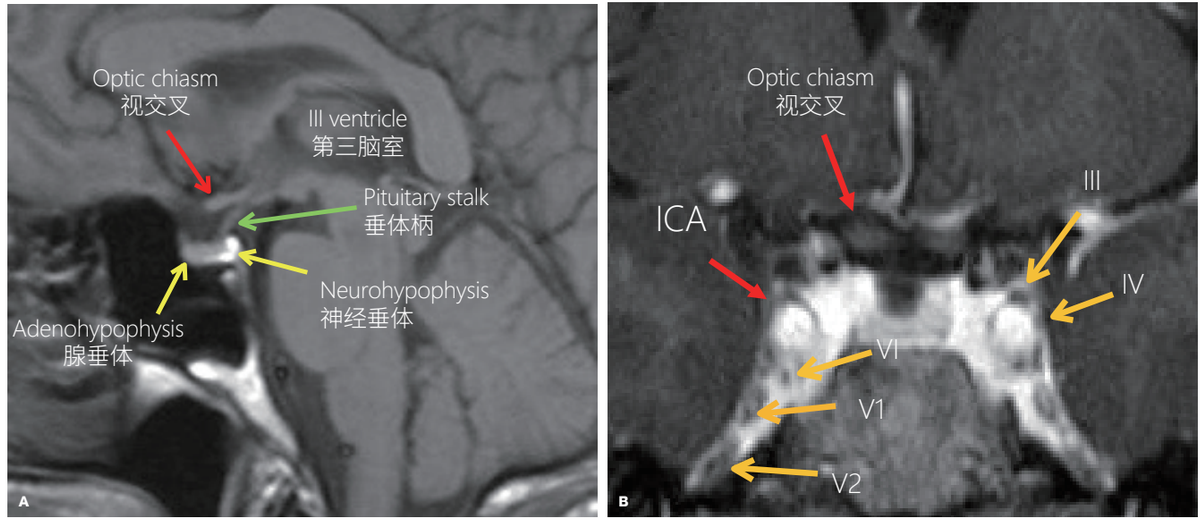
轴位 T2 加权像 (A) 和矢状位 T1 加权像 (B) 显示的小脑解剖结构。

/ Pituitary Gland

The pituitary gland lies in the sella turcica (figure 13), below the hypothalamus and optic chiasm; it is divided into anterior (adenohypophysis) and posterior (neurohypophysis) lobes. The pituitary stalk connects the pituitary gland to the brain. The cavernous sinuses are located laterally to the pituitary gland, they contain the cranial nerves III, IV, V1, V2,VI and the cavernous segment of the internal carotid artery (ICA).

FIGURE 13

Anatomy of the pituitary fossa and cavernous sinuses as seen on sagittal T1- weighted (A) and contrast-enhanced coronal T1-weighted (B) images.



/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 垂体

垂体位于蝶鞍内（图 13），下丘脑和视交叉下方，分为前叶（腺垂体）和后叶（神经垂体）。垂体柄连接垂体与大脑。海绵窦位于垂体外侧，内含脑神经 III、IV、V1、V2、VI 以及颈内动脉 (ICA) 的海绵窦段。

图 13

在矢状位 T1 加权像 (A) 和增强冠状位 T1 加权像 (B) 上观察垂体窝及海绵窦的解剖。

/ Meningeal Layers

Three layers of membranous coverings envelop the central nervous system, from inside out, the pia, arachnoid and dura mater (figure 14).

The pia covers the gyrus and sulcus of the brain surface.

External to the pia lies the arachnoid layer, between the pia and the arachnoid lies the subarachnoid space filled with cerebrospinal fluid (CSF).

The dura is a thick fibrous membrane tightly bound to the inner table of the skull.

Two potential spaces can be differentiated: the subdural space between the arachnoid and the dura and the epidural or extradural space.

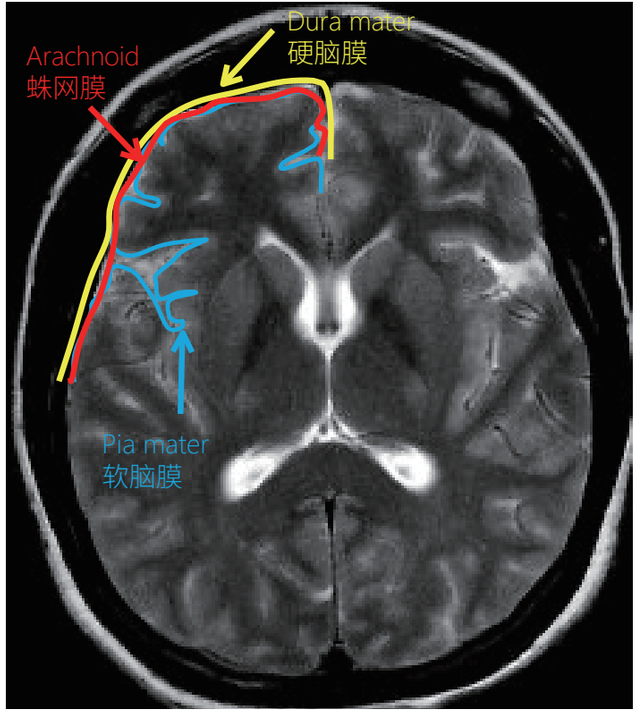


FIGURE 14

Schematic illustration of the meningeal layers

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 中枢 **神经系统**

章节大纲：

/ 脑膜层

中枢神经系统由三层膜性结构包裹，由内向外依次为软脑膜、蛛网膜和硬脑膜（图 14）。

软脑膜覆盖于脑表面的脑回和脑沟。

蛛网膜层位于软脑膜外侧，两者之间的蛛网膜下腔充满脑脊液 (CSF)。

硬脑膜是一层厚纤维膜，紧密附着于颅骨内板。

可区分两个潜在腔隙：蛛网膜和硬脑膜之间的硬膜下腔，以及硬膜外或硬膜外腔。

图 14

脑膜层示意图

/ Ventricles

The lateral ventricles (figures 15 and 16) are paired C-shaped structures comprising a body and atrium (at) along with 3 projections into the frontal (fh), temporal and occipital lobes termed “horns”. The lateral ventricles communicate with the third ventricle through the interventricular foramina of Monro.

The third ventricle communicates with the fourth ventricle through the aqueduct, from here the cerebrospinal fluid (CSF) passes through the Mangendie and Lushka foramina to the foramen magnum (fm), and from here to the cerebral surface.

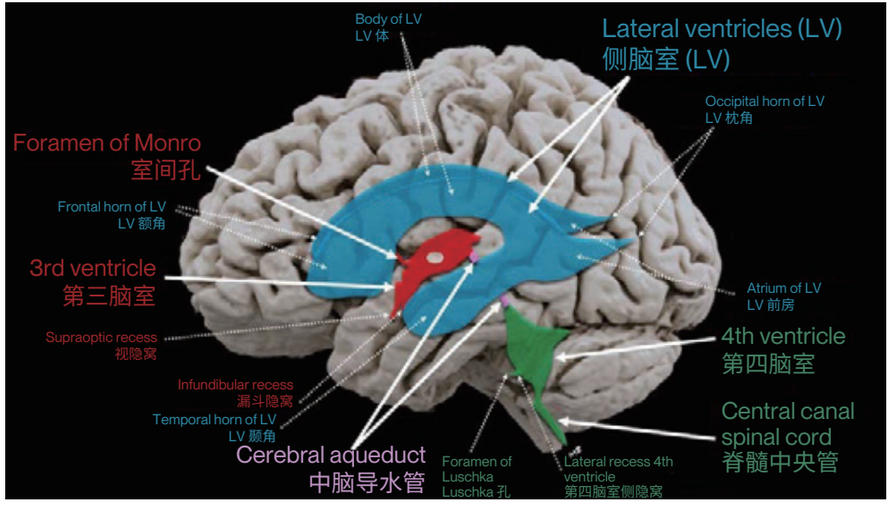


FIGURE 15

Schematic illustration of the 3D anatomy of the ventricular system (lateral view). Courtesy Minerva Becker, MD, Geneva University Hospitals.

/ Central Nervous System

CHAPTER OUTLINE:

/ 脑室

侧脑室（图 15 和图 16）是成对的 C 形结构，包含体部、房部 (at) 以及三个分别延伸至额叶 (fh)、颞叶和枕叶的突起，称为“角”。侧脑室通过室间孔与第三脑室相通。

第三脑室通过中脑导水管与第四脑室连通，脑脊液 (CSF) 由此经 Magendie 孔和 Luschka 孔流向枕骨大孔 (fm)，并进一步到达脑表面。

/ 中枢神经系统

章节大纲：

图 15

脑室系统三维解剖示意图（侧视图）。由日内瓦大学医院 Minerva Becker 医学博士提供。

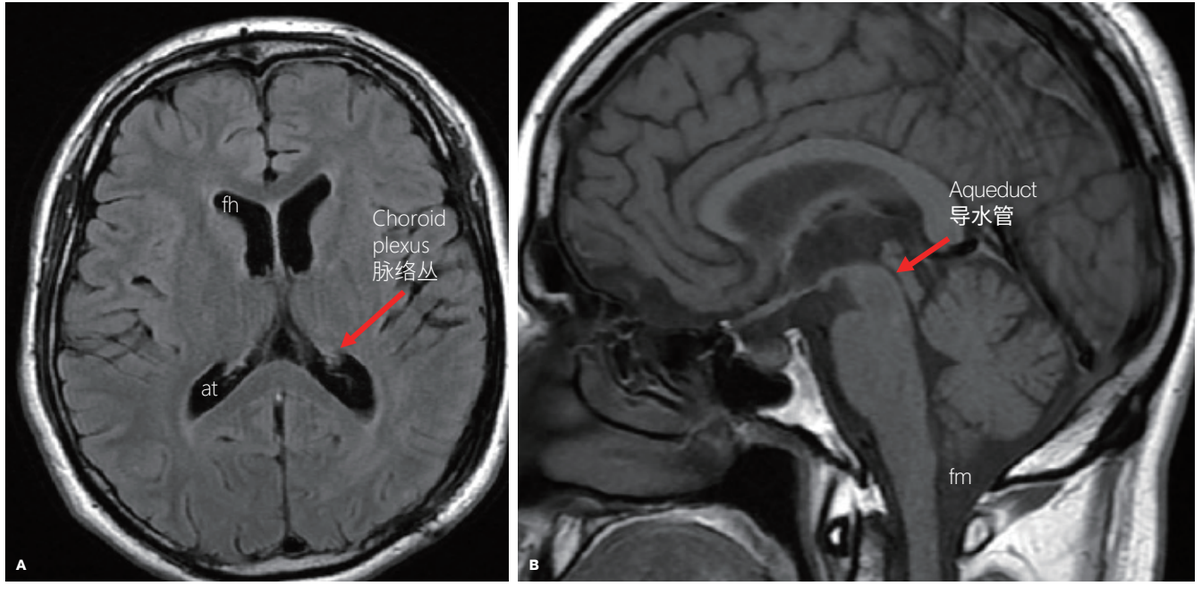


FIGURE 16

Anatomy of the ventricular system as seen on axial (A) and sagittal (B) MR images

Central Nervous System

CHAPTER OUTLINE:

中枢神经系统

章节大纲：

图 16

在轴位 (A) 与矢状位 (B) MR 图像上观察脑室系统的解剖

/ Cranial Nerves

The human body has 12 pairs of cranial nerves that control motor and sensory functions of the head and neck.

The first two cranial nerves: olfactory nerve (CN I, figure 17) and optic nerve (CN II) are extensions of the CNS.

The cranial nerves III to XII arise from the brainstem and leave the central nervous system through cranial foramina:

- / Oculomotor nerve (CN III)
- / Trochlear nerve (CN IV)
- / Trigeminal nerve (CN V)
- / Abducens (CN VI)
- / Facial nerve (fn, figure 17)
- / Vestibulocochlear nerve (CN VIII, figure 17)
- / Glossopharyngeal nerve (CN IX)
- / Vagus nerve (CN X)
- / Accessory nerve (CN XI)
- / Hypoglossal nerve (CN XII)

The cranial nerves can be routinely seen on MRI using dedicated high-resolution sequences.

<∞> REFERENCE

Romano N., Federici M., Castaldi A. Imaging of cranial nerves: a pictorial overview. Insights Imaging 2019; 10:33

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 脑神经

人体有 12 对脑神经，控制头颈部的运动和感觉功能。

前两对脑神经：嗅神经（CN I，图 17）和视神经 (CN II) 是中枢神经系统的延伸。

第 III 至第 XII 对脑神经起自脑干，经颅孔离开中枢神经系统：

- / 动眼神经 (CN III)
- / 滑车神经 (CN IV)
- / 三叉神经 (CN V)
- / 外展神经 (CN VI)
- / 面神经（fn，图 17）
- / 前庭蜗神经（CN VIII，图 17）
- / 舌咽神经 (CN IX)
- / 迷走神经 (CN X)
- / 副神经 (CN XI)
- / 舌下神经 (CN XII)

这些脑神经可通过专用的高分辨率 MRI 序列常规显示。

<∞> 参考文献

Romano N., Federici M., Castaldi A. Imaging of cranial nerves: a pictorial overview. Insights Imaging 2019; 10:33

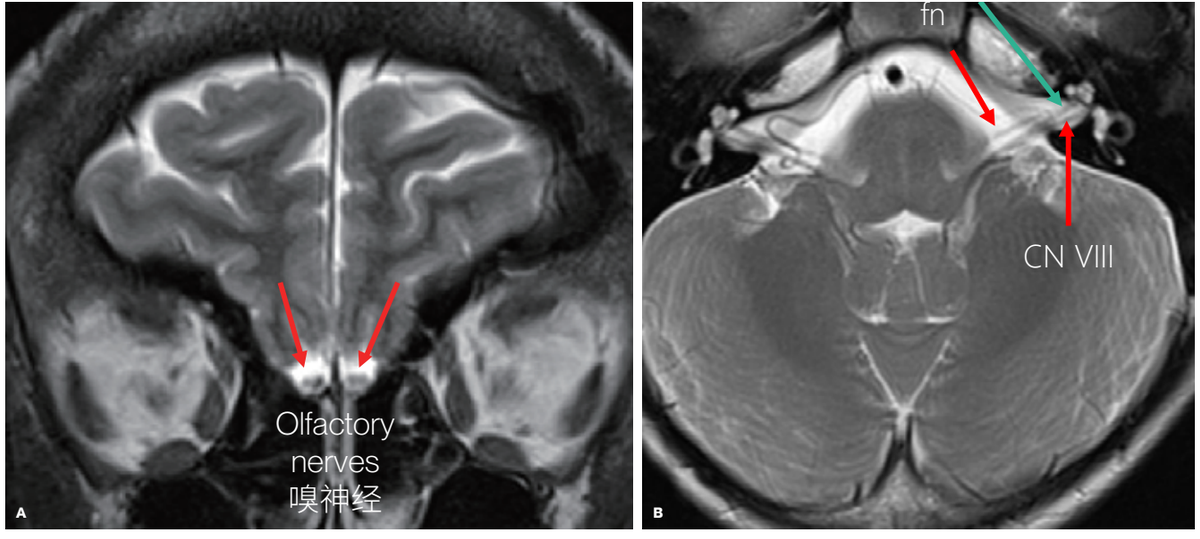


FIGURE 17

Anatomy of the cranial nerves. (A) olfactory bulbs as seen on a coronal T2-weighted MR image (arrows). B. Cochleovestibular nerves (CN VIII) as seen on an axial T2-weighted MR image (arrows). The cochlear nerve (turquoise arrow) lies anterior to the vestibular nerves (red arrow).

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 中枢 **神经系统**

章节大纲：

图 17

脑神经解剖。(A) 在冠状位 T2 加权 MR 图像上可见嗅球（箭头）。B. 在轴位 T2 加权 MR 图像上可见前庭蜗神经 (CN VIII)（箭头）。蜗神经（蓝绿色箭头）位于前庭神经（红色箭头）的前方。

/ Cerebral Arterial System

The arterial cerebral circulation can be divided into anterior and posterior circulation (figure 18). The anterior circulation comprises all the branches of the internal carotid artery (ICA).

Anterior circulation

Internal Carotid Artery segments

/ Cervical
/ Lacerum
/ Petrous
/ Cavernous
/ Clinoid
/ Ophthalmic

Branches of the internal carotid artery

/ Ophthalmic artery
/ Posterior communicating artery
/ Anterior choroid artery
/ Anterior cerebral artery (aca)
/ Middle cerebral artery (mca)

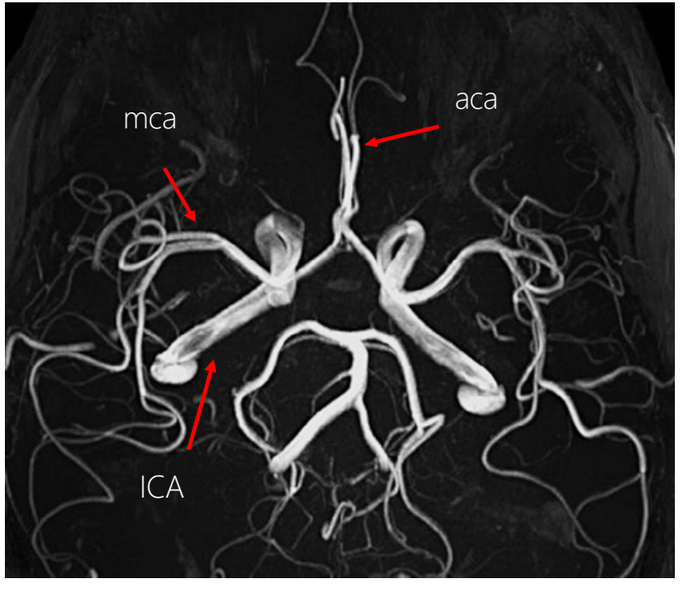


FIGURE 18

Anatomy of the circle of Willis as seen on a TOF MRI sequence.

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 中枢**神经系统**

章节大纲：

/ 脑动脉系统

脑动脉循环可分为前循环和后循环（图 18）。前循环包括颈内动脉 (ICA) 的所有分支。

前循环

颈内动脉分段

/ 颈段
/ 破裂孔段
/ 岩段
/ 海绵窦段
/ 床突段
/ 眼段

颈内动脉分支

/ 眼动脉
/ 后交通动脉
/ 脉络膜前动脉
/ 大脑前动脉 (aca)
/ 大脑中动脉 (mca)

图 18

TOF MRI 序列显示的 Willis 环解剖结构。

/ Cerebral Arterial System

The posterior circulation (figure 18) comprises all the branches of the vertebral and basilar arteries:

- / Posterior circulation Vertebral arteries (va)
- / Posteroinferior cerebellar artery (pica)
- / Basilar artery (ba)
- / Anteroinferior cerebellar artery (aica)
- / Superior cerebellar artery (sca)
- / Posterior cerebral artery (pca)

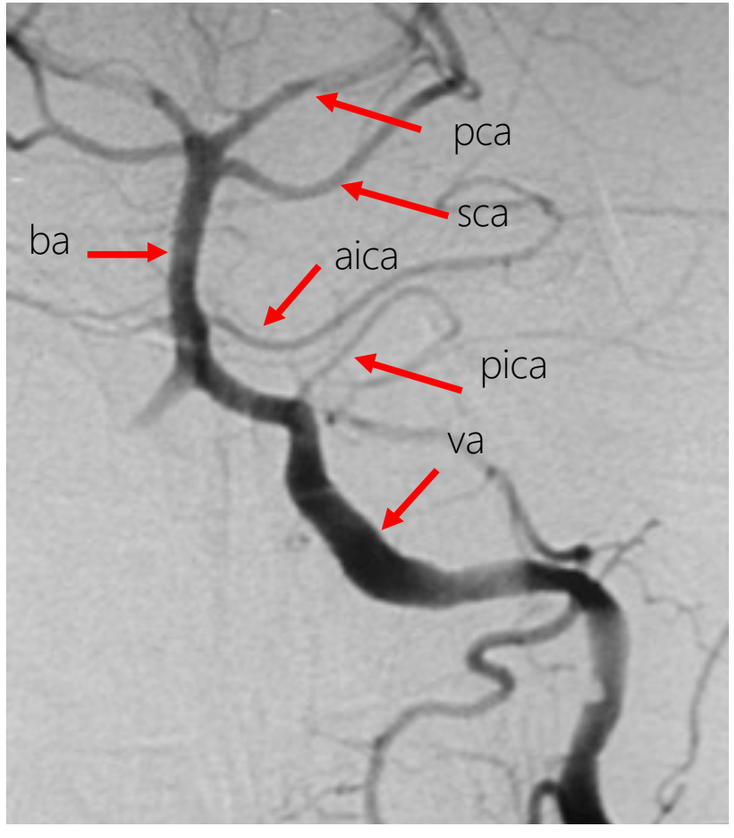


FIGURE 19

Anatomy of the posterior circulation as seen on digital subtraction angiography (coronal view).

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 脑动脉系统

后循环（图 18）包括椎动脉和基底动脉的所有分支：

- / 后循环椎动脉 (va)
- / 小脑后下动脉 (pica)
- / 基底动脉 (ba)
- / 小脑前下动脉 (aica)
- / 小脑上动脉 (sca)
- / 大脑后动脉 (pca)

图 19

数字减影血管成像显示的后循环解剖结构（冠状位视图）。

/ Venous Cerebral System

The cerebral venous system (figure 20) can be divided into a superficial and a deep system:

/ the superficial system consists of sagittal sinuses and cortical veins – these drain superficial surfaces of both cerebral hemispheres

/ the deep system consists of the lateral sinus, straight sinus, and sigmoid sinus along with draining deeper cortical veins

Superficial system (figure 20)

Dural sinuses

/ Superior sagittal sinus (SSS)
/ Inferior sagittal sinus
/ Transverse sinus
/ Straight sinus (sts)
/ Sigmoid sinus (sgs)
/ Cavernous sinuses
/ Petrosal sinuses
/ Sphenoparietal sinus
/ Pterygoid sinuses
/ Inferior vermian veins

Superficial cerebral veins

/ Cortical veins (cv)
/ Superficial middle cerebral vein (Sylvian) Vein of Trolard
/ Vein of Labbé

Deep system (figure 20)

Superior sagittal sinus (SSS) Inferior sagittal sinus Transverse sinus

/ Internal cerebral veins (iicv)
/ Septal veins
/ Thalomoestriate veins
/ Basal veins of Rosenthal
/ Vein of Galen (gv)
/ Subependymal veins

/ Central Nervous System

CHAPTER OUTLINE:

/ 脑静脉系统

脑静脉系统（图 20）可分为浅静脉系统和深静脉系统：

/ 浅静脉系统由矢状窦和皮层静脉组成 - 这些结构引流双侧大脑半球的浅表区域

/ 深静脉系统包括横窦、直窦和乙状窦，以及更深部皮层引流静脉

/ 中枢神经系统

章节大纲：

浅静脉系统（图 20）

硬脑膜窦

/ 上矢状窦 (SSS)
/ 下矢状窦
/ 横窦
/ 直窦 (sts)
/ 乙状窦 (sgs)
/ 海绵窦
/ 岩窦
/ 蝶顶窦
/ 翼状窦
/ 下蚓静脉

浅表脑静脉

/ 皮质静脉 (cv)
/ 大脑中浅静脉 (Sylvian) Trolard 静脉
/ Labbé 静脉

深静脉系统（图 20）

上矢状窦 (SSS) 下矢状窦 横窦

/ 大脑内静脉 (iicv)
/ 透明隔静脉
/ 丘脑纹状体静脉
/ Rosenthal 基底静脉
/ Galen 静脉 (gv)
/ 室管膜下静脉

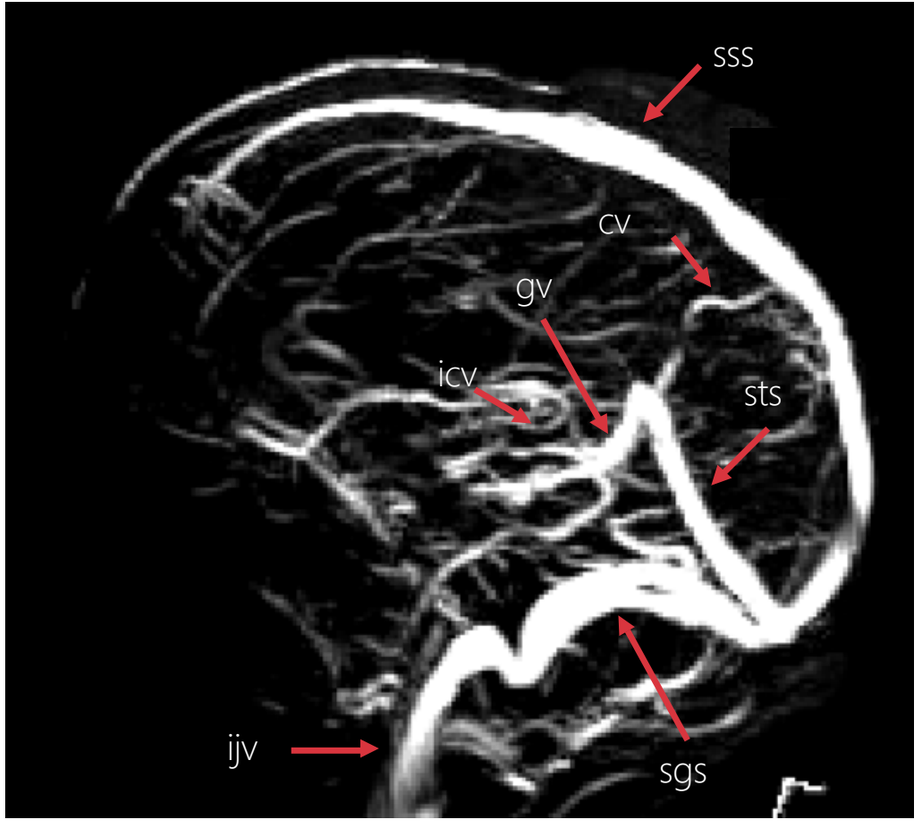


FIGURE 20

Anatomy of the cerebral venous system as seen on an MRI phlebogryphy..

- cv = cortical veins
- Icv = internal cerebral veins
- Ijv = internal jugular vein
- gv = vein of Galen
- SSS = superior sagittal sinus
- Sts = straight sinus
- Sgs = sigmoid sinus

Central Nervous System

CHAPTER OUTLINE:

<▪> 核心知识

中枢神经系统

章节大纲：

图 20

MRI 静脉成像显示的脑静脉系统的解剖结构。

- cv=皮质静脉
- Icv=大脑内静脉
- Ijv=颈内静脉
- gv=Galen 静脉
- SSS=上矢状窦
- Sts=直窦
- Sgs=乙状窦

/ Spine

The adult vertebral column (figure 21) consists of 33 vertebrae (vb) arranged in five regions. Seven cervical vertebrae, twelve thoracic vertebrae, five lumbar vertebrae, five sacral and four coccygeal vertebrae.

The first two cervical vertebrae the atlas and axis articulate with the head, and the sacrum articulates with the pelvis.

The intervertebral disks (d) separate the vertebral bodies, providing flexibility to the vertebral column.

FIGURE 21

Anatomy of the spine and spinal cord as seen on a sagittal T2-weighted MR image.

CHAPTER OUTLINE:

/ 脊柱

章节大纲：

成人脊柱（图 21）由 33 块椎骨 (vb) 组成，分为五个区域。颈椎 7 节、胸椎 12 节、腰椎 5 节、骶椎 5 节、尾椎 4 节。

前两节颈椎 - 寰椎和枢椎 - 与头部相连，骶骨与骨盆相连。

椎间盘 (d) 分隔各椎体，为脊柱提供灵活性。

图 21

矢状位 T2 加权 MR 图像显示的脊柱和脊髓的解剖结构。

/ Spinal Cord

The spinal cord begins at the end of the brain stem and continues down in the centre of the spinal canal to the level of T12, L1 vertebrae.

Its lower end, the conus medullaris is continuous at its lower end with the threadlike filum terminale that attaches the spinal cord to the osseous canal at S4 level.

A transverse section of the spinal cord (figure 22) shows white matter in the periphery (wm), H-shaped grey matter inside (gm) and a central ependymal canal filled with CSF.

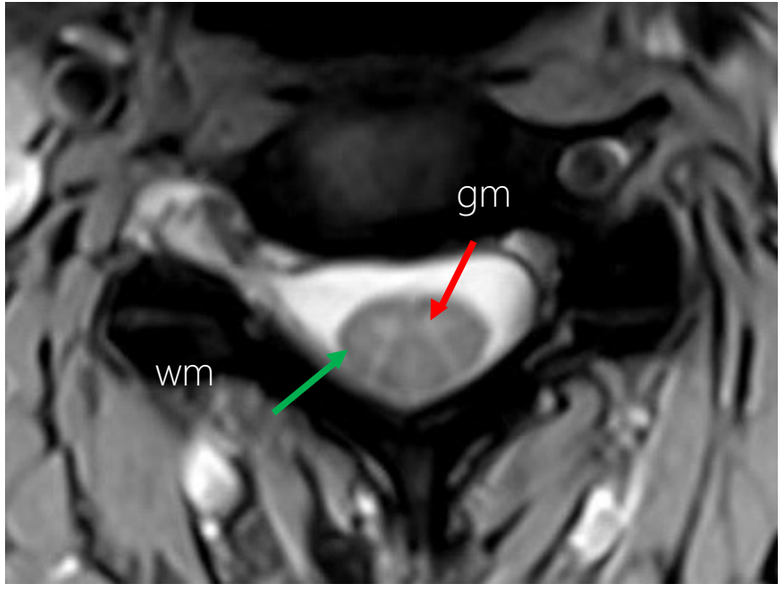


FIGURE 22

Anatomy of the spinal cord as seen on an axial T2-weighted MR image.

CHAPTER OUTLINE:

/ 脊髓

章节大纲：

脊髓起始于脑干末端，沿椎管中央向下延伸至 T12、L1 椎体水平。

其下端为脊髓圆锥，向下延续为细丝状的终丝，将脊髓固定于 S4 水平的骨性椎管。

脊髓横断面（图 22）显示：外周为白质 (wm)，内部为 H 形灰质 (gm)，中央为充满脑脊液的室管膜中央管。

图 22

轴位 T2 加权 MR 图像显示的脊髓解剖结构。

Strengths, Weaknesses and Role of Imaging Modalities

Central Nervous System

CHAPTER OUTLINE:

中枢神经系统

章节大纲：

影像学检查方法的优势、局限和作用

/ Ultrasonography (US)

Ultrasonography (also called ultrasound examination, US) uses high-frequency sound waves for imaging. External mechanical waves are applied, that interact with the area of the body to be imaged and a pulse echo technique is used to create an image.

It is a non-invasive, accurate, and cost-effective method of detecting and assessing flow in the carotid and vertebral arteries to diagnose vascular stenosis, dissection, thrombosis and/or obstruction.

Transcranial ultrasound is indicated in neonates to assess hypoxic-ischemic encephalopathy, haemorrhage, ventricular size and arterial or venous patency.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

/ 超声 (US)

章节大纲：

超声检查（又称超声波检查，US）利用高频声波进行成像。通过施加外部机械波，使其与待成像的体部区域相互作用，并采用脉冲回声技术生成图像。

这是一种无创、准确且经济高效的方法，可用于检测和评估颈动脉及椎动脉的血流，以诊断血管狭窄、夹层、血栓形成和/或阻塞。

经颅超声适用于新生儿，可用于评估缺氧缺血性脑病、出血、脑室大小及动静脉通畅性。

/ Computed Tomography (CT)

Computed Tomography scanners consist of an x-ray tube and an opposing x-ray detector mounted on a ring, rotating around the patient to acquire projections through the patient at various angles.

It is the method of choice for the demonstration of acute intracranial haemorrhage, intracranial calcifications and delineating bony fractures.

CT-Angiography can be used to evaluate the arterial and venous system of the brain.

Perfusion CT is performed by repeated imaging through the brain after intravenous injection of a contrast agent bolus – it is used in stroke evaluation.

Dual-energy CT is a recent technique that is used for tissue characterisation, bone removal, and metal artifact reduction.

The contrast agent used on CT images is an Iodine-containing contrast medium.

<=> REFERENCE

> see also eBook chapter on Contrast Media

CHAPTER OUTLINE:

章节大纲：

/ 计算机断层扫描 (CT)

计算机断层扫描仪由 X 线管和对置的 X 线探测器组成，安装于环形机架上，围绕患者旋转，以从不同角度获取穿透人体的投影图像。

该技术是显示急性颅内出血、颅内钙化及明确骨折的首选方法。

CT 血管成像可用于评估脑动脉和静脉系统。

灌注 CT 通过静脉快速注射对比剂后对脑部进行重复扫描 - 用于脑卒中评估。

双能 CT 是近年来用于组织特征分析、骨性结构去除及金属伪影减少的新技术。

CT 检查使用的对比剂为含碘对比剂。

<=> 参考文献

> 另请参阅《对比剂》电子书章节

/ Magnetic Resonance Imaging (MRI)

MRI uses a strong static magnetic field and radiofrequency waves to generate the images (4).

MRI has a higher soft-tissue contrast than CT, which means that different types of tissues can be better distinguished.

The contrast media used on MRI is a Gadolinium chelate. Gadolinium. It is a complex molecule with chemical bonds made between a gadolinium ion and a carrier molecule (a chelating agent) that prevents the toxicity of gadolinium while maintaining its contrast properties.

<∞> REFERENCES

> For Gadolinium chelates see eBook chapter on Contrast Media

Pooley R.A. Fundamental Physics of MR Imaging. RadioGraphics 2005; 25:1087–1099

/ Central Nervous System

CHAPTER OUTLINE:

/ 磁共振成像 (MRI)

/ 中枢神经系统

章节大纲：

MRI 通过强静态磁场与射频波生成图像 (4)。

MRI 的软组织对比度高于 CT，因而可以更好地区分不同类型的组织。

MRI 检查使用的对比剂为钆螯合物。钆。钆螯合物是一种由钆离子与载体分子（螯合剂）通过化学键结合的复合物，可在保持钆对比增强特性的同时避免其毒性。

<∞> 参考文献

> 有关钆螯合物，请参阅《对比剂》电子书章节

Pooley R.A. Fundamental Physics of MR Imaging. RadioGraphics 2005; 25:1087-1099

/ Morphological Sequences

The basic morphological images obtained on MRI are T1-weighted, T2-weighted, and Fluid attenuated inversion recovery (FLAIR) images. T1-weighted images provide detailed anatomical information, T2-weighted images provide high contrast images with a high spectrum of different signal intensities from the different tissue types. FLAIR images are obtained with an inversion recovery sequence with a long inversion time that removes signal from the cerebrospinal fluid (CSF), the brain tissue contrast is similar to T2-weighted images but CSF appears dark instead of bright.

MR angiography (MRA) is a non-invasive method for imaging of the vasculature, it can be performed with or without a contrast agent injection.

/ Functional Sequences

Diffusion Weighted Imaging (DWI) is an MRI technique that measures the translational water molecules motion. Apparent diffusion coefficient (ADC) is a quantitative measurement of the magnitude of diffusion of water molecules within tissue, it can be assessed using different b values on the DWI, changing the gradient amplitude. This information is useful for the diagnosis of acute ischemic stroke, infection, and tumour characterisation.

Perfusion MRI can be performed with or without a contrast agent injection and depicts the cerebral circulation.

Functional MRI (fMRI) maps the location of the neuronal activity in the cortex and deep grey matter. MR spectroscopy (MRS) provides chemical information about the cerebral tissue.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 形态序列

MRI的基础形态学图像包括 T1 加权像、T2 加权像和液体衰减反转恢复 (FLAIR) 像。T1 加权像提供详细的解剖学信息，T2 加权像呈现不同组织的丰富信号强度差异，具有较高对比度。FLAIR 为长反转时间的反转恢复序列，可抑制脑脊液 (CSF) 信号，其脑组织对比度与 T2 加权像相似，但 CSF 呈低信号而非高信号。

MR 血管成像 (MRA) 是一种无创的血管成像方法，可采用增强或非增强扫描。

/ 功能序列

弥散加权成像 (DWI) 是一种测量组织内水分子扩散运动的 MRI 技术。表观扩散系数 (ADC) 是量化组织内水分子扩散程度的指标，可通过在 DWI 序列中采用不同梯度场强的 b 值进行评估。该技术对急性缺血性脑卒中、感染及肿瘤特征的诊断具有重要价值。

灌注 MRI 可采用增强或非增强扫描，用于显示脑部血流灌注循环。

功能 MRI (fMRI) 可定位大脑皮层及深部灰质的神经元活动区域。MR 波谱 (MRS) 可提供脑组织的化学成分信息。

/ Digital Subtraction Angiography

Digital Subtraction Angiography (DSA) is used for imaging blood vessels intracranially and in the neck.

A Iodine-containing contrast agent is injected through a catheter introduced percutaneously via the femoral artery. The catheter is advanced into the arteries of interest for selective contrast injection. It is better than CT and MRI for the evaluation of small distal cerebral and spinal arteries due to its superior spatial resolution.

It is used for therapeutic endovascular treatment in stroke patients and patients with vascular lesions (aneurysms, arterio-venous malformations, arterial dissection, venous thrombosis).

/ Central Nervous System

CHAPTER OUTLINE:

/ 数字减影血管成像

/ 中枢神经系统

章节大纲：

数字减影血管成像 (DSA) 用于颅内及颈部血管成像。

通过经皮穿刺股动脉置入导管后注入含碘对比剂。将导管推进至目标动脉进行选择性造影。由于其出色的空间分辨率，DSA 在评估远端细小脑动脉和脊髓动脉方面优于 CT 和 MRI。

该技术适用于脑卒中及血管病变（动脉瘤、动静脉畸形、动脉夹层、静脉血栓）的腔内治疗。

/ Advantages and Disadvantages of Imaging Modalities

>|< COMPARE

MODALITIES	STRENGTHS	WEAKNESSES	INDICATIONS
Ultrasound	Non invasive Non-ionising radiation	Operator dependent	Carotid and vertebral disease Brain evaluation neonates
Computed Tomography	High resolution Short scanning time	Ionising radiation Iodine contrast	Stroke Brain hemorrhage Spine fractures Spine degenerative disease
Magnetic Resonance Imaging	Non-ionising radiation High soft tissue contrast High resolution Functional information	Long scanning time Contraindicated (coclear implants, pace-makers...) Gadolinum contrast	Congenital or developmental lesions Stroke Tumours Neurodegenerative diseases Infectious diseases
Digital Substraction Angiography	Therapeutic procedure High spacial resolution	Invasive Radiation	Stroke (endovascular treatment Aneurysms Cerebrovascular malformations

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 影像学检查方法的优缺点

>|< 比较

检查方法	优势	劣势	适应证
超声	无创 非电离辐射	操作者依赖性	颈动脉和椎动脉疾病 新生儿脑部评估
计算机断层扫描	高分辨率 扫描时间短	电离辐射 需使用碘对比剂	脑卒中 脑出血 脊柱骨折 脊柱退行性疾病
磁共振成像	非电离辐射 高软组织对比度 高分辨率 可获取功能信息	扫描时间长 存在禁忌证（如人工耳蜗、心脏起搏器等） 需使用钆对比剂	先天性或发育性病变 脑卒中、肿瘤 神经退行性疾病 感染性疾病
数字减影血管成像	可实施治疗性操作 高空间分辨率	有创 存在辐射	脑卒中（腔内治疗） 动脉瘤 脑血管畸形

Main Indications to Brain Imaging by Pathology

Central Nervous System

CHAPTER OUTLINE:

中枢神经系统

章节大纲：

按病理分类的脑部影像学主要适应症

/ Brain Main Indications

Congenital Lesions

/ Imaging in congenital brain malformations

Trauma

/ Brain haemorrhage (epidural, subdural, parenchymal, intraventricular)

Ischemic Disease

/ Acute stroke, chronic, haemorrhagic

Brain Tumours

/ Intraaxial, extra-axial

Pituitary Gland Tumours

/ Adenoma, Rathke's cleft cyst, craniopharyngioma

Inflammatory/Infectious Diseases

/ Demyelinating disease, infections (bacterial, viral , fungal, parasitic)

Neurodegenerative Diseases

/ Alzheimer, Parkinson

Vascular Lesions

/ Aneurysms, cerebro-vascular malformations

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 中枢**神经系统**

章节大纲：

/ 脑部主要适应症

先天性病变

/ 先天性脑畸形的影像学检查

外伤

/ 脑出血（硬膜外、硬膜下、脑实质、脑室内）

缺血性疾病

/ 急性脑卒中、慢性缺血、出血性脑卒中

脑肿瘤

/ 轴内、轴外

垂体肿瘤

/ 腺瘤、Rathke 裂囊肿、颅咽管瘤

炎症性/感染性疾病

/ 脱髓鞘疾病、感染（细菌、病毒、真菌、寄生虫）

神经退行性疾病

/ 阿尔茨海默病、帕金森病

血管病变

/ 动脉瘤、脑血管畸形

/ Congenital Lesions

Congenital brain malformations can be produced by a genetic defect, or be secondary to a disruption in the normal anatomical development of the brain structures due to prenatal infection, haemorrhage, and ischemia.

Agenesis of the corpus callosum (figure 23) is caused by disruption of brain cell migration during foetal development. It can occur as an isolated condition or in combination with other brain or facial abnormalities.

Most meningoencephaloceles (figure 24) are of congenital origin. They are neural tube defects with a sac-like structure containing meninges, cerebrospinal fluid (CSF) and/or brain tissue that extends bellow the skull base through a bone defect. Congenital meningoencephaloceles are thought to be caused by TORCH infections (toxoplasma, rubella, cytomegalovirus, herpes simplex virus) during embryogenesis and also by a variety of genetic factors. Encephaloceles can occur as isolated lesions or in combination with other malformations, e.g., Chiari malformation or migration anomalies.

<∞> REFERENCES

> For further congenital brain anomalies, see eBook chapter on Paediatric Radiology.

<!> ATTENTION

Although MRI is the imaging modality of choice to diagnose congenital brain lesions, in selected cases, additional CT images may be necessary to precisely assess skull base defects for planning of surgery.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 先天性病变

先天性脑畸形可由遗传缺陷导致，也可继发于产前感染、出血和缺血引起的脑结构正常解剖发育中断。

胼胝体发育不全（图 23）是由胎儿发育过程中脑细胞迁移中断所致。可单独发生，或合并其他脑部或面部异常。

大多数脑膜脑膨出（图 24）为先天性。他们是神经管缺陷，表现为隐窝状结构，内含脑膜、脑脊液 (CSF) 和/或脑组织，通过颅底骨缺损处向外膨出。先天性脑膜脑膨出被认为由胚胎期的 TORCH 感染（弓形虫、风疹、巨细胞病毒、单纯疱疹病毒）及多种遗传因素导致。脑膨出可单独发生，或合并其他畸形（如 Chiari 畸形或神经元迁移异常）。

<∞> 参考文献

> 其他先天性脑部异常详见电子书《儿科放射学》章节。

<!> 注意

MRI 是诊断先天性脑部病变的首选影像学方法，但在特定病例中，为制定手术计划可能需要补充 CT 检查以精确评估颅底缺损情况。

FIGURE 23

Agenesis of the corpus callosum. On the sagittal midline T2-weighted image no corpus callosum is demonstrated (arrows). See for comparison Fig. 10 (normal corpus callosum).

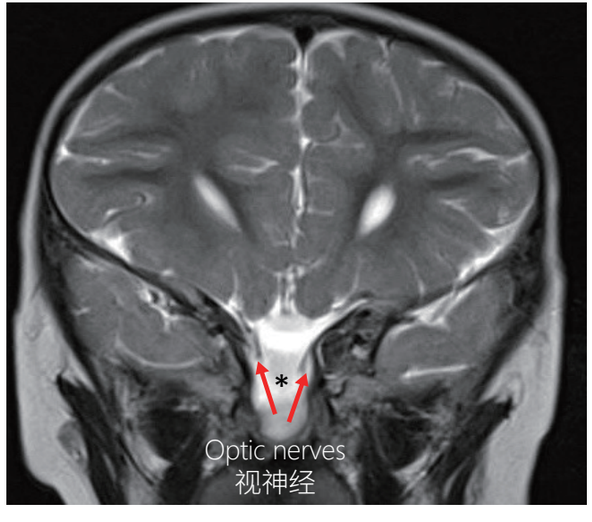


FIGURE 24

Anterior encephalocele mostly containing CSF (asterisk) as seen on a coronal T2-weighted image. Anterior skull defect with herniated optic nerves.

Central Nervous System

CHAPTER OUTLINE:

中枢神经系统

章节大纲：

图 23

胼胝体发育不全。正中矢状位 T2 加权像显示胼胝体缺失（箭头）。参见对比图 10（正常胼胝体）。

图 24

冠状位 T2 加权像显示前部脑膨出，主要含脑脊液（星号）。前颅底缺损伴视神经疝出。

/ Trauma

One of the most common causes of brain haemorrhage is trauma. It is important to correctly locate the bleeding site on imaging studies, as treatment and prognosis depend on it. Traumatic haemorrhage can be classified as intra-axial (within brain parenchyma) and extra-axial (external to brain parenchyma):

Intra-axial haemorrhage:

Cerebral haemorrhage (intraparenchymal bleeding most frequently frontobasal and in the temporal lobes)

Extra-axial haemorrhage (figure 25):

- Subarachnoid (bleeding under the arachnoid, in the subarachnoid space)
- Subdural (bleeding between the inner layer of the dura mater and the arachnoid, cannot cross the midline, can cross suture lines)
- Epidural (bleeding between the dura mater and the skull, associated to bone fracture, can cross the midline, do not cross suture lines)
- Intraventricular (bleeding within the ventricles). It is a distinct entity in the new-born
  (> see chapter on Paediatric Imaging)

<!> ATTENTION

CT is the imaging modality of choice to evaluate bleeding after brain trauma.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 外伤

脑出血最常见病因之一是创伤。影像学检查应准确定位出血部位，因其决定治疗方案和预后。外伤性出血可分为轴内（脑实质内）和轴外（脑实质外）：

轴内出血：

大脑出血（脑实质内出血最常见于额叶底部和颞叶）

<!> 注意

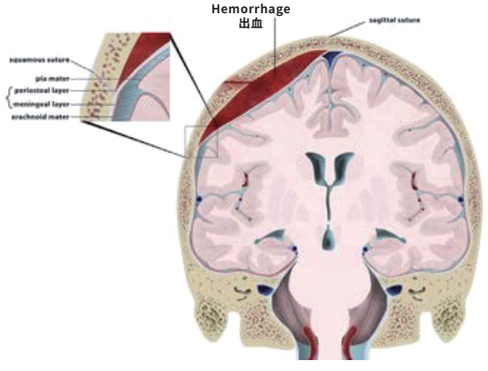
CT 是评估脑创伤后出血的首选影像学检查方法。

轴外出血（图 25）：

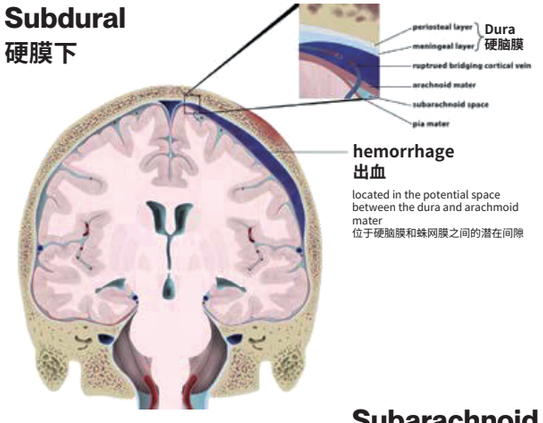
- 蛛网膜下腔（蛛网膜下方、蛛网膜下腔内的出血）
- 硬膜下（硬脑膜内层与蛛网膜间出血，可跨越颅缝但不跨越中线）
- 硬膜外（硬脑膜与颅骨之间出血，常伴骨折，可跨越中线但不跨越颅缝）
- 脑室内（脑室内的出血）。此为新生儿特有类型
  (> 请参阅《儿科影像学》章节)

/ Extra-axial Haemorrhage

Extradural (epidural)
硬膜外（硬脑膜外）



Subdural
硬膜下



Subarachnoid
蛛网膜下腔

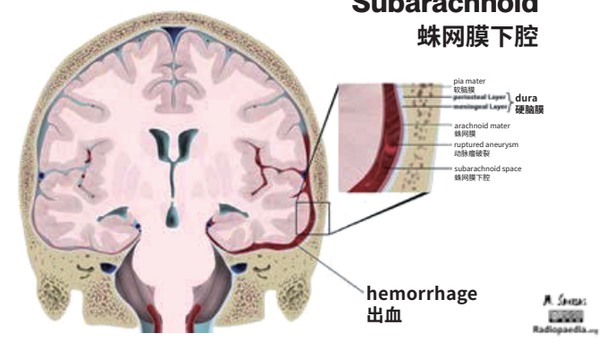


FIGURE 25

Schematic representations of the different types of acute extra-axial haemorrhage.

Case courtesy of Dr Matt Skalski, Radiopaedia.org. rID: 21542.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 轴外出血

图 25

不同类型急性轴外出血的示意图。

病例由 Dr Matt Skalski 提供。Radiopaedia.org. rID：21542.

/ Intracranial Haemorrhage

The density of intracranial haemorrhage changes over time (figure 26):

1. Prior to clotting, the hyperacute haematoma (for a few minutes) has the same density as normal blood.
2. As it clots (within hours), the density of acute haematoma increases, which makes it clearly visible on CT.
3. Over days to weeks, the density of the subacute haematoma decreases, it becomes isodense compared to brain tissue > therefore, it becomes more difficult to detect.
4. Later, chronic haematoma will have a similar density as cerebrospinal fluid.

<!> ATTENTION

Multiple factors affect the actual time it takes the haematoma to undergo the above-mentioned changes.

Haematoma CT density
血肿 CT 密度

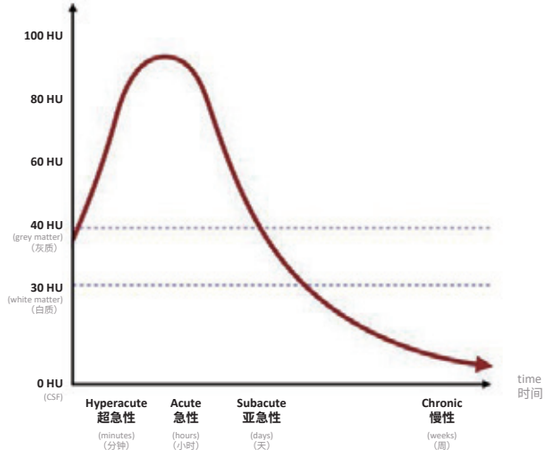


FIGURE 26

Graph demonstrating the evolution of the density of intracranial hemorrhage on CT. Case courtesy of Assoc Prof Frank Gaillard, Radiopaedia.org. rID:36064

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 颅内出血

颅内出血的密度随时间变化（图 26）：

1. 形成凝血块前的超急性血肿（数分钟内）与正常血液密度相同。
2. 随着血液凝结（数小时内），急性血肿密度增高，在 CT 上清晰可见。
3. 数天至数周后，亚急性血肿的密度降低，逐渐与脑组织等密度，因此更难检测。
4. 之后，慢性血肿的密度与脑脊液相似。

<!> 注意

多种因素可影响血肿发生上述变化的实际时间。

图 26

图示为 CT 显示的颅内出血密度变化。病例由副教授 Frank Gaillard 提供。Radiopaedia.org. rID：36064

/ Intra-axial Haemorrhage

Intraparenchymal haemorrhage (figure 27) is bleeding into the brain parenchyma proper.

Brain contusions and haemorrhage after trauma characteristically occur in the inferior frontal lobes and anterior-inferior temporal lobes.

Acute intracerebral haemorrhage is seen as areas of high attenuation values on CT images (hyperdense, see also figure 25).

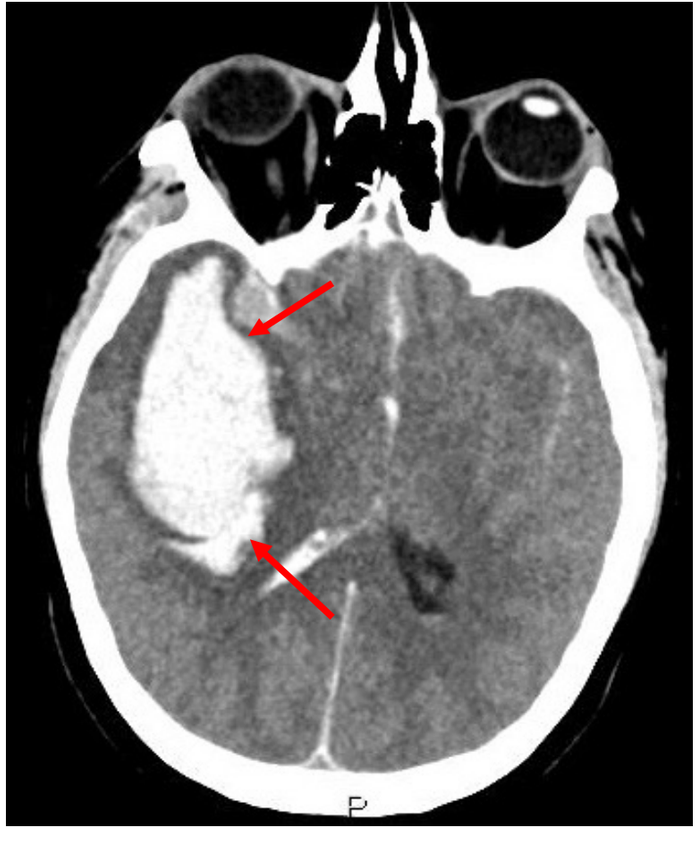


FIGURE 27

Acute intraparenchymal haematoma (arrows) seen on a non- contrast enhanced CT image

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 中枢 **神经系统**

章节大纲：

/ 轴内出血

脑实质内出血（图 27）是指血液直接进入脑实质的出血。

创伤后的脑挫伤和出血通常发生在下额叶和前下颞叶。

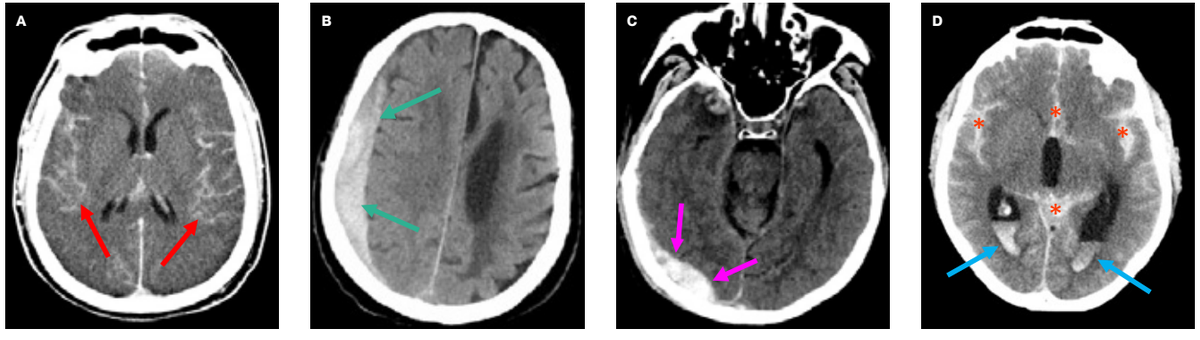
急性脑内出血在 CT 图像上表现为高 CT 值（高密度，见图 25）。

图 27

CT 平扫图像显示的急性脑实质内血肿（箭头）

/ Extra-axial Haemorrhage

The different types of acute extra-axial haemorrhage and their distinctive imaging characteristics are illustrated in figure 28.



Subarachnoid: hyperdense material fills the subarachnoid space (which is usually hypodense as CSF is hypodense)

Subdural: crescent shape, hyperdense collection

Epidural: biconvex or lenticular shape, sharply demarcated

Intraventricular: hyperdense material within the ventricles. As blood is heavier than CSF, it tends to pool in the occipital horns.

FIGURE 28

Illustrative examples of acute extra-axial haemorrhage as seen on axial CT images (A-C). Note the presence of additional subarachnoid haemorrhage (asterisks) in D.

/ 轴外出血

不同类型的急性轴外出血及其特征性影像学表现如图 28 所示。

蛛网膜下腔：高密度物质填充蛛网膜下腔（通常因脑脊液呈低密度而显低密度）

硬膜下：新月形，高密度积聚物

硬膜外：双凸或透镜状，边界清晰

脑室内：脑室内高密度影。由于血液比重高于脑脊液，常积聚于枕角。

图 28

轴位 CT 图像显示的急性轴外出血示例 (A-C)。注意 D 图中同时存在的蛛网膜下腔出血（星号）。

/ Ischemic Disease

/ Acute Infarct

Acute stroke results from a brain blood vessel occlusion. Ischemia accounts for 85% of presentations and primary haemorrhage for 15%.

Primary ischemia results from atherothrombotic occlusion or an embolism.

Knowledge of the vascular territories is crucial to recognize infarctions in arterial territories, in watershed regions or venous infarctions.

<∞> REFERENCES

Srinivasan A., Goyal M., Al Azri F., Cheemun Lum C. State-of-the-Art Imaging of Acute Stroke. RadioGraphics 2006; 26:S75–S95

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章节大纲：

/ 缺血性疾病

/ 急性梗死

急性脑卒中由脑血管闭塞引起。缺血性卒中占 85%，原发性出血性卒中占 15%。

原发性缺血由动脉粥样硬化血栓性闭塞或栓塞引起。

掌握血管分布区域对识别动脉供血区梗死、分水岭区梗死及静脉性梗死至关重要。

<∞> 参考文献

Srinivasan A., Goyal M., Al Azri F., Cheemun Lum C. State-of-the-Art Imaging of Acute Stroke. RadioGraphics 2006; 26:S75–S95

/ Acute Arterial Ischemic Infarct

It follows the distribution of the arterial cerebral irrigation territories (figure 29) .

Unenhanced CT can help identify a haemorrhage. This is a contraindication to thrombolytic therapy and it can also detect early- stage acute ischemia.

The CT findings in acute ischemia (figure 30) include: local hypoattenuation in an arterial distribution due to cytotoxic oedema, sulcal effacement and mass effect, the hyperdense vessel sign (middle cerebral artery thrombus), the insular ribbon sign, and obscuration of the lentiform nucleus, caused by a loss of contrast between grey matter and white matter due to cytotoxic oedema.

CT-angiography is useful for evaluating the intracranial and extracranial vessels to demonstrate the location of the arterial occlusion.

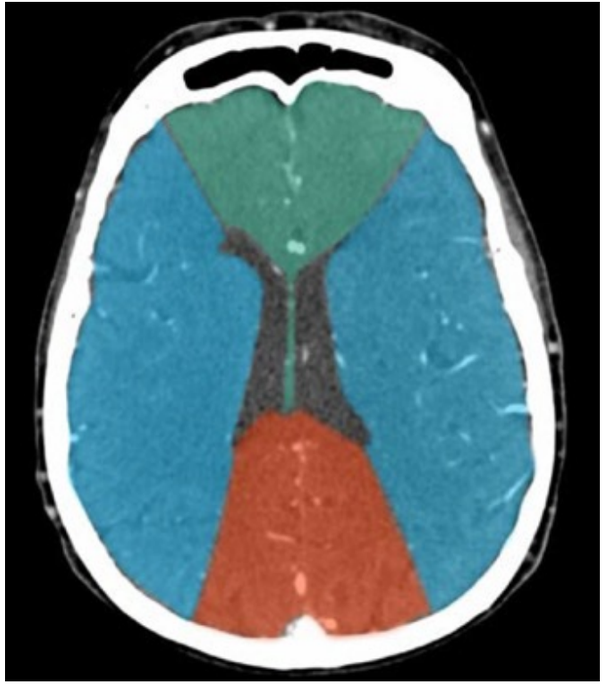

FIGURE 29

Cerebral arterial vascular territories. Anterior cerebral artery (green). Middle cerebral artery (blue). Posterior cerebral artery (red).

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/ 中枢 **神经系统**

章节大纲：

/ 急性动脉性缺血性梗死

其遵循脑动脉供血区域的分布（图 29）。

CT 平扫可以帮助识别出血。这是溶栓治疗的禁忌症，它也可检测早期急性缺血。

急性缺血的 CT 表现（图 30）包括：由细胞毒性水肿引起的动脉分布区的局部低密度、脑沟模糊和占位效应、高密度血管征（大脑中动脉血栓形成）、岛带征，以及豆状核模糊（由细胞毒性水肿引起的灰质和白质对比度丧失引起）。

CT 血管成像可用于评估颅内和颅外血管，以明确动脉闭塞部位。

图 29

脑动脉供血区域。大脑前动脉（绿色）。大脑中动脉（蓝色）。大脑后动脉（红色）。

/ Acute Arterial Infarct

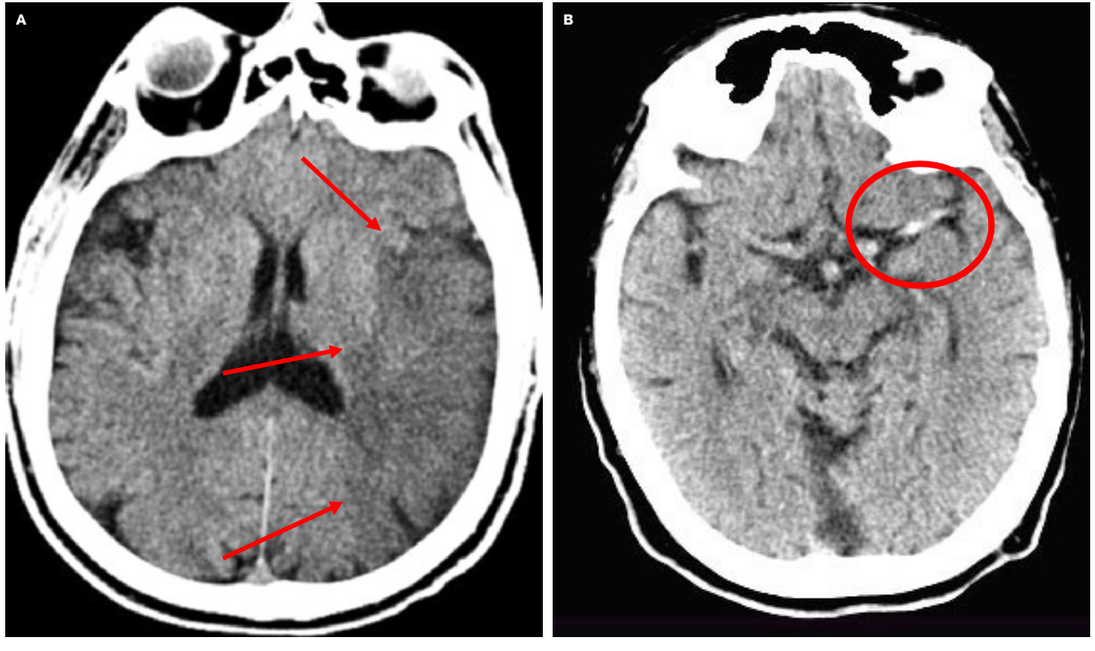

FIGURE 30

A. Acute ischemic infarct (arrows) seen as a hypoattenuating area on non-enhanced CT due to cytotoxic oedema in the left middle cerebral artery territory. B. Hyperdense left middle cerebral artery sign (circle) on non-enhanced CT corresponding to an acute thrombus.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 急性动脉性梗死

图 30

A. 急性缺血性梗死（箭头）：CT平扫 显示左侧大脑中动脉供血区因细胞毒性水肿呈现低密度区域。B. CT 平扫显示左侧大脑中动脉高密度征（圆圈），对应急性血栓形成。

/ Acute Arterial Ischemic Infarct

Acute cerebral ischemia may result in a central irreversibly infarcted tissue "core" surrounded by a peripheral region of salvageable tissue, called "penumbra". The ischemia may be reversible if reperfusion is obtained quickly, without early recanalisation, the infarction gradually expands to include the penumbra.

The penumbra can be evaluated both on CT images (indicated by a discrepancy in perfusion maps, figure 31) and on MR images (indicated by a mismatch between diffusion and perfusion maps). CT-angiography is used to detect the location of the intravascular occlusion (figure 31).

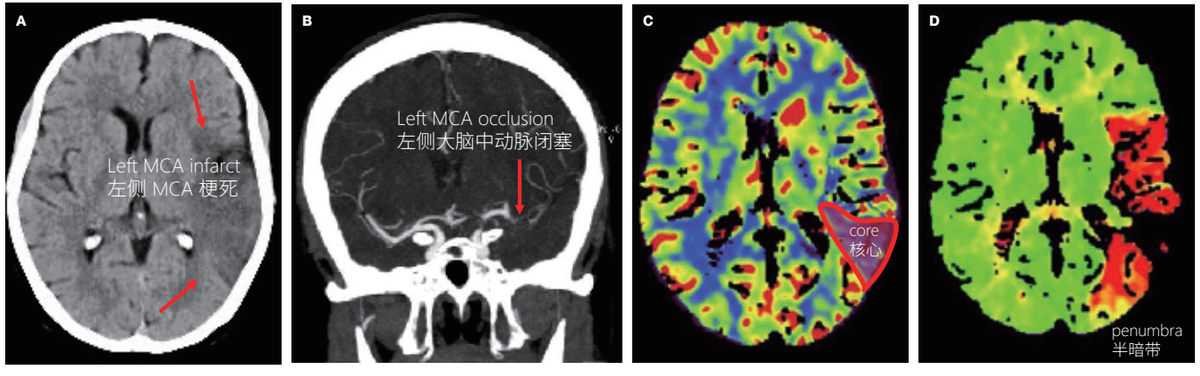

FIGURE 31

A. Acute ischemic infarct (arrows) seen as a hypoattenuating area on non-enhanced CT (A) in the left middle cerebral artery territory. B. Coronal reconstruction of an angio-CT series shows occlusion of the left MCA. C. The CBV (cerebral blood volume) perfusion parametric map shows the core whereas the penumbra can be assessed on the TTP (time to peak) perfusion parametric map (D).

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章节大纲：

/ 急性动脉缺血性梗死

急性脑缺血可导致中央形成不可逆梗死的“核心区”，周围环绕可挽救的脑组织，称为“半暗带”。若及时实现血流再灌注，缺血可能可逆；若无早期血管再通，梗死将逐渐扩大至半暗带。

半暗带可通过 CT 图像（表现为灌注参数图不匹配，图 31）和 MR 图像（表现为弥散与灌注参数图不匹配）评估。CT 血管成像用于检测血管内闭塞部位（图 31）。

图 31

A. 急性缺血性梗死（箭头）CT 平扫 (A) 显示左侧大脑中动脉供血区低密度区域。B. CT 血管成像冠状位重建显示左侧大脑中动脉闭塞。C. CBV（脑血容量）灌注参数图显示梗死核心区，而 TTP（达峰时间）灌注参数图 (D) 可评估半暗带。

MR imaging findings in patients with acute cerebral ischemia include hypointense signal in white matter on T1-weighted and hyperintense signal on T2-weighted images with loss of grey matter–white matter differentiation, sulcal effacement and mass effect.

Acute stroke causes cytotoxic oedema with intracellular water accumulation and overall decreased rate of water molecular diffusion. Areas of cytotoxic oedema, in which the motion of water molecules is restricted, appear bright on Diffusion Weighted Imaging (DWI) and low on the apparent diffusion coefficient (ADC) map (figure 32).

<!> ATTENTION

DWI is the most sensitive sequence for stroke imaging.

MR-angiography is useful for detecting intravascular occlusion.

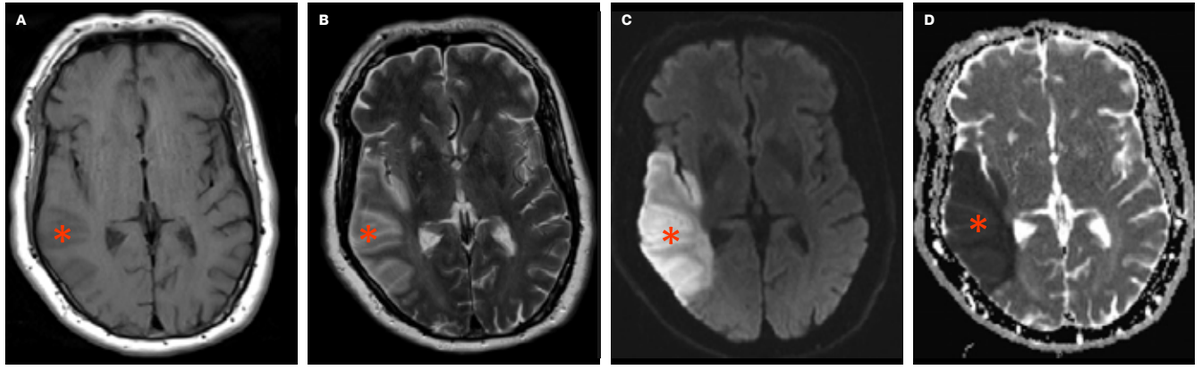

FIGURE 32

Acute right middle cerebral artery territory infarct (asterisks). Hypointense on T1-weighted (A) and hyperintense on T2- weighted images (B), sulcal effacement and mass effect. Diffusion restriction, demonstrating high signal on DWI (C) and low signal on the ADC map (D).

Central Nervous System

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章节大纲：

急性脑缺血患者的 MR 影像表现包括 T1 加权像上白质低信号和 T2 加权像上高信号伴灰质-白质分界消失、脑沟模糊及占位效应。

急性脑卒中导致细胞毒性水肿，引起细胞内水分积聚和水分子的弥散速率整体降低。在扩散加权成像 (Diffusion Weighted Imaging, DWI) 上，水分子运动受限的细胞毒性水肿区域呈高信号，而在表观扩散系数 (apparent diffusion coefficient, ADC) 图上呈低信号（图 32）。

<!> 注意

DWI 是脑卒中影像学检查最敏感的序列。

MR 血管成像有助于检测血管闭塞。

图 32

右侧大脑中动脉供血区急性梗死（星号）。T1 加权像低信号 (A) 和 T2 加权像高信号 (B)，伴脑沟模糊及占位效应。弥散受限表现为 DWI 高信号 (C) 和 ADC 图低信号 (D)。

/ Chronic Ischemic Infarct

MR imaging may help determine the age of an ischemic stroke.

In chronic infarcts, the T1 signal remains low and the T2 signal is high.

The ADC values are high (figure 33), resulting in high signal. DWI signal is variable, but as time goes on signal progressively decreases.

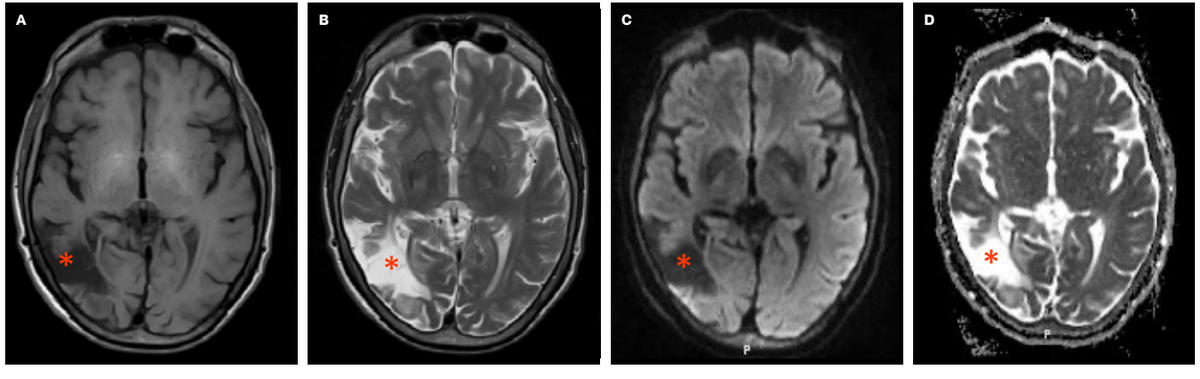

FIGURE 33

Chronic right middle cerebral artery territory infarct (asterisks) as seen on MRI. Hypointense on T1-weighted and hyperintense on T2-weighted images. Low signal on DWI and high signal on the ADC map.

/ Central **Nervous System**

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/ 中枢 **神经系统**

章节大纲：

/ 慢性缺血性梗死

MR 影像有助于确定缺血性脑卒中的发生时间。

慢性梗死表现为，T1 仍为低信号，T2 为高信号。

ADC 值增高（图 33），导致高信号。DWI 信号多变，但随时间推移逐渐降低。

图 33

MRI 显示右侧大脑中动脉供血区慢性梗死（星号）。T1 加权像低信号，T2 加权像高信号。DWI 呈低信号，ADC 图呈高信号。

/ Cerebral Venous Thrombosis

Cerebral venous thrombosis results from occlusion of a dural venous sinus (figure 34), cortical vein or deep cerebral vein. Very often thrombosis of multiple venous structures coexist.

Risk factors include hormonal factors, oral contraceptive pills, prothrombotic haematogenic diseases, sepsis and tumours.

Clinical presentation and imaging findings are variable and correspond to a venous territory distribution.

A poor venous outflow caused by cerebral venous thrombosis can lead to oedema, cerebral venous infarction (50% of cases) and intracranial haemorrhage.

<!> ATTENTION

Cerebral venous thrombosis does not respect the topography of arterial territories. In the absence of a hyperdense sinus or vein, findings can be subtle on non-contrast CT !

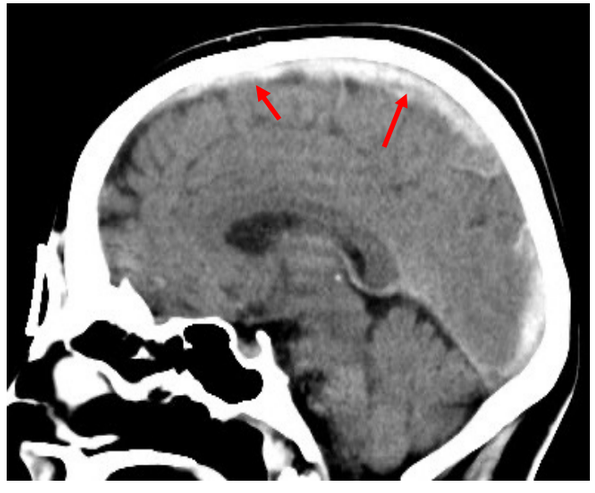

FIGURE 34

Extensive superior sagittal sinus thrombosis as seen on non-contrast CT. The acute thrombus appears hyperdense and is indicated by arrows.

CHAPTER OUTLINE:

章节大纲：

/ 脑静脉血栓形成

脑静脉血栓形成由硬脑膜静脉窦（图 34）、皮质静脉或深部脑静脉闭塞所致。常为多静脉并存血栓形成。

危险因素包括激素因素、口服避孕药、血栓形成性血液疾病、败血症及肿瘤。

其临床特征和影像学表现多样，符合静脉分布区域特征。

脑静脉血栓导致的静脉回流受阻可引起水肿、脑静脉梗死（50% 的病例）和颅内出血。

<!> 注意

脑静脉血栓不符合动脉供血区分布特征。若无静脉窦或静脉高密度征，CT 平扫表现可能十分隐匿！

图 34

CT 平扫显示的广泛上矢状窦血栓。急性血栓呈高密度，用箭头标示。

<!> ATTENTION

/ Haemorrhagic Infarction, Parenchymal Haematoma and Hypertensive Haemorrhage

Haemorrhagic transformation is a complication of ischemic stroke and it includes haemorrhagic infarction (petechial haemorrhage, most often asymptomatic) and parenchymal haematoma (often associated with neurological deterioration). Haemorrhagic transformation is seen more often in patients with anticoagulant treatment or thrombolytic therapy.

Intracerebral haemorrhage can be divided into primary haemorrhage (without an underlying lesion) and secondary haemorrhage (with an underlying lesion). The most common cause of primary haemorrhage is hypertension and the most common cause of secondary haemorrhage is cerebral venous thrombosis.

Hypertensive haemorrhage is typically located in the basal ganglia, thalamus, pons, brain lobes or cerebellum. Haemorrhage is most easily detected with CT as an area of high attenuation on non-contrast images (figure 35), but it can also be depicted with gradient echo (GE)MR-sequences, as low signal intensity areas (figure 36).

On CT angiography, active contrast extravasation can be observed within the haematoma. Complications that can be detected by CT include spread of haemorrhage to other brain areas or ventricles, brain oedema, brain herniation and hydrocephalus. Follow-up CT is used to measure haematoma expansion and is useful for clinical decision making and prognosis.

CHAPTER OUTLINE:

章节大纲：

<!> 注意

/ 出血性梗死、脑实质血肿与高血压性脑出血

出血性转化是缺血性脑卒中的并发症，包括出血性梗死（点状出血，通常无症状）和脑实质血肿（常伴神经功能恶化）。出血性转化更常见于接受抗凝治疗或溶栓治疗的患者。

脑出血可分为原发性出血（无基础病变）和继发性出血（有基础病变）。原发性出血最常见病因为高血压，继发性出血最常见病因为脑静脉血栓。

高血压性脑出血典型部位包括基底节、丘脑、脑桥、脑叶或小脑。CT 平扫最容易检出出血，表现为高密度区域（图 35），但梯度回波（gradient echo，GE）MR 序列也可显示出血，表现为低信号区域（图 36）。

CT 血管成像时，血肿内可见活动性对比剂外渗。CT 可检测到的并发症包括出血扩散至其他脑区或脑室、脑水肿、脑疝和脑积水。随访 CT 用于测量血肿扩大，对临床决策和预后判断具有重要价值。

/ Haemorrhagic Infarction

FIGURE 35

Haemorrhagic infarct (arrow) as seen on CT.

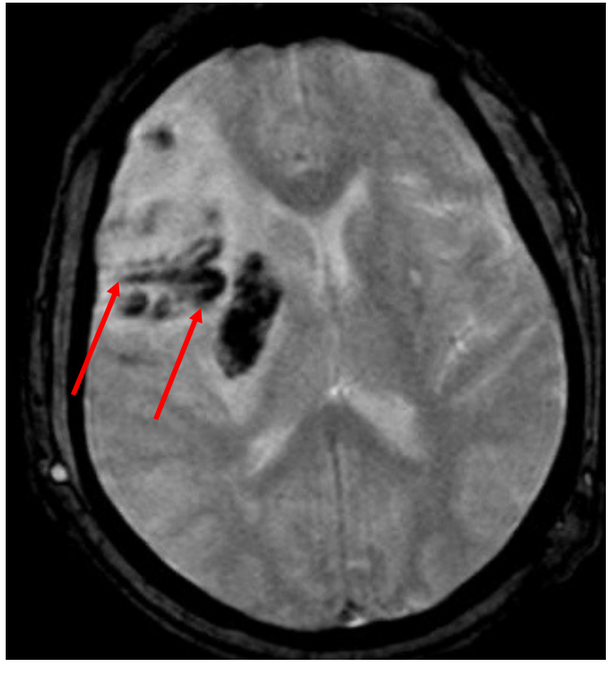

FIGURE 36

Haemorrhagic infarct (arrow) on a gradient- echo sequence

/ Central Nervous System

CHAPTER OUTLINE:

/ 出血性梗死

/ 中枢神经系统

章节大纲：

图 35

CT 显示的出血性梗死（箭头）。

图 36

梯度回波序列显示的出血性梗死（箭头）

/ Brain Tumours

<!> ATTENTION

/ Intra-axial Brain Tumours

These are tumours located within the brain parenchyma. The characteristic radiological sign of intra-axial tumours is the outward displacement of the grey mater and the CSF of the subarachnoid space (figure 37).

Intra-axial tumours include:

- Primary brain tumours:
  - Glial tumours (astrocytoma, oligodendroglioma, ependymoma)
  - Non-glial tumours (lymphoma)
- Brain metastases

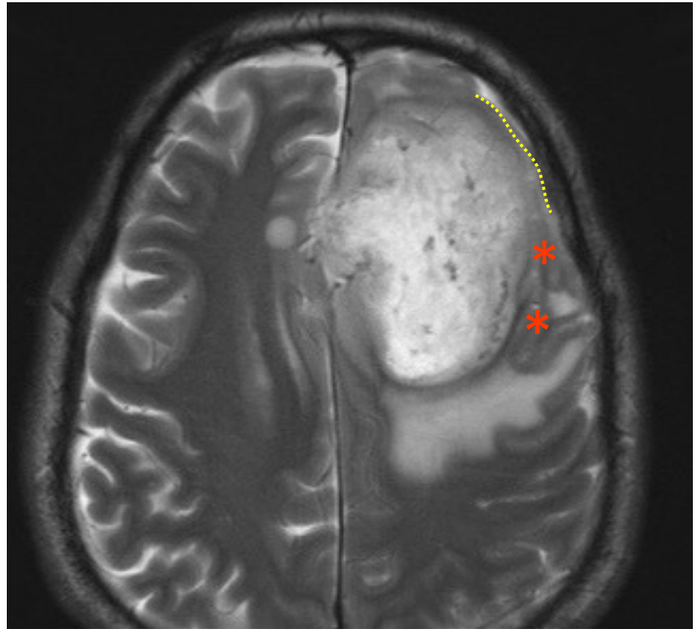

FIGURE 37

T2-weighted image demonstrates the characteristic radiological sign of intra-axial tumours (here a glioblastoma): outward displacement of the grey mater (red asterisks) and the CSF (yellow line) of the subarachnoid space.

/ 脑肿瘤

/ 轴内脑肿瘤

指位于脑实质内的肿瘤。轴内肿瘤的特征性影像学表现是灰质和蛛网膜下腔脑脊液的外移（图 37）。

轴内肿瘤包括：

- 原发性脑肿瘤：
  - 胶质肿瘤（星形细胞瘤、少突神经胶质瘤、室管膜瘤）
  - 非胶质肿瘤（淋巴瘤）
- 脑转移瘤

图 37

T2 加权像显示了轴内肿瘤（此处为胶质母细胞瘤）的特征性放射学征象：灰质（红色星号）和蛛网膜下腔脑脊液（黄线）的外移。

Glioma

Gliomas are brain tumours that start in glial cells. There are three main types of glial cells: astrocytes (provide nutrients to neurons and structural support), oligodendrocytes (form the myelin sheath of axons in the CNS) and ependymal cells (produce cerebrospinal fluid).

Diffuse gliomas are classified into two categories: adult type diffuse gliomas and paediatric type diffuse gliomas according to the CNS World Health organization (WHO).

Adult type gliomas are classified into three catgories bsed on genetic and molecular characteristics. These include : Astrocytoma-IDH mutant, Oligodendrodendroglioma-IDH mutant, 1p/19q codeleted and Glioblastoma (GB)-IDH wild type.

GB is the most common adult type diffuse glioma; it represents 70% of all diffuse gliomas (figure 38).

Astrocytoma-IDH mutant is the second most commonon adult diffuse glioma, accounting for aproximately 12% of adult type diffuse gliomas.

Astrocytoma-IDH mutant is classified as grade 2, 3 ot 4 based on its level of malignancy.

Oligodendroglioma-IDH mutant, 1p/19q is the third most common, representing about 5% of adult type diffuse gliomas, they are classified as grade 2 or 3 based on their malignancy. Oligodendrogliomas arer typically observed in middle-aged adults. Calcification is found in 20%–91% of cases (figure 39).

Ependymomas tend to arise within or abutting the ventricular system or from the lining of the central canal of the spinal cord. They most often occur in the posterior fossa (60%).

<∞> REFERENCES

> For paediatric CNS tumours, see eBook chapter on Paediatric Radiology.

Louis DN, Perry A, Wesseling P, Brat DJ, Cree IA, Figarella-Branger D, Hawkins C, Ng HK, Pfister SM, Reifenberger G, Soffietti R, von Deimling A, Ellison DW. The 2021 WHO Classification of Tumors of the Central Nervous System: a summary. Neuro Oncol. 2021 Aug 2;23(8):1231-1251.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

胶质瘤

胶质瘤是起源于胶质细胞的脑肿瘤。胶质细胞有三种主要类型：星形细胞（为神经元提供营养和结构支持）、少突胶质细胞（形成轴突的髓鞘）和室管膜细胞（产生脑脊液）。

根据世界卫生组织 (World Health organization, WHO) 中枢神经系统分类，弥漫性胶质瘤分为两类：成人型弥漫性胶质瘤和儿童型弥漫性胶质瘤。

成人型胶质瘤根据遗传和分子特征分为三类。包括：星形细胞瘤-IDH 突变型是第二常见的成人型弥漫性胶质瘤类型，约占 12%。

GB 是最常见的成人型弥漫性胶质瘤，占所有弥漫性胶质瘤的 70%（图 38）。

星形细胞瘤-IDH 突变型是第二常见的类型，约占所有成人型弥漫性胶质瘤的 12%。 星形细胞瘤-IDH 突变型根据其恶性程度分为 2 级、3 级或 4 级。

少突胶质细胞瘤-IDH 突变型伴 1p/19q 共缺失位列第三，约占成人型弥漫性胶质瘤的 5%，根据其恶性程度分为 2 级或 3 级。少突胶质细胞瘤常见于中年人。20%-91% 的病例可见钙化（图 39）。

室管膜瘤通常发生于脑室系统内或毗邻区域，或脊髓中央管。它们最常见于颅后窝 (60%)。

<∞> 参考文献

> 儿童 CNS 肿瘤详见电子书《儿科放射学》章节。

Louis DN, Perry A, Wesseling P, Brat DJ, Cree IA, Figarella-Branger D, Hawkins C, Ng HK, Pfister SM, Reifenberger G, Soffietti R, von Deimling A, Ellison DW. The 2021 WHO Classification of Tumors of the Central Nervous System: a summary. Neuro Oncol. 2021 Aug 2;23(8):1231-1251.

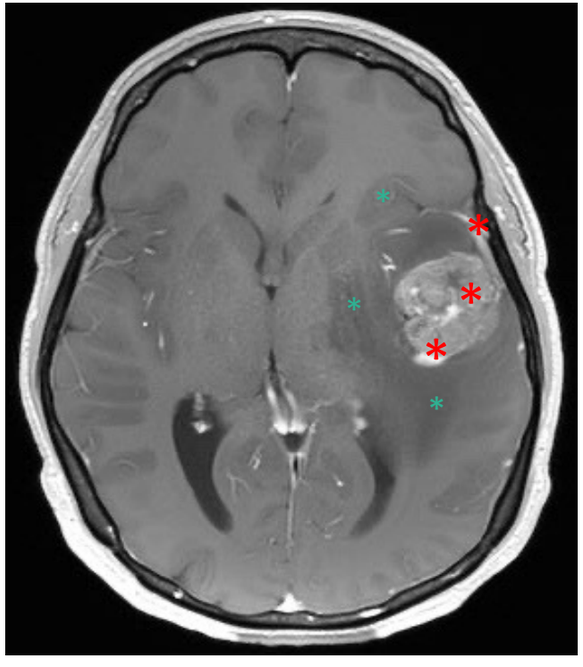

FIGURE 38

Contrast-enhanced T1-weighted image shows a glioblastoma with variable enhancement (red asterisks) surrounded by vasogenic oedema (green asterisks).

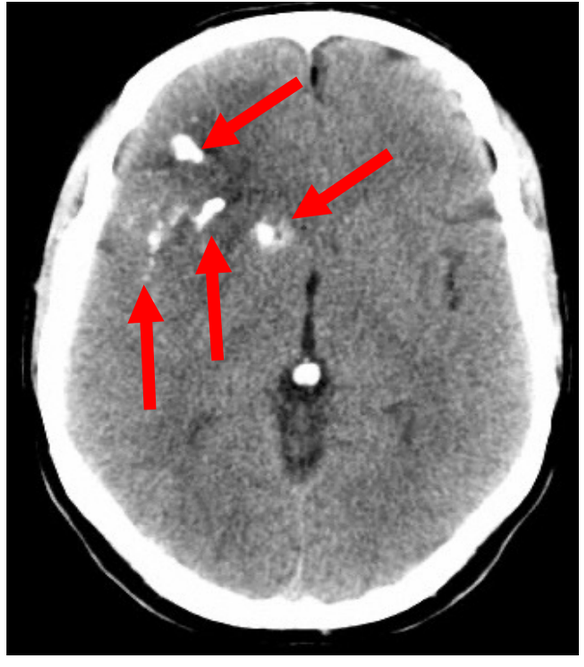

FIGURE 39

Non-contrast CT shows an oligodendroglioma with typical calcifications (arrows).

Central Nervous System

CHAPTER OUTLINE:

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章节大纲：

图 38

增强 T1 加权像显示胶质母细胞瘤呈不均匀强化（红色星号），周围伴血管源性水肿（绿色星号）。

图 39

CT 平扫显示少突神经胶质瘤伴典型钙化（箭头）。

Lymphoma of the CNS has two major subtypes: secondary CNS involvement by systemic lymphoma (most frequent) and primary central nervous system lymphoma (PCNSL) localised in the brain, leptomeninges, spinal cord or eyes, without evidence of it outside the CNS.

Brain lymphoma classically presents as a well defined homogeneously enhancing supratentorial mass with high attenuation values on non-contrast CT images due highly packed abnormal cells.

MRI reveals intermediate to low signal intensity on T1-weighted images and isointense or hypointense signal relative to the grey matter on T2-weighted images, with intense homogeneous enhancement (figure 40). Water diffusion is often restricted due to the high cellularity within the tumour, making it appear strongly hyperintense on DWI and hypointense on ADC maps.

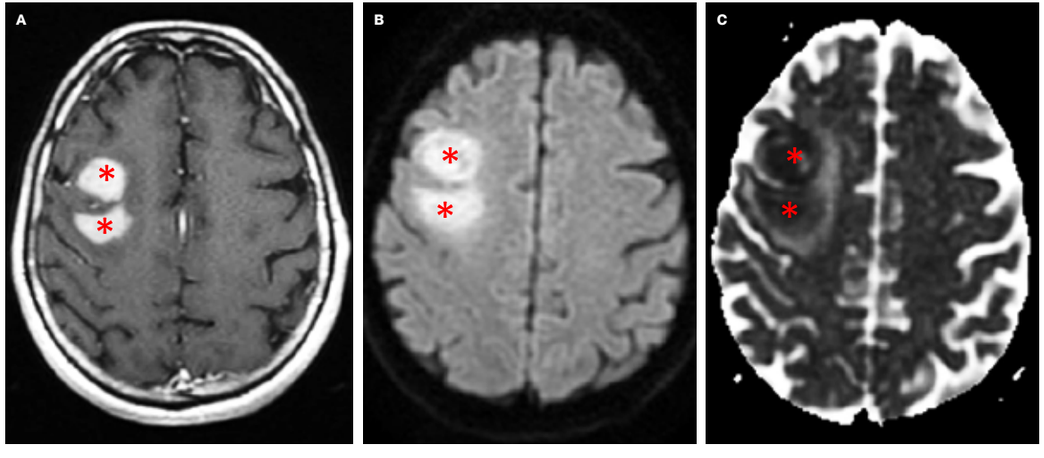

FIGURE 40

Lymphoma (asterisks). Frontal intra-axial mass showing enhancement on the T1-weighted gadolinium enhanced image (A) and diffusion restriction, hyperintense on DWI (B) and hypointense on ADC (C).

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章节大纲：

中枢神经系统淋巴瘤有两种主要亚型：系统性淋巴瘤继发中枢神经系统受累（最常见）和原发性中枢神经系统淋巴瘤 (PCNSL)，后者局限于脑组织、软脑膜、脊髓或眼睛，无中枢神经系统外病灶。

脑淋巴瘤的典型表现为幕上界限清楚的均匀强化肿块，CT 平扫图像因异常细胞密集呈现高密度。

MRI T1 加权像呈中等至低信号，T2 加权像相对于灰质呈等信号或低信号，并出现明显均匀强化（图 40）。因肿瘤高细胞密度常出现弥散受限，使其在 DWI 上呈明显高信号，在 ADC 上呈低信号。

图 40

淋巴瘤（星号）。额叶肿块在 T1 加权增强像显示强化 (A)和弥散受限，DWI 高信号 (B) 和 ADC 低信号 (C)。

Brain metastases are characteristically located in the grey matter-white matter junction. They represent the most frequent brain tumours in adults.

Multiple tumours in the brain usually indicate metastatic disease. Multiple nodular enhancing lesions are seen in hematogenous dissemination of metastatic neoplasms (figure 41).

In adults, the most common primary tumours responsible for brain metastases are carcinomas originating in the lung, breast, kidney, colon and melanoma.

<!> ATTENTION

MRI is more sensitive than contrast-enhanced CT for the detection of brain metastases. MRI is the preferred imaging modality to detect brain metastases.

<∞> REFERENCES

Smirniotopoulos J.G.,. Murphy F.M., Rushing E.J.,Rees J.H.,Schroeder. Patterns of Contrast Enhancement in the Brain and Meninges. RadioGraphics 2007; 27:525–551

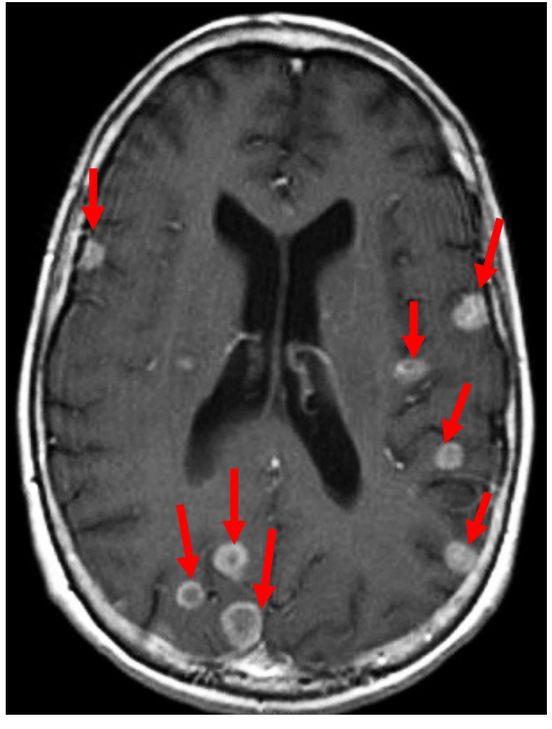

FIGURE 41

Multiple ring enhancing intra- axial lesions (arrows) on a T1- weighted contrast-enhanced image. Metastases from lung adenocarcinoma.

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中枢神经系统

章节大纲：

脑转移瘤通常位于灰质-白质交界处。它们是成人中最常见的脑肿瘤。

脑内多发性肿瘤通常提示转移性疾病。血行播散的转移性肿瘤可见多发性结节状强化灶（图 41）。

在成人中，导致脑转移瘤的最常见原发肿瘤是肺癌、乳腺癌、肾癌、结肠癌和黑色素瘤。

<!> 注意

MRI 检测脑转移瘤的敏感性高于增强 CT。MRI 是检测脑转移瘤的首选影像学检查方式。

<∞> 参考文献

Smirniotopoulos J.G.,. Murphy F.M., Rushing E.J.,Rees J.H.,Schroeder. Patterns of Contrast Enhancement in the Brain and Meninges. RadioGraphics 2007; 27:525–551

图 41

Multiple ring enhancing intra- axial lesions (arrows) on a T1- weighted contrast-enhanced image. Metastases from lung adenocarcinoma.

/ Extra-axial Brain Tumours

These are tumours located outside the brain parenchyma. A CSF cleft and medial displacement of both the subarachnoid vessels and the grey matter are characteristic signs of extra-axial tumours.

The most common extra-axial tumours are the following:

- / Meningioma / solitary fibrous tumour (2021 WHO classification term replacing the older term “hemangiopericytoma”)
- / Craniopharyngioma
- / Pineal parenchymal tumours
- / Cranial nerve schwannomas

Other most common mass-like extra-axial lesions are:

- / Epidermoid cysts
- / Arachnoid cysts

<∞> REFERENCES

Louis DN, Perry A, Wesseling P, Brat DJ, Cree IA, Figarella-Branger D, Hawkins C, Ng HK, Pfister SM, Reifenberger G, Soffietti R, von Deimling A, Ellison DW. The 2021 WHO Classification of Tumors of the Central Nervous System: a summary. Neuro Oncol. 2021 Aug 2;23(8):1231-1251.

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章节大纲：

/ 轴外脑肿瘤

指位于脑实质外的肿瘤。脑脊液裂隙以及蛛网膜下腔血管和灰质的内侧移位是轴外肿瘤的特征性表现。

最常见的轴外肿瘤包括：

- / 脑膜瘤/孤立性纤维性肿瘤（2021 年 WHO 分类术语，取代旧术语“血管外皮细胞瘤”）
- / 颅咽管瘤
- / 松果体实质肿瘤
- / 颅神经鞘瘤

其他最常见的肿瘤样轴外病变包括：

- / 表皮样囊肿
- / 蛛网膜囊肿

<∞> 参考文献

Louis DN, Perry A, Wesseling P, Brat DJ, Cree IA, Figarella-Branger D, Hawkins C, Ng HK, Pfister SM, Reifenberger G, Soffietti R, von Deimling A, Ellison DW.The 2021 WHO Classification of Tumors of the Central Nervous System: a summary.Neuro Oncol.2021 Aug 2;23(8):1231-1251.

Meningioma is the most common tumour of the meninges (non-glial neoplasm) and the most common extra-axial tumour.

Meningiomas are most often indolent, they are more common in women and are typically seen after 40 years of age. Malignant and atypical meningiomas are slightly more often seen in males.

Clinical symptoms include headache, paralysis and mental status changes.

As with other CNS tumours, molecular markers contribute to the diagnosis and grading of meningioma subtypes.

The MRI features of meningiomas are characteristic (figures 42 and 43).

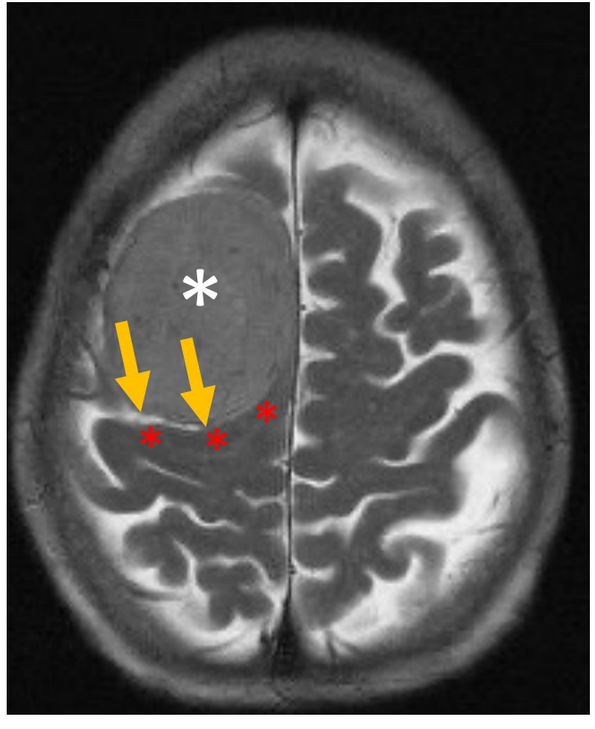

FIGURE 42

Meningioma (white asterisk). Medial displacement of the CSF (yellow arrows) and grey matter (red asterisks) typical of an extra-axial tumour.

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CHAPTER OUTLINE:

中枢神经系统

章节大纲：

脑膜瘤是最常见的脑膜肿瘤（非胶质肿瘤），也是最常见的轴外肿瘤。

脑膜瘤通常生长缓慢，女性更常见，且多发生于 40 岁以上人群。恶性和非典型性脑膜瘤在男性中稍多见。

临床症状包括头痛、瘫痪和意识状态改变。

与其他中枢神经系统肿瘤类似，分子标志物有助于脑膜瘤亚型的诊断和分级。

脑膜瘤的 MRI 表现具有特征性（图 42 和 43）。

图 42

脑膜瘤（白色星号）。脑脊液（黄色箭头）和灰质（红色星号）的内侧移位是轴外肿瘤的典型表现。

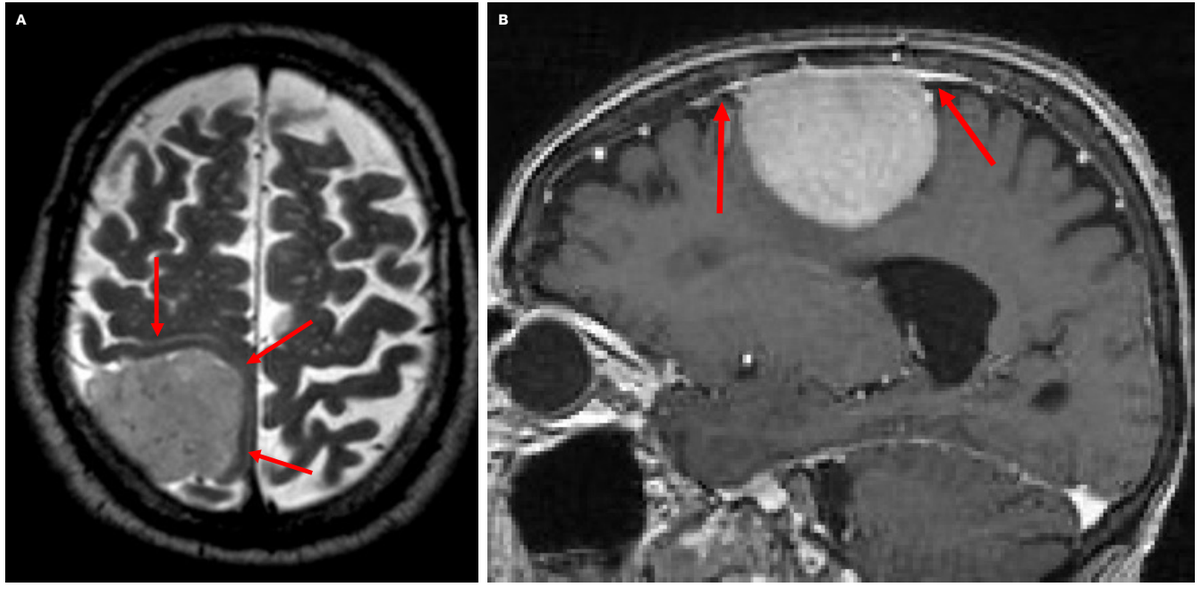

FIGURE 43

Characteristic MRI features of meningioma. (A) Axial T2-weighted image shows medial displacement of grey matter (arrows) by the meningioma (asterisk). (B) Contrast-enhanced sagittal T1-weighted image shows homogeneous enhancement and a broad dural base or a dural tail (arrows).

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章节大纲：

图 43

脑膜瘤的特征性 MRI 表现。(A) 轴位 T2 加权像显示脑膜瘤（星号）造成灰质内侧移位（箭头）。(B) 对比增强矢状位 T1 加权像显示均匀强化及宽大的硬膜基底或硬膜尾征（箭头）。

Epidermoid is a rare, benign congenital lesion derived from ectoderm and lined by squamous epithelium. Epidermoid has cystic contents including debris, keratin, water and cholesterol. The lesion typically occurs between 20 and 40 years of age.

On many MRI sequences, epidermoids are indistinguishable from simple arachnoid cysts, with the exception of DWI sequences as epidermoids display restricted diffusion, as opposed to arachnoid cysts, which do not (figure 45).

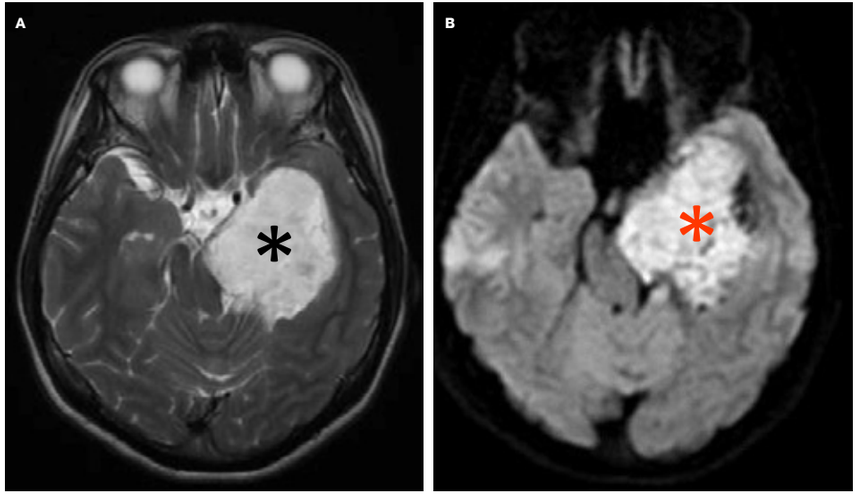

FIGURE 44

On T2-weighted MR images (A) the epidermoid (asterisk) has a high signal similar to CSF. On the DWI image (B), the epidermoid (asterisk) has a high signal because of restricted diffusivity allowing its differentiation from an arachnoid cyst. Arachnoid cysts have a low signal on DWI because diffusivity is not restricted as they contain CSF.

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章节大纲：

表皮样囊肿是一种罕见的良性先天性病变，起源于外胚层并由鳞状上皮覆盖。表皮样囊肿囊内含有碎屑、角蛋白、水分和胆固醇等成分。该病变好发于 20 至 40 岁人群。

在多数 MRI 序列上，表皮样囊肿与单纯性蛛网膜囊肿难以区分，但 DWI 序列例外 - 表皮样囊肿表现为扩散受限，而后者则无此表现（图 45）。

图 44

在 T2 加权 MR 图像 (A) 上，表皮样囊肿（星号）呈现与脑脊液相似的高信号。在 DWI 图像 (B) 中，由于扩散受限，表皮样囊肿（星号）呈现高信号，借此可与蛛网膜囊肿相鉴别。蛛网膜囊肿因内含脑脊液且无扩散受限，在 DWI 上表现为低信号。

/ Pituitary Gland Tumours

The most frequent pituitary gland tumours are adenomas (figure 45): microadenomas < 10mm size and macroadenomas > 10mm size. Macroadenomas can extend superiorly compressing the optic chiasm and laterally they can extend into the cavernous sinus.

Pituitary adenomas either present with hormonal imbalance (about half of them are secretory) or mass effect on the optic chiasm and cavernous sinus. Very large tumours can lead to hydrocephalus or they can invade the paranasal sinuses.

Other common lesions that can be found in the pituitary gland region are Rathke's cleft cyst and craniopharyngiomas (figure 46). There are two distinct types of craniopharyngiomas (adamantinomatous and papillary) that can be differentiated one from another on the basis of molecular testing. Both craniopharyngioma types arise in the sellar/ suprasellar region and are relatively benign.

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 中枢 **神经系统**

章节大纲：

/ 垂体肿瘤

最常见的垂体瘤是腺瘤（图 45）：微腺瘤（<10 mm）和大腺瘤（>10 mm）。大腺瘤可向上生长压迫视交叉，或向侧方延伸至海绵窦。

垂体腺瘤的临床表现包括激素失衡（约半数具有分泌功能）或对视交叉和海绵窦的占位效应。巨大肿瘤可能导致脑积水或侵犯副鼻窦。

鞍区其他常见病变包括 Rathke 裂囊肿和颅咽管瘤（图 46）。颅咽管瘤有 2 种不同类型（造釉细胞型和乳头型），可通过分子检测来鉴别。两种类型均发生于鞍区/鞍上区，且相对良性。

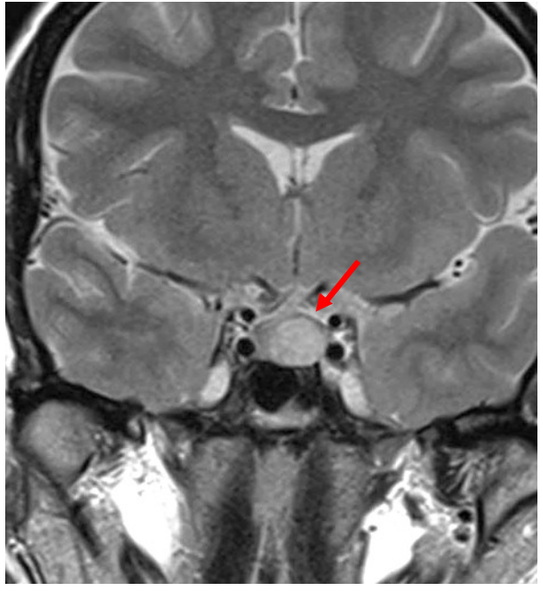

FIGURE 45

Typical macroadenoma (arrow) on a coronal T2- weighted image

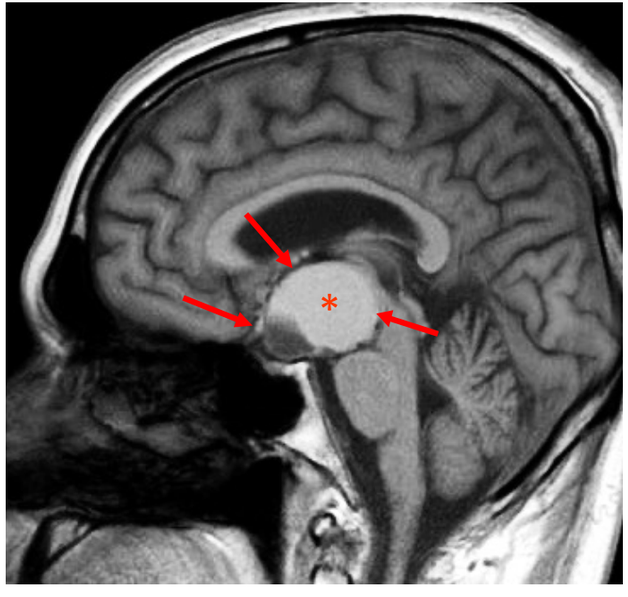

FIGURE 46

Craniopharyngioma (arrows) on a sagittal T1-weighted image. Note the large cystic hyperintense component (asterisk).

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CHAPTER OUTLINE:

章节大纲：

图 45

冠状位 T2 加权像显示的典型大腺瘤（箭头）

图 46

矢状位 T1 加权像显示的颅咽管瘤（箭头）。注意其巨大的囊性高信号成分（星号）。

/ Inflammatory/Infectious Disease

/ Demyelinating Disease

Multiple sclerosis (MS) is the most common inflammatory demyelinating disease of the central nervous system in young and middle-aged adults.

White matter lesions in MS characteristically involve the periventricular white matter, corpus callosum, U-fibers, temporal lobes, brainstem, cerebellum and spinal cord (figure 47).

Dawson fingers (ovoid lesions perpendicular to the ventricles) are typical for MS and are the result of inflammation around penetrating venules.

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 炎症性/感染性疾病

/ 脱髓鞘疾病

/ 中枢 **神经 系统**

章节大纲：

多发性硬化 (multiple sclerosis, MS) 是青中年人群中最常见的中枢神经系统炎性脱髓鞘疾病。

MS 的白质病变通常累及脑室周围白质、胼胝体、U 型纤维、颞叶、脑干、小脑和脊髓（图 47）。

Dawson 手指征（垂直于脑室的卵圆形病变）是 MS 的典型表现，由穿通小静脉周围炎症所致。

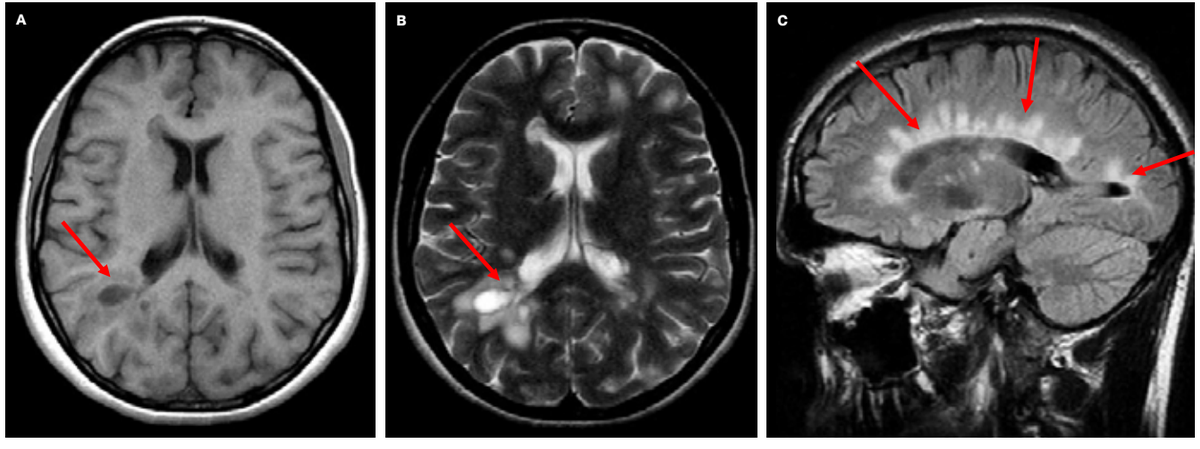

FIGURE 47

Multiple sclerosis with characteristic periventricular white matter ovoid lesions perpendicular to the ventricles (arrows). The lesions are isointense on T1-weighted (A), hyperintense on T2-weighted (B) and on FLAIR (C) images.

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章节大纲：

图 47

多发性硬化伴垂直于脑室的特征性脑室周围白质卵圆形病灶（箭头）。病灶在 T1 加权像上呈等信号 (A)，在 T2 加权像 (B) 和 FLAIR (C) 上呈高信号。

/ Infections

Infections of the CNS can be produced by different agents; bacterial, viral, fungal, or parasitic. The spectrum of abnormalities seen include: meningitis, cerebritis, abscesses, subdural or epidural empyema, and ventriculitis.

Immunocompromised patients have an increased risk for infectious complications. Infections can be viral, bacterial, fungal or parasitic in origin.

Bacterial brain abscesses (figure 48) present as focal masses with a high signal intensity centre on T2- weighted images with marked perifocal oedema, and ring-like enhancement on gadolinium enhanced T1- weighted images. Restricted diffusion is seen on DWI due to the viscosity of pus, resulting in a high signal intensity on DWI and low ADC.

Progressive multifocal leukoencephalopathy (PML) is a demyelinating disorder which occurs in immunocompromised patients as a results of the reactivation of the John Cunningham (JC) virus. Classically it is seen in HIV patients, in post-transplant or leukemia patients. In addition, PML is also seen in patients with recovering immune system. PML involves the white matter. Lesions have low signal intensity on T1-weighted and high signal intensity on T2-weighted images and neither show restriction on DWI nor enhancement with gadolinium (figure 49).

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 中枢 **神经系统**

章节大纲：

/ 感染

CNS 感染可由不同的病原体引起，包括细菌、病毒、真菌或寄生虫。所见异常表现包括：脑膜炎、脑炎、脓肿、硬膜下或硬膜外积脓和脑室炎。

免疫功能低下患者发生感染性并发症的风险更高。感染源可为病毒、细菌、真菌或寄生虫。

细菌性脑脓肿（图 48）表现为局灶性肿块，T2 加权像呈中心高信号伴明显的灶周水肿，增强 T1 加权像呈环状强化。由于脓液黏度较高，DWI 弥散受限，可见 DWI 呈高信号，ADC 较低。

进行性多灶性白质脑病 (progressive multifocal leukoencephalopathy, PML) 是一种脱髓鞘疾病，由 John Cunningham (JC) 病毒再激活引发，见于免疫功能低下患者。典型病例见于 HIV 感染者、移植后或白血病患者。此外，免疫系统恢复期患者也可能出现 PML。PML 累及白质。病灶在 T1 加权像上呈低信号，T2 加权像上呈高信号，DWI 上无受限表现，钆增强后也无强化（图 49）。

/ Bacterial Abscess

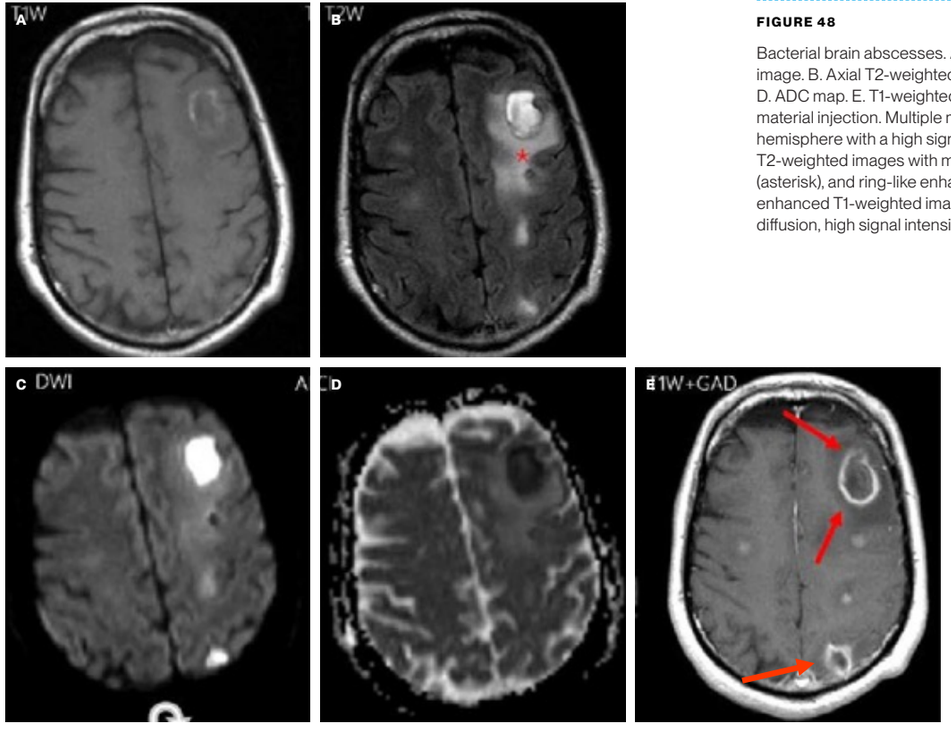

FIGURE 48

Bacterial brain abscesses. A. Axial T1-weighted image. B. Axial T2-weighted image. C. DWI image. D. ADC map. E. T1-weighted image after contrast material injection. Multiple masses in the left brain hemisphere with a high signal intensity centre on T2-weighted images with marked perifocal oedema (asterisk), and ring-like enhancement on gadolinium enhanced T1-weighted images (arrows). Restricted diffusion, high signal intensity on DWI and low ADC.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

/ 细菌性脓肿

章节大纲：

图 48

细菌性脑脓肿。A.轴位 T1 加权像。B.轴位 T2 加权像。C.DWI 图像。D.ADC 图。E.注射对比剂后的 T1 加权像。左脑半球多发占位性病变，T2 加权像呈中心高信号伴明显灶周水肿（星号），钆增强 T1 加权像呈环状强化（箭头）。弥散受限，DWI 呈高信号，ADC 值低。

/ Progressive Multifocal Leukoencephalopathy (PML)

Progressive multifocal leukoencephalopathy (PML) is a demyelinating disorder which occurs in immunocompromised patients as a result of the reactivation of the John Cunningham (JC) virus.

Classically it is seen in HIV patients, in post-transplant or leukemia patients. In addition, PML is also seen in patients with recovering immune system. PML involves the white matter (figure 49).

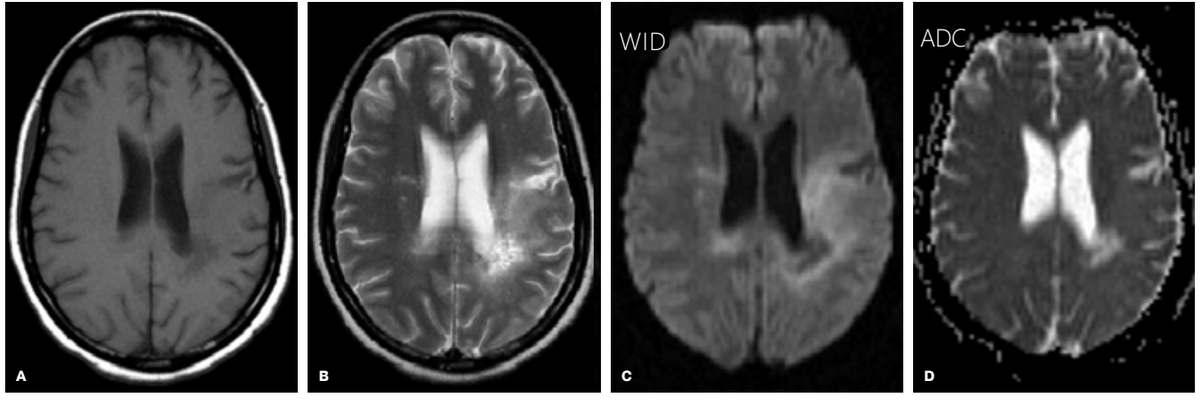

FIGURE 49

Characteristic PML findings. Lesions have low signal intensity on T1-weighted (A) and high signal intensity on T2-weighted (B) images and neither show restriction on DWI (C and D). They are bilateral, asymmetric, supratentorial and confluent. No enhancement with gadolinium is seen (not shown).

/ Central **Nervous System**

CHAPTER OUTLINE:

/ 中枢 **神经系统**

章节大纲：

/ 进行性多灶性白质脑病 (PML)

进行性多灶性白质脑病 (PML) 是一种脱髓鞘疾病，由 John Cunningham (JC) 病毒再激活引发，见于免疫功能低下患者。典型病例见于 HIV 感染者、移植后或白血病患者。此外，免疫系统恢复期患者也可能出现 PML。PML 累及白质（图 49）。

图 49

PML 特征性影像表现。病灶在 T1 加权像 (A) 上呈低信号，T2 加权像 (B) 上呈高信号，DWI（C 和 D）上无弥散受限表现。病灶呈双侧不对称性分布，位于幕上脑区并呈融合性改变。钆增强扫描未见强化（未放置图像）。

Neurodegenerative Disorders

Neurodegenerative disorders include a wide spectrum of diseases including diseases that produce dementia and movement disorders.

- Alzheimer disease (figure 50): most common form of dementia. Accumulation of cerebral amyloid-β (Aβ) within the brain leads to inflammation, neurotoxicity and finally atrophy in typical brain locations, i.e., mesial temporal lobe, especially the hippocampus, and temporo-parietal cortex.
- Vascular dementia: second most common cause of dementia. The accumulation of white matter lesions and cerebral haemorrhage is caused by chronic hypertension and atherosclerosis.
- Parkinson: nigrostriatal dopaminergic degeneration.
- Multiple system atrophy (MSA, figure 51): anomalies in alpha synuclein metabolism.
- Cerebral amyloid angiopathy: accumulation of cerebral amyloid-β (Aβ) in cortical vessels leading to lobar intracerebral haemorrhage.
- Creutzfeldt-Jakob disease (CJD, figure 52): transmissible encephalopathy caused by a prion protein (causes bovine spongiform encephalopathy in cows).

<!> ATTENTION

MRI is the imaging modality of choice for the assessment of volume changes in typical brain locations and can distinguish between different types of dementia.

Nuclear medicine studies are also very useful to assess dementias as they can detect brain abnormalities prior to symptom onset.

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神经退行性疾病

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章节大纲：

神经退行性疾病涵盖一系列疾病，包括导致痴呆和运动障碍的疾病。

- 阿尔茨海默病（图 50）：最常见的痴呆类型。β-淀粉样蛋白 (Aβ) 在脑内积聚，引发炎症反应、神经毒性，最终导致典型脑区萎缩，例如，内侧颞叶，尤其是海马体和颞顶叶皮质。
- 血管性痴呆：痴呆的第二常见病因。慢性高血压和动脉粥样硬化导致白质病变进展和脑出血。
- 帕金森病：黑质纹状体多巴胺能神经元变性。
- 多系统萎缩（MSA，图 51）：α-突触核蛋白代谢异常。
- 脑血管淀粉样变性：β-淀粉样蛋白 (Aβ) 在皮质血管中积聚，引发脑叶出血。
- 克雅氏病（CJD，图 52）：由朊蛋白（引起牛海绵状脑病）引起的传染性脑病。

<!> 注意

评估典型脑区体积变化，MRI 是首选的影像学检查方法，可区分不同类型的痴呆。

核医学检查对痴呆评估同样重要，因其可在症状出现前检测到脑部异常。

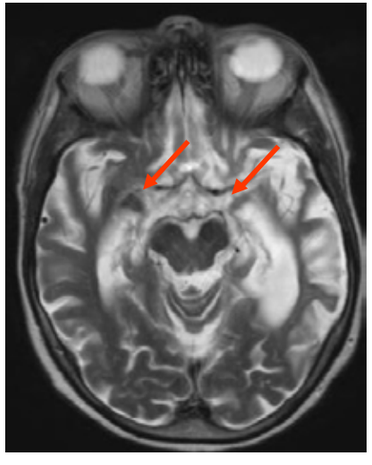

FIGURE 50

Alzheimer global cortical atrophy and hippocampal atrophy (arrows) on T2-weighted image.
Compare image with Fig. 9 (normal brain without atrophy).

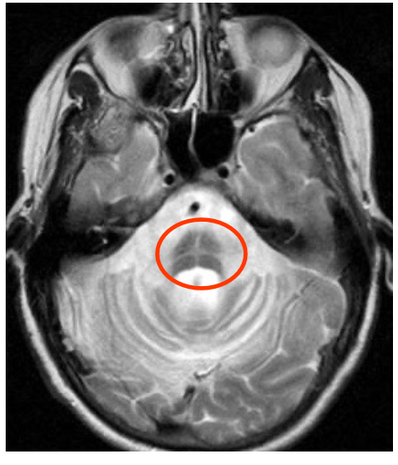

FIGURE 51

MSA pontine atrophy with hot cross bun sign on T2-weighted images (hyperintense signal of the pons, red circle).

FIGURE 52

CJD characteristic imaging findings on DWI include restricted diffusion in the cerebral cortex, in the striatum (arrows) and in the thalamus (asterisks

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章节大纲：

图 50

T2 加权像显示阿尔茨海默病全脑皮质萎缩及海马体萎缩（箭头）。可与图 9（正常无萎缩脑组织）进行对比。

图 51

T2 加权像显示 MSA 脑桥萎缩伴十字面包征（脑桥高信号，红圈）。

图 52

CJD 在 DWI 上的特征性影像学表现包括大脑皮质、纹状体（箭头）和丘脑（星号）弥散受限

/ Vascular Lesions

Intracranial aneurysms are localised pathological dilatations of cerebral arteries (figure 53). Rupture risk is estimated using a score which includes several parameters, such as age, population characteristics, hypertension, site and size of the aneurysm and previous subarachoid haemorrhage.

Intracranial vascular malformations (figure 54) include: brain capillary telangiectasia, development venous anomaly, cerebral cavernous malformation, arteriovenous and dural arteriovenous malformations.

<!> ATTENTION

CT-angiography and MR-angiography are the imaging methods of choice for the diagnosis of vascular lesions.

Digital subtraction angiography is used to assess the flow dynamics and for endovascular treatment..

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/ 血管病变

章节大纲：

颅内动脉瘤是脑动脉的局部病理性扩张（图 53）。其破裂风险通过评分系统评估，参数包括年龄、人群特征、高血压、动脉瘤位置与大小，以及既往蛛网膜下腔出血史。

颅内血管畸形（图 54）包括：脑毛细血管扩张、发育性静脉异常、脑海绵状血管畸形、动静脉畸形及硬脑膜动静脉畸形。

<!> 注意

CT 血管成像和 MR 血管成像是诊断血管病变的首选影像学方法。

数字减影血管成像用于评估血流动力学及腔内治疗。

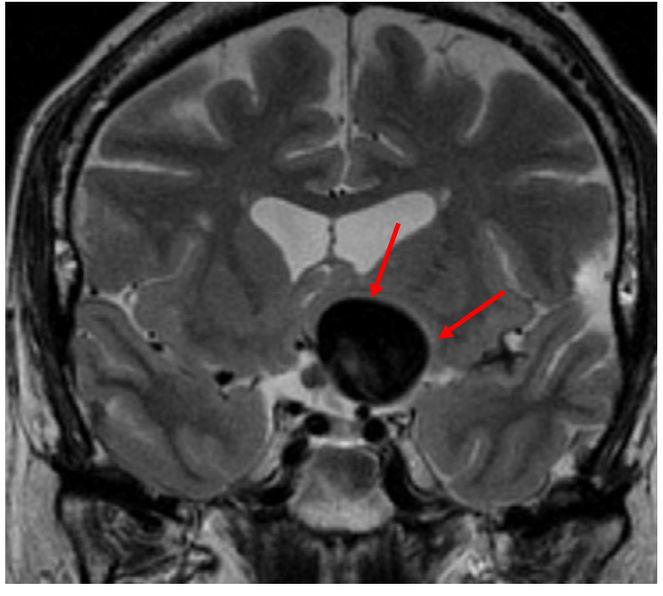

FIGURE 53

Left internal carotid artery aneurysm (arrows)

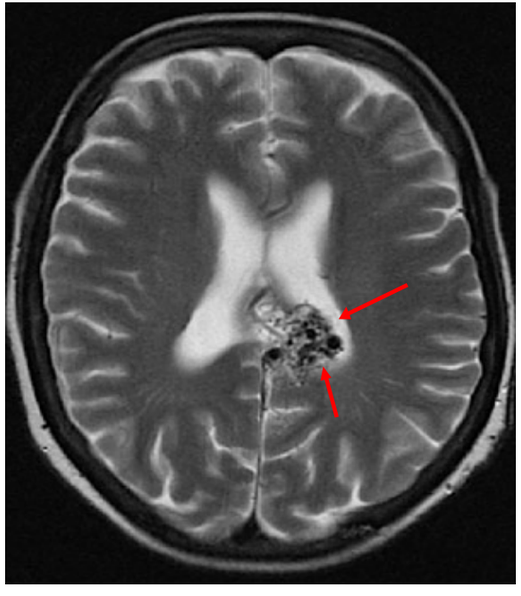

FIGURE 54

Arteriovenous malformation seen as curvilinear, dilated structures with flow voids (arrows)

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章节大纲：

图 53

左侧颈内动脉瘤（箭头）

图 54

动静脉畸形表现为迂曲扩张的流空信号影（箭头）

Main Indications to Spinal Cord Imaging by Pathology

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章节大纲：

按病理分类的脊髓影像学主要适应症

/ Spinal Cord: Main Indications

Trauma

/ Vertebral fractures, spinal cord injury

Degenerative disease

Spinal tumours

/ Intramedullary, intradural, extradural

Infarcts/Inflammatory/infectious diseases

Vascular lesions

/ - Infarct, Arterio-venous malformations

CHAPTER OUTLINE:

/ 脊髓：主要适应症

章节大纲：

外伤

/ 椎体骨折、脊髓损伤

退行性疾病

脊柱肿瘤

/ 髓内、硬膜内、硬膜外

梗死/炎症性/感染性疾病

血管病变

/ - 梗死、动静脉畸形

/ Trauma

/ Vertebral Fractures

Compression fractures are the most common form of spinal injury seen in 90% of cases. There is either loss of height of the anterior part of the vertebral body or disruption of the vertebral endplate, the posterior cortex of the vertebral body is intact (figure 55).

In burst fractures, there is loss of height of the vertebral body and retropulsion of a posterior vertebral body fragment (figure 56).

In translation – rotation fractures, there is displacement in the horizontal plane. In distraction fractures, there is separation of two adjacent vertebrae.

<∞> REFERENCE

> see also eBook chapter on Musculoskeletal Imaging

<!> ATTENTION

CT and MRI are complementary imaging techniques in spinal trauma:

- CT is the first line imaging technique in the emergency setting. It is accurate, fast and cost-effective and allows precise evaluation of bone structures.
- Disc herniation and haemorrhage should be evaluated with MRI. In addition, MRI should be used whenever spinal cord injury is suspected and to determine the cause of spinal cord compression.

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章节大纲：

/ 外伤

/ 椎体骨折

压缩性骨折是最常见的脊柱损伤形式，见于 90% 的病例。表现为椎体前部高度丢失或椎体终板断裂，但椎体后缘皮质保持完整（图 55）。

爆裂性骨折表现为椎体高度丢失，并伴有椎体后缘骨块后移（图 56）。

平移-旋转骨折表现为水平方向上的椎体移位。牵拉性骨折表现为相邻两节椎体分离。

<∞> 参考文献

> 另请参阅《骨骼肌肉影像学》电子书章节

<!> 注意

CT 和 MRI 是脊柱创伤的互补成像技术：

- CT 是急诊情况下的首选影像学检查方法。具有准确、快速、经济高效的特点，可精确评估骨结构。
- 椎间盘突出和出血应使用 MRI 进行评估。此外，当怀疑脊髓损伤或需明确脊髓受压原因时，都应进行 MRI 检查。

FIGURE 55

Compression fracture

FIGURE 56

Burst fracture

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章节大纲：

图 55

压缩性骨折

图 56

爆裂性骨折

/ Spinal Cord Injury

Spinal cord injuries after trauma are better depicted on MRI images.

The spectrum of cord injuries after trauma include: intraspinal haemorrhage, cord oedema and contusion.

Cord oedema and contusion depict high signal intensity on T2-weighted MRI images (figure 57).

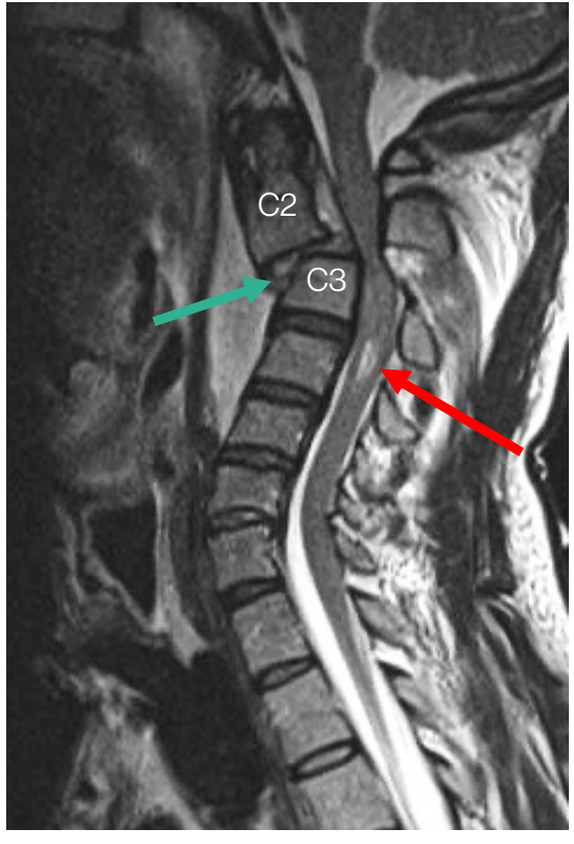

FIGURE 57

Sagittal T2-weighted image depicting disc fracture (green arrow), C2-C3 vertebral luxation and cord contusion (red arrow)

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/ 中枢神经系统

章节大纲：

/ 脊髓损伤

创伤后的脊髓损伤在 MRI 图像上显示更佳。

创伤后脊髓损伤的类型包括：椎管内出血、脊髓水肿及脊髓挫伤。

脊髓水肿及脊髓挫伤在 T2 加权 MRI 图像上呈高信号（图 57）。

图 57

矢状位 T2 加权图像显示椎间盘断裂（绿色箭头）、C2-C3 椎体脱位及脊髓挫伤（红色箭头）

/ Degenerative Disease

Degenerative disease of the spine includes degeneration of bony structures and the intervertebral disc.

Osteochondrosis comprise; disc height loss, intradiscal gas collections (vacuum), endplate erosion and sclerosis.

Spondylosis occurs as a consequence of degeneration of the vertebral bodies with osteophytes or bony spurs formation.

Disc herniation is defined as localised displacement of disc material beyond the normal margins of the intervertebral disc space (figures 58 and 59).

Disc herniation is classified as protrusion or extrusion (figure 60).

<∞> REFERENCES

> see also eBook chapter on Musculoskeletal Imaging

Kushchayev S.V., Glushko T., Jarraya M., Schuleri K.H., Preul M.C., Brooks M.L., Teytelboym O.M. ABCs of the degenerative spine. Insights into Imaging 2018; 9:253–274

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章节大纲：

/ 退行性疾病

脊柱退行性疾病包括骨性结构及椎间盘的退行性改变。

骨软骨病包括椎间盘高度丢失、椎间盘内积气（真空现象）、终板侵蚀及硬化。

椎体退行性变可导致椎体骨赘或骨刺形成，称为脊椎病。

椎间盘突出是指椎间盘物质局限性移位超出椎间隙正常边界（图 58 和图 59）。

椎间盘突出可分为突出型或脱出型（图 60）。

<∞> 参考文献

> 另请参阅《骨骼肌肉影像学》电子书章节

Kushchayev S.V., Glushko T., Jarraya M., Schuleri K.H., Preul M.C., Brooks M.L., Teytelboym O.M. ABCs of the degenerative spine. Insights into Imaging 2018; 9:253–274

/ Disc Herniation

FIGURE 58

Cervical disc herniation (T2- weighted image, arrows)

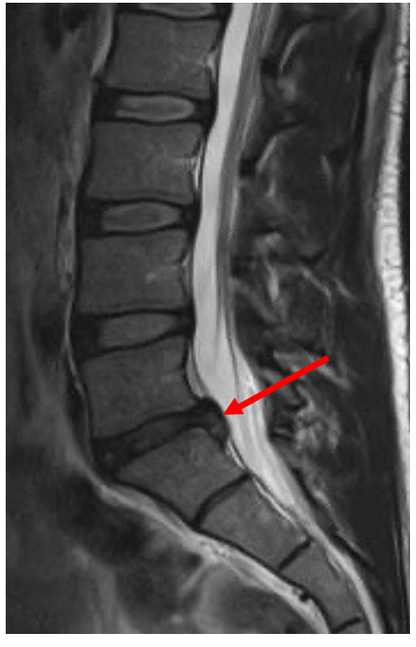

FIGURE 59

Lumbar disc herniation (T2-weighted image, arrow)

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/ 中枢神经系统

/ 椎间盘突出

章节大纲：

图 58

颈椎间盘突出（T2 加权像，箭头）

图 59

腰椎间盘突出（T2 加权像，箭头）

/ Disc Herniation

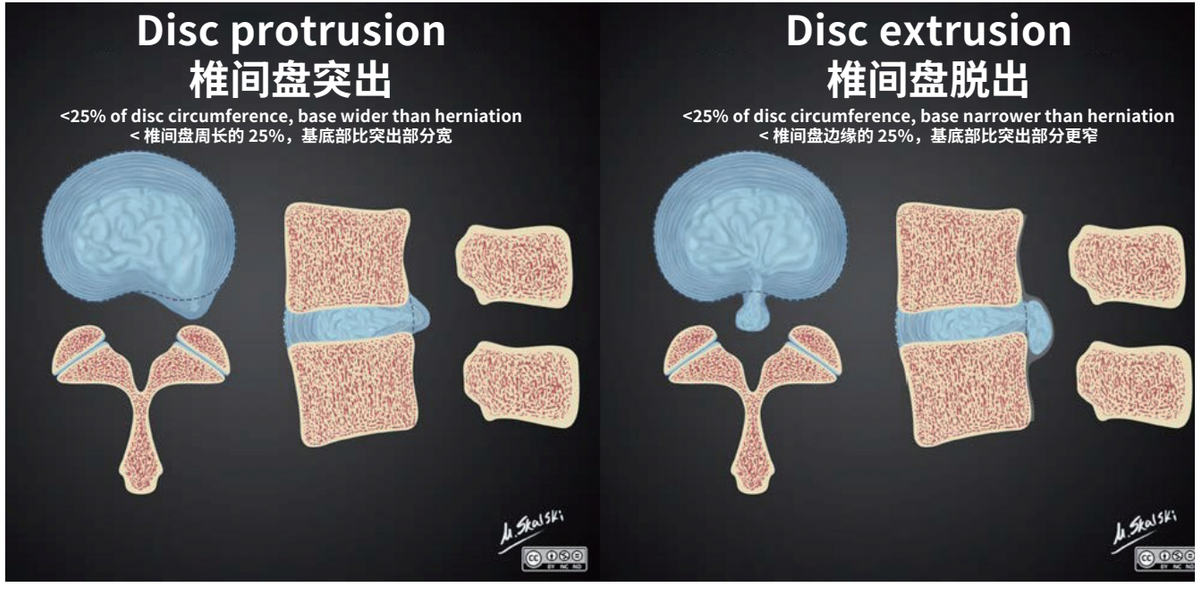

FIGURE 60

Difference between disk protrusion and disk extrusion. Case courtesy of Dr Matt Skalski, Radiopaedia.org, rID: 32040.

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/ 中枢 **神经系统**

/ 椎间盘突出

章节大纲：

图 60

椎间盘突出和椎间盘脱出之间的差异。病例由 Dr Matt Skalski 提供。Radiopaedia.org. rID：32040.

The abnormalities that can be demonstrated by CT in spinal degenerative disease include osteophyte formation (spondylosis); hypertrophy of articular processes; articular cartilage thinning; vacuum phenomenon in joints and discs; synovial and subchondral cysts (osteochondrosis) and calcification of the joint capsule, vertebral end plates and ligaments (figure 61).

Magnetic resonance imaging better depicts internal disc dehydration and degeneration demonstrating low signal on T2 Weighted images secondary to decrease in the water content (figure 61).

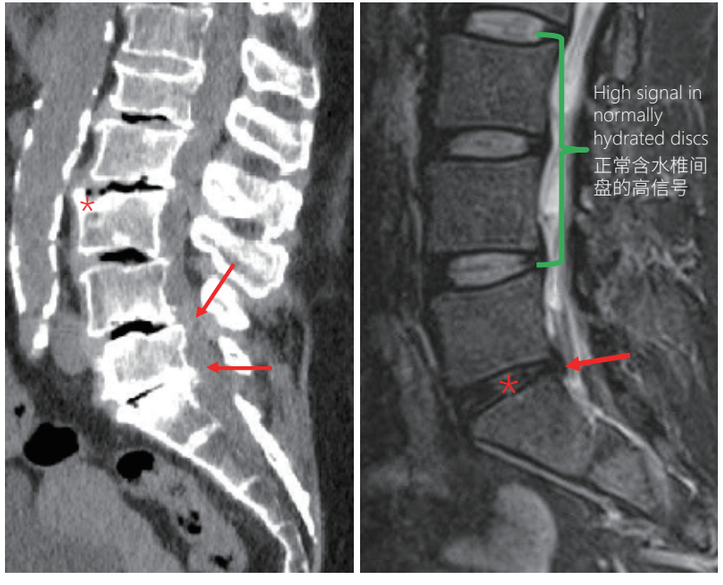

FIGURE 61

Spondylosis and osteochondrosis. A. Sagittal CT image showing degenerative changes : spondylosis (arrows) and osteochondrosis (asterisks). B. T2-weighted MRI image showing the normal high signal on hydrated discs and the low signal on L5-S1 disc due to degeneration (asterisk). Disc protrusion (arrow).

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章节大纲：

脊柱退行性病变在 CT 上可显示的异常包括骨赘形成（脊椎病）；关节突肥大；关节软骨变薄；关节及椎间盘真空现象；滑膜及软骨下囊肿（骨软骨病）以及关节囊、椎体终板和韧带钙化（图 61）。

磁共振成像能更好地显示椎间盘内部脱水及退变，由于含水量降低在 T2 加权像上表现为低信号（图 61）。

图 61

脊椎病与骨软骨病。A.矢状位 CT 图像显示退行性改变：脊椎病（箭头）和骨软骨病（星号）。B.T2 加权 MRI 图像显示正常含水椎间盘的高信号及 L5-S1 退变椎间盘的低信号（星号）。椎间盘突出（箭头）。

/ Spinal Tumours

MRI is the modality of choice to help evaluate spinal cord tumours.

A key issue on imaging is location of the mass in the different compartments:

/ Intramedullary

/ Intradural-extramedullary

/ Extradural

<∞> REFERENCES

Shih R.Y., Koeller K.K. Intramedullary Masses of the Spinal Cord: Radiologic- Pathologic Correlation. RadioGraphics 2020; 40:1125–1145

/ Central Nervous System

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/ 中枢神经系统

章节大纲：

/ 脊柱肿瘤

MRI 是评估脊髓肿瘤的首选检查方法。

影像学检查的关键问题是确定肿瘤的解剖位置分区：

/ 髓内

/ 硬膜下-髓外

/ 硬膜外

<∞> 参考文献

Shih R.Y., Koeller K.K. Intramedullary Masses of the Spinal Cord: Radiologic- Pathologic Correlation. RadioGraphics 2020; 40:1125–1145

/ Intramedullary Spinal Cord Tumours

Intramedullary masses of the spinal cord are located inside the substance of the cord and expand the cord parenchyma.

Ependymoma is the most common intramedullary spinal cord tumour in adults other spinal cord, followed by astrocytoma and hemangioblastoma. Ependymomas are centrally located, well-defined enhancing masses, hypointense to isointense on T1- weighted and hypointense to isointense on T2-weighted MR images and they can present cystic or haemorrhagic components (figure 62).

Astrocytoma are well-defined enhancing masses eccentrically located in the spinal cord.

Hemangioblastoma is the third most common intramedullary tumour. It is a mesenchymal hypervascular enhancing tumour cantered in the pial surface.

FIGURE 62

Ependymoma with cystic components (arrow) on sagittal T2-weighted image.

/ 脊髓髓内肿瘤

脊髓髓内肿瘤位于脊髓实质内，可导致脊髓实质膨大。

室管膜瘤是成人最常见的脊髓髓内肿瘤，其次为星形细胞瘤和血管母细胞瘤。室管膜瘤通常位于中央，呈边界清晰的强化肿块，T1 加权像呈等/低信号，T2 加权 MR 图像呈等/低信号，可伴有囊变或出血成分（图 62）。

星形细胞瘤为边界清晰的强化肿块，常偏心性生长于脊髓内。

血管母细胞瘤是第三常见的髓内肿瘤。它是一种起源于软脑膜表面的间叶源性富血供强化肿瘤。

图 62

矢状位 T2 加权像显示伴囊性成分的室管膜瘤（箭头）。

/ Intradural-extramedullary Spinal Tumours

Schwannomas and meningiomas are the most common intradural-extramedullary masses.

Meningiomas are characteristically iso to hypointense on T1-weighted images and slightly hyperintense on T2-weighted MR images with strong enhancement on postcontrast images imaging and a sharp-edged enhancing border (dural tail sign) as seen in figure 63.

FIGURE 63

Sagittal T1-weighted gadolinium enhanced image demonstrating the dural tail sign (arrows) in a spinal meningioma.

/ Central **Nervous System**

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章节大纲：

/ 硬膜下-髓外脊柱肿瘤

神经鞘瘤和脑膜瘤是最常见的硬膜下-髓外肿瘤。

脑膜瘤的特征性表现为：T1 加权像呈等/低信号，T2 加权 MR 图像呈稍高信号，增强扫描明显强化，并可见边缘清晰的强化边界（硬膜尾征），如图 63 所示。

图 63

矢状位 T1 加权钆增强图像显示脊膜瘤的硬膜尾征（箭头）。

/ Extradural Spinal Tumours

The spine is the third most common site for metastatic disease, following the lung and liver.

Spinal metastases are the most common spinal tumors 20 times more common than primary spinal neoplasms. Metastatic disease to the spine can involve the bone, epidural space, leptomeninges, and the spinal cord.

The most common primary malignant tumours involving the spine are breast, lung and prostate tumours (figure 64).

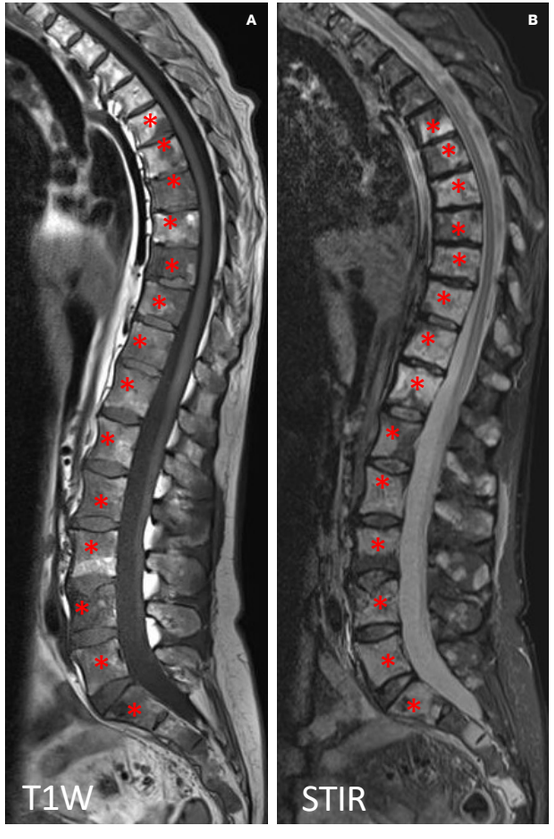

FIGURE 64

Sagittal T1-weighted (A) and STIR (B) images demonstrating multiple vertebral bone marrow metastases from a breast carcinoma: low signal on T1W sequence, high signal on STIR sequence (asterisks).

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 硬膜外脊柱肿瘤

脊柱是转移性肿瘤第三好发部位，仅次于肺和肝脏。

脊柱转移瘤是最常见的脊柱肿瘤，其发病率是原发性脊柱肿瘤的 20 倍。脊柱转移性病变可累及骨骼、硬膜外间隙、软脊膜和脊髓。

最常发生脊柱转移的原发恶性肿瘤为乳腺癌、肺癌和前列腺癌（图 64）。

图 64

矢状位 T1 加权 (A) 和 STIR (B) 图像显示乳腺癌多发椎体骨髓转移：T1W 序列呈低信号，STIR 序列呈高信号（星号）。

/ Inflammatory/Infectious Diseases

Inflammatory/infectious diseases include, demyelinating, infectious, granulomatous, metabolic, toxic and paraneoplastic disorders.

MRI is the modality of choice in the evaluation of inflammatory/infectious conditions of the spine.

Multiple sclerosis (MS) spinal cord lesions are more frequently located in the cervical spine (figure 65); they show high signal intensity on T2-weighted MRI images and are usually about the length of a vertebral body on sagittal images.

Postinfectious myelitis (figure 66) depicts high signal on T2-weighted MR images and usually extends over three to four vertebral segments.

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/ Central **Nervous System**

CHAPTER OUTLINE:

/ 炎症性/感染性疾病

/ 中枢**神经系统**

章节大纲：

炎症性/感染性疾病包括脱髓鞘性、感染性、肉芽肿性、代谢性、中毒性及副肿瘤性疾病。

MRI 是评估脊柱炎症性/感染性疾病的首选检查方法。

多发性硬化 (multiple sclerosis, MS) 脊髓病变好发于颈椎（图 65），在 MRI 的 T2 加权像上呈高信号，矢状位图像上病灶长度通常与单个椎体高度相仿。

感染后脊髓炎（图 66）在 T2 加权 MRI 图像上呈高信号，通常累及 3-4 个椎体节段。

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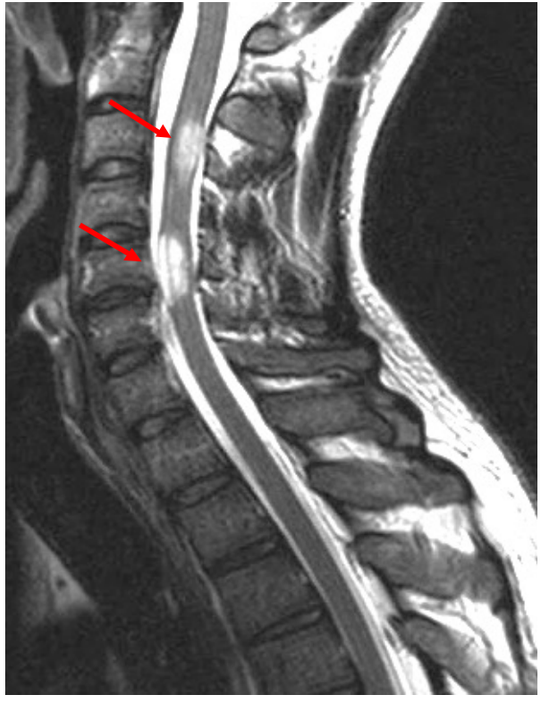

FIGURE 65

Sagittal T2-weighted image demonstrating two short segment high signal intensity lesions in the cervical spinal cord in MS.

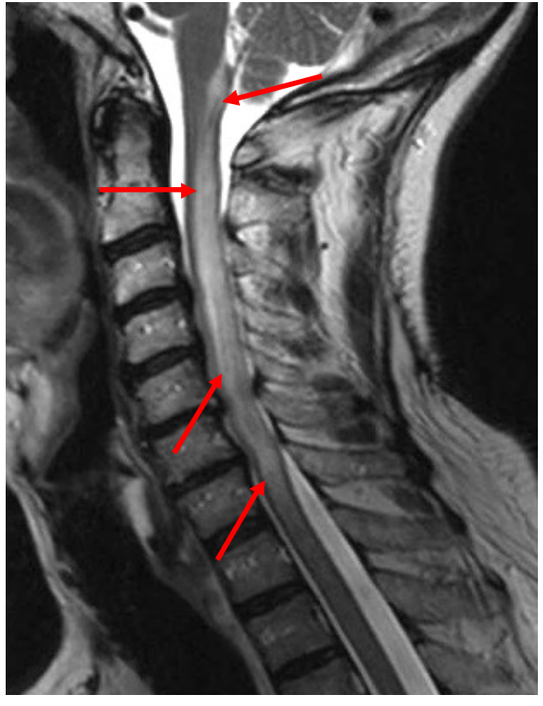

FIGURE 66

Sagittal T2-weighted image demonstrating a long segment high signal intensity lesion in the cervical spinal cord in postinfectious myelitis.

Central Nervous System

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中枢神经系统

章节大纲：

图 65

矢状位 T2 加权像显示 MS 患者颈髓内两处短节段高信号病灶。

图 66

矢状位 T2 加权像显示感染后脊髓炎患者颈髓内长节段高信号病灶。

/ Vascular Lesions

Vascular disorders of the spinal cord can be caused by venous or arterial ischemia and vascular malformations.

Acute arterial ischemia is typically seen as a complication of aortic aneurysm surgery or catheterisation. Spinal cord infarctions show a swollen cord and hyperintensity on T2-weighted images (figure 67).

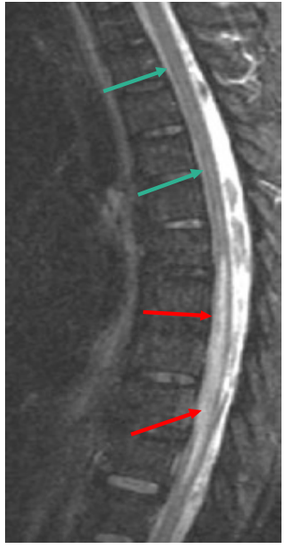

FIGURE 67

Spinal cord infarction demonstrating cord swelling and increased signal (red arrows) on a sagittal T2-weighted image. Areas without spinal cord infarction (green arrows)

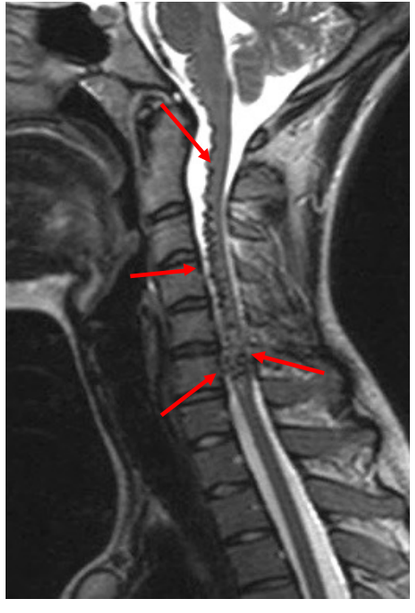

FIGURE 68

Vascular malformation. Sagittal T2- weighted image showing dilated serpiginous vessels (arrows).

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 血管病变

脊髓血管病可由静脉或动脉缺血以及血管畸形引起。

急性动脉缺血通常是主动脉瘤手术或导管插入术的并发症。
脊髓梗死表现为脊髓肿胀，并在 T2 加权像上呈现高信号（图 67）。

图 67

脊髓梗死在矢状位 T2 加权像上显示脊髓肿胀及信号增高（红色箭头）。无脊髓梗死的区域（绿色箭头）

图 68

血管畸形。矢状位 T2 加权像显示扩张迂曲的血管（箭头）。

/ Take-Home Messages

- / Detailed knowledge of the anatomy is essential for image interpretation.
- / Magnetic resonance imaging is the imaging modality of choice for the evaluation of CNS pathology.
- / Computed tomography is an important diagnostic modality used for urgent evaluation of patients with head or spinal trauma, to assess the presence of haemorrhage or bone fractures.
- / Digital subtraction angiography is used for cerebrovascular interventions including mechanical thrombectomy, carotid angioplasty and stenting.
- / Ultrasound is a safe and non-invasive imaging technique for the visualisation of intra and extracranial vessels and the measurement of blood velocity using Doppler imaging.
- / Knowledge of the vascular territories is important to recognize infarctions in arterial territories.
- / The first thing to determine when evaluating a brain tumour is if it is located outside the brain (extra-axial) or within the brain (intra-axial).
- / Functional MRI Diffusion Weighted images are very useful for the diagnosis of acute ischemic stroke, infection, and tumour characterisation.
- / MRI is the best imaging method to visualise the spinal cord and nerves.
- / Computed tomography allows an excellent delineation of vertebral fractures.

/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 核心要点

- / 详细了解解剖结构是影像解读的基础。
- / 磁共振成像是评估中枢神经系统病变的首选影像学方法。
- / 计算机断层扫描是急诊评估颅脑或脊柱创伤的重要诊断手段，可用于评估是否存在出血或骨折。
- / 数字减影血管成像可用于脑血管介入治疗，包括机械取栓、颈动脉血管成形术和支架置入术。
- / 超声作为一种安全无创的影像技术，可通过多普勒成像实现颅内和颅外血管的可视化及血流速度测量。
- / 掌握血管分布区域对识别动脉供血区梗死很重要。
- / 在评估脑肿瘤时，首先要确定肿瘤是位于脑外（轴外）还是脑内（轴内）。
- / 功能 MRI 扩散加权图像对于急性缺血性脑卒中、感染和肿瘤表征具有重要的诊断价值。
- / MRI 是显示脊髓和神经结构的最佳影像学方法。
- / 计算机断层扫描能清晰显示椎体骨折的细节特征。

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Central Nervous System

CHAPTER OUTLINE:

中枢神经系统

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Test Your Knowledge

Central Nervous System

CHAPTER OUTLINE:

知识测试

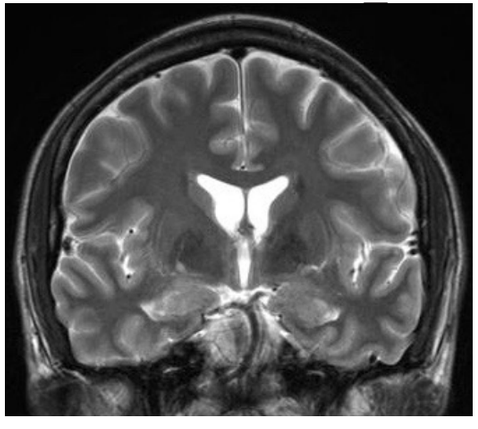
中枢神经系统

章节大纲：

/ Test Your Knowledge

<?> QUESTION

1 Through which foramina do the lateral ventricles communicate with the third ventricle?



/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 知识测试

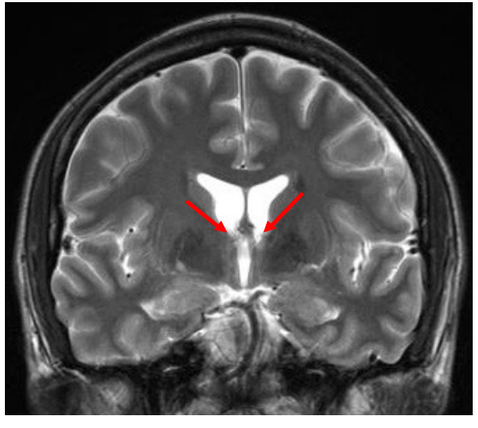
<?> 问题

1 侧脑室通过哪个孔与第三脑室相通?

/ Test Your Knowledge

<?> ANSWER

1 Through which foramina do the lateral ventricles communicate with the third ventricle?



- Through the Monro foramina

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

<?> 回答

1 侧脑室通过哪个孔与第三脑室相通？

- 通过室间孔（Monro 孔）

Test Your Knowledge

<?> QUESTION

2 What sulcus is the red arrow pointing to and what sulcus is the blue arrow pointing to?

CHAPTER OUTLINE:

知识测试

<?> 问题

2 红色箭头指示哪个脑沟？蓝色箭头指示哪个脑沟？

章节大纲：

/ Test Your Knowledge

<?> ANSWER

2 What sulcus is the red arrow pointing to and what sulcus is the blue arrow pointing to?

- The red arrow points out the marginal sulcus running within the parietal lobe and the blue arrow points at the central sulcus (the central sulcus separates the frontal lobe from the parietal lobe)

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

<?> 回答

2 红色箭头指示哪个脑沟？蓝色箭头指示哪个脑沟？

- 红色箭头指示顶叶内的边缘沟，蓝色箭头指示中央沟（中央沟将额叶与顶叶分隔）

Test Your Knowledge

<?> QUESTION

3 55-year-old male patient with right hemiparesis. What is the diagnosis?

Central Nervous System

CHAPTER OUTLINE:

中枢神经系统

章节大纲：

知识测试

<?> 问题

3 55 岁男性患者，右侧偏瘫。诊断是什么？

/ Test Your Knowledge

<?> ANSWER

3 55-year-old male patient with right hemiparesis. What is the diagnosis?

- Acute left infarct in the left middle cerebral artery vascular territory
  Hypoattenuating brain tissue in the left hemisphere (arrows)
  Gray and white matter involvement
  Blurred basal ganglia (asterisk)
  Insular Ribbon sign, hypodensity of the insular cortex (in)
  Good differentiation between normal and affected tissue
  Mass effect

/ 知识测试

<?> 回答

3 55 岁男性患者，右侧偏瘫。诊断是什么？

- 左侧大脑中动脉供血区急性梗死
  左半球脑组织低密度（箭头）
  灰质和白质受累
  基底节区模糊（星号）
  岛带征，岛叶皮质低密度 (in)
  正常与病变组织分界清晰
  占位效应

Test Your Knowledge

<?> QUESTION

4 63-year-old male with right sciatica. What is the diagnosis?

知识测试

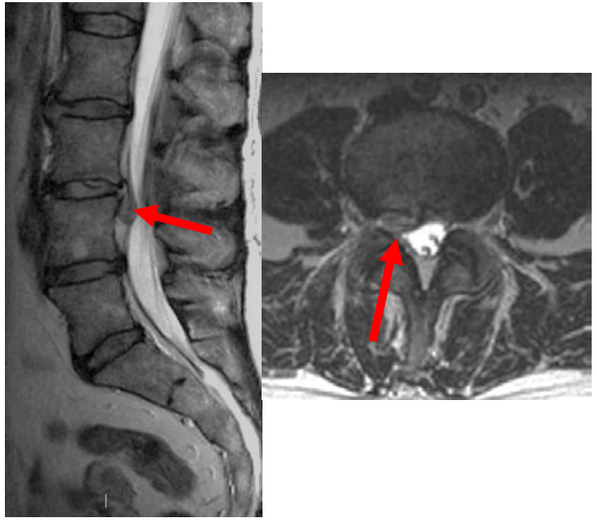
<?> 问题

4 63 岁男性，右侧坐骨神经痛。诊断是什么？

/ Test Your Knowledge

<?> ANSWER

4 What is your diagnosis based on these MRI images ?



- L3-L4 right subarticular disc herniation (arrow).

  Extrusion of the disc outside the annulus fibrosus, deforming the thecal sac on the right and compressing the right L4 nerve root.

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

<?> 回答

4 根据这些 MRI 图像，您的诊断是什么?

- L3-L4 右侧关节突下椎间盘突出（箭头）。

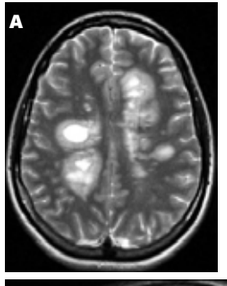
  椎间盘脱出纤维环，右侧硬膜囊变形，右侧 L4 神经根受压。

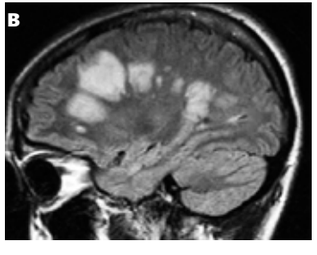
/ Test Your Knowledge

<?> QUESTION

5

31-year-old female with a long history of recurrent episodes of numbness and tingling in her arms and legs, vision loss and fatigue – what is your most likely diagnosis?





/ Central Nervous System

CHAPTER OUTLINE:

/ 中枢神经系统

章节大纲：

/ 知识测试

<?> 问题

5

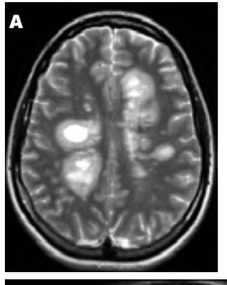
31 岁女性，长期反复发作四肢麻木刺痛、视力减退和疲劳。您最可能的诊断是什么？

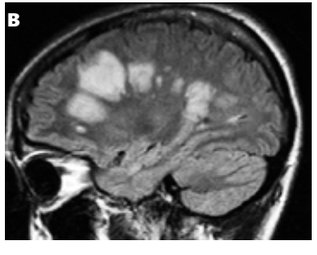
/ Test Your Knowledge

<?> ANSWER

5

31-year-old female with a long history of recurrent episodes of numbness and tingling in her arms and legs, vision loss and fatigue – what is your most likely diagnosis?





- Multiple sclerosis

  Multiple lesions wite matter lesions adjacent to the ventricles. Ovoid lesions perpendicular to the ventricles called Dawson fingers

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

<?> 回答

5

31 岁女性，长期反复发作四肢麻木刺痛、视力减退和疲劳。您最可能的诊断是什么？

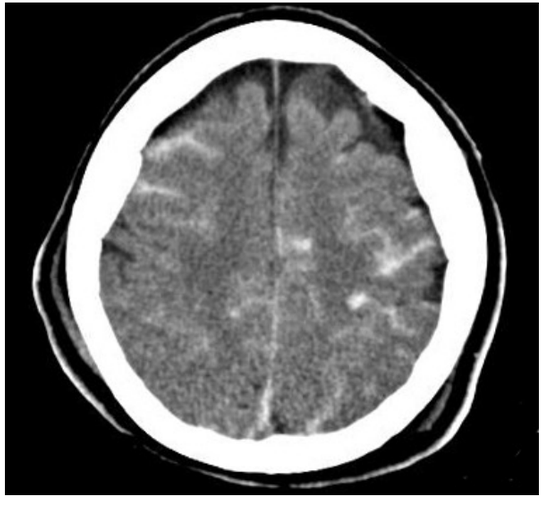
- 多发性硬化

  脑室旁多发白质病变。垂直于脑室的卵圆形病灶（称为 Dawson 手指征）

Test Your Knowledge

<?> QUESTION

6 45-year-old male with acute onset of severe headache – what is your most likely diagnosis?



Central Nervous System

CHAPTER OUTLINE:

知识测试

<?> 问题

6 45 岁男性，急性剧烈头痛发作。您最可能的诊断是什么？

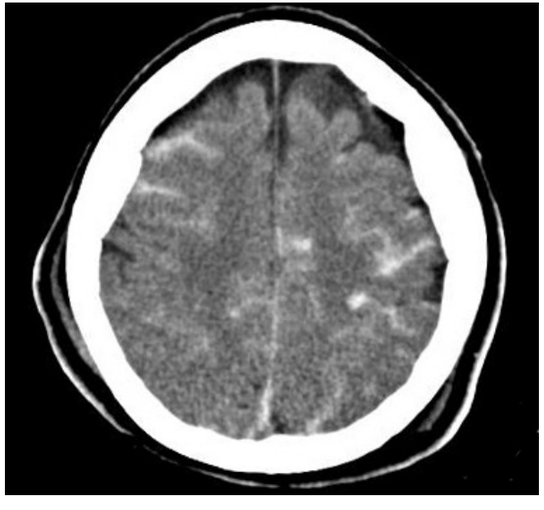
中枢神经系统

章节大纲：

Test Your Knowledge

<?> ANSWER

6 45-year-old male with acute onset of severe headache – what is your most likely diagnosis?



- Subarachnoid haemorrhage

  High attenuation value fluid filling the sulci of the convexity

Central Nervous System

CHAPTER OUTLINE:

知识测试

<?> 回答

6 45 岁男性，急性剧烈头痛发作。您最可能的诊断是什么？

- 蛛网膜下腔出血

  脑凸面脑沟内高密度液体

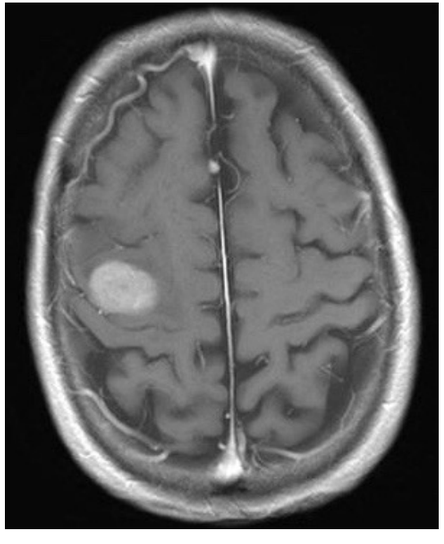
中枢神经系统

章节大纲：

Test Your Knowledge

<?> QUESTION

7 67-year-old male presents with seizures. Where is the lesion located?



Central Nervous System

CHAPTER OUTLINE:

知识测试

<?> 问题

7 67 岁男性，癫痫发作。病灶位于哪里？

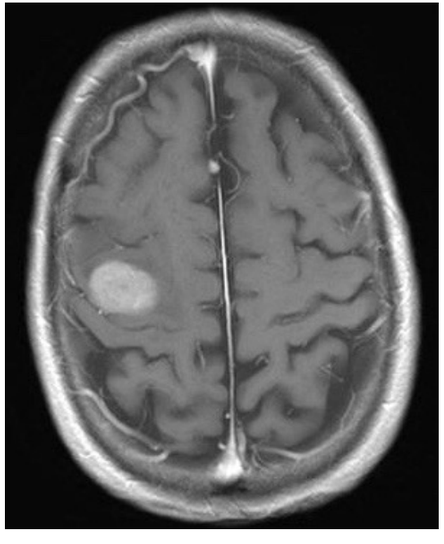
中枢神经系统

章节大纲：

/ Test Your Knowledge

<?> ANSWER

7 67-year-old male presents with seizures. Where is the lesion located?



- In the right central gyrus, immediately anterior to the central sulcus

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

<?> 回答

7 67 岁男性，癫痫发作。病灶位于哪里？

- 右侧中央回，紧邻中央沟前方

Test Your Knowledge

<?> QUESTION

8

18-year-old female with sudden paraplegia. Reported a respiratory viral process the week before. What is the most likely diagnosis?

Central Nervous System

CHAPTER OUTLINE:

中枢神经系统

章节大纲：

知识测试

<?> 问题

8

18 岁女性，突发截瘫。一周前有呼吸道病毒感染史。最可能的诊断是什么？

/ Test Your Knowledge

<?> ANSWER

8

18-year-old female with sudden paraplegia. Reported a respiratory viral process the week before. What is the most likely diagnosis?

- Myelitis. Long segment of the spinal cord (over three segments) depicting high signal intensity on this T2-weighted MR image.

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

<?> 回答

8

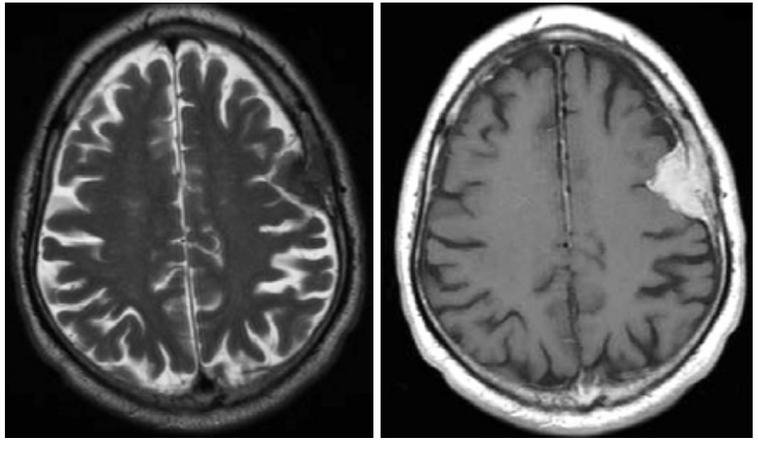
18 岁女性，突发截瘫。一周前有呼吸道病毒感染史。最可能的诊断是什么？

- 脊髓炎。T2 加权 MR 图像显示脊髓长节段（超过三个节段）高信号。

/ Test Your Knowledge

<?> QUESTION

9 In which compartment is this tumour located? What is the most likely diagnosis?



CHAPTER OUTLINE:

章节大纲：

/ 知识测试

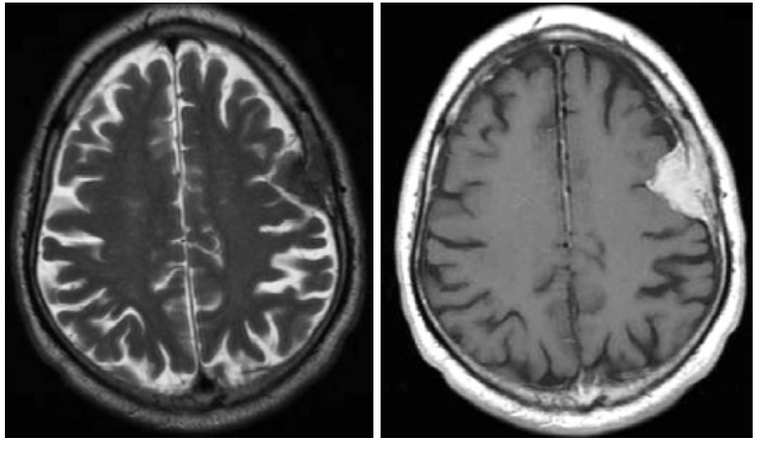
<?> 问题

9 该肿瘤位于哪个解剖分区？最可能的诊断是什么？

Test Your Knowledge

<?> ANSWER

9 In which compartment is this tumour located? What is the most likely diagnosis?



- It is an extra-axial tumour, displaces medially the CSF and the cortex. It enhances homogeneously and presents a dural tail. The most likely diagnosis is meningioma.

CHAPTER OUTLINE:

章节大纲：

知识测试

<?> 回答

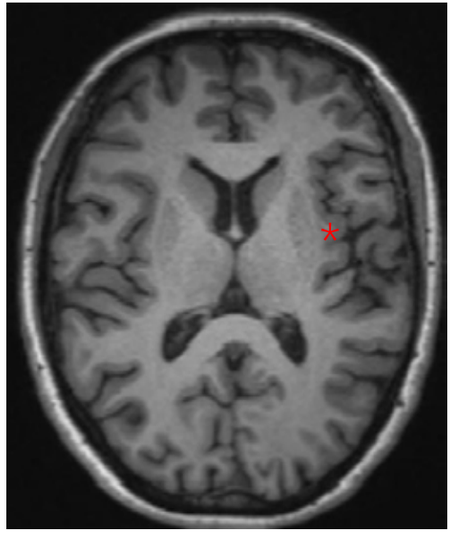
9 该肿瘤位于哪个解剖分区？最可能的诊断是什么？

- 它是一种轴外肿瘤，向内侧推压脑脊液和皮质。均匀强化并可见硬膜尾征。最可能的诊断是脑膜瘤。

Test Your Knowledge

<?> QUESTION

10 What anatomical structure is the red asterisk indicating?



Central Nervous System

CHAPTER OUTLINE:

知识测试

<?> 问题

10 红色星号指示什么解剖结构?

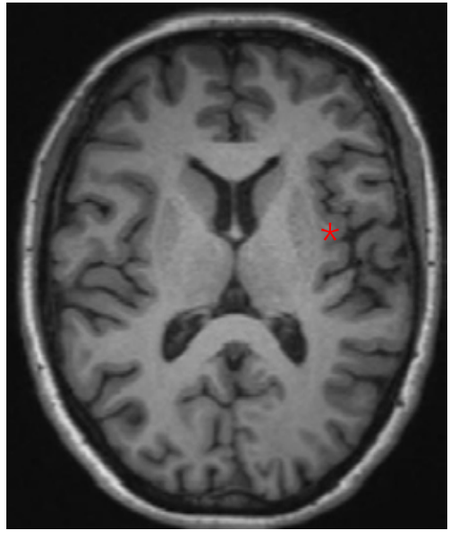
中枢神经系统

章节大纲:

/ Test Your Knowledge

<?> ANSWER

10 What anatomical structure is the red asterisk indicating?



- The insula. It is located in depth to the Sylvian fissure.

CHAPTER OUTLINE:

章节大纲：

/ 知识测试

<?> 回答

10 红色星号指示什么解剖结构？

- 岛叶。它位于外侧裂深部。