# *Pediatric Neuroradiology Clinical Cases for Physicians, Neuropsychologists and Students*

## *Casos clínicos de neuroradiología pediátrica para profesionales de la medicina, neuropsicología y para estudiantes*

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## Book Review / Reseña de libro
## *Pediatric Neuroimaging: Cases and Illustrations*

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*Pediatric Neuroimaging: Cases and Illustrations*, edited by Liu and Zhang (2022), offers a comprehensive library of clinical case presentations on pediatric neuropathologies, with their respective radiological findings. The book is written by radiologists who are experts in the field of pediatric neuroradiology and diagnoses, providing a valuable reference tool for those interested in this field. Pediatricians, radiologists, neurologists, neuropsychologists, and students will find the case-based format quick, easy to read, and useful to correlate clinical presentations with imaging findings. It is important to note that basic knowledge of neuroanatomical structures, anatomical orientations and imaging techniques is recommended to fully understand the radiological findings and case presentations in this book.

With a total of 215 pages, this work is divided into nine chapters covering topics such as congenital brain malformations, intracranial infections, metabolic encephalopathies, and craniocerebral trauma in the pediatric population. All the cases presented in each section begin with a chief complaint, followed by their imaging findings and a discussion of the disease pathology. Within the imaging findings, there is a radiological description with their respective planes and image modalities, provided with visual cues that help the reader identify specifically what is being described. For example, in the first cases of Chapter 1, imaging anomalies of the corpus callosum are presented, and the structural anomalies of the affected patient were discussed in axial and sagittal T1W1 and T2W2 results of Magnetic Resonance Imaging (MRI). Furthermore, every chapter reliably provides a detailed description of the neuroimaging findings and makes emphasis differentiating between closely related pathologies that affect the same brain structures, aiding in differential diagnoses. This book review provides a

summary and a discussion of the contents of each chapter. The analysis is done through the eyes of a medical student and a clinical psychology student, both with interests in neuroradiology and neuropathological conditions in the pediatric population.

## Chapter 1: Congenital Malformations of the Brain

The authors begin the book by discussing cases of congenital malformations of the brain. There are 15 unique pediatric cases that discuss a range of pathologies that affect different areas of the cerebrum. Common symptom manifestations in children with brain congenital malformations are epilepsy and developmental delay. Therefore, it is of great importance to perform radiological imaging in conjunction with an assessment of clinical symptomatology to make a more accurate diagnosis. The authors divided congenital malformations are categorized into distinct groups based on their clinical manifestations and pathophysiological characteristics. Some of the most notable cases discussed are anomalies of the corpus callosum, encephaloceles, schizencephaly and the Chiari malformation.

A minor limitation of this chapter is the use of outdated medical terms such as “mental retardation.” This term is scientifically outdated and promotes negative mental health stigma, affecting patients, family members and people with disabilities (Nash et al., 2017). The preferred and most appropriate terminology is "intellectual disability" or "developmental delay" which is medically accepted because is respectful and has an inclusive approach (Boat & Wu, 2015). There is also the use of ambiguous terms such as “low intelligence” and we believe the authors could have provided specific details of this or avoided altogether mentioning this term. In addition, the authors should use an updated system to classify seizures, such as the *International League Against Epilepsy (ILAE) Classification of Epilepsies* (Scheffer et al., 2017), and avoid using outdated terms such as “refractory partial-complex epilepsy.”

Two of the cases discussed especially sparked our interest. One case was about tuberous sclerosis and the other was about neurofibromatosis type I. The authors make an excellent discussion of these cases with descriptive clinical features, high-quality imaging and clear emphasis on the findings. Nevertheless, the authors do not mention precisely what was the congenital malformation. There is a description of the lesion’s characteristics of these pathologies within the brain, but no mention of how the brain structure was affected, nor how they varied from the norm. We believe these two pathologies can be described better in the Brain Tumors chapter or in the Other Brain Diseases chapter.

## Chapter 2: Brain Tumors

This chapter focuses on detailing the neuroimaging of the brain tumors classified by the 2016 WHO Classification of Tumors of the Central Nervous System book (Louis et al., 2016). It is important to note that a new edition of this publication was released by the WHO in 2021, with updated neoplasm diagnosis criteria and management paradigms; however, this edition was not used as a reference in this book. The authors mention that brain tumors rank second in incidence for solid tumors in the pediatric population. With the advances made by neuroimaging, it has come to knowledge that not only are many brain tumor subtypes in children, but also these can differ greatly from the cerebral tumors found in adults. In minors, their peak of incidence depends on the type of tumor (e.g., astrocytoma’s, neuroblastoma)

and their predilection to affect specific areas of the brain in greater proportion. For example, pilocytic astrocytoma in the pediatric population tend to occur in greater proportion in the infratentorial portion of the brain, compared to the supratentorial portion. For detecting brain tumors in children, MRI is the preferred method that will help the physician specialist better identify these anomalies.

This chapter classifies the cases in categories based on the region of the brain affected. The first set of cases pertaining to supratentorial astrocytoma include pleomorphic xanthoastrocytoma, diffuse astrocytoma, glioblastoma multiforme and others. In this section, we will discuss cases of tumors in the pineal gland region, including germinoma, teratoma, and pineocytoma. Choroid plexus tumors are discussed in the third section and include choroid plexus papilloma, choroid plexus carcinoma and others. The fourth section of this chapter is concerned with discussing cases of the posterior fossa, and includes tumors such as medulloblastoma, pilocytic astrocytoma, ependymoma and other less common tumors. Neoplasms and tumor-like lesions of the sellar region are presented in the fifth section, mentioning those such as craniopharyngioma, pituitary adenoma, glioma of the optic chiasm and hypothalamus. Brain stem tumors and metastatic neoplasms are discussed in the sixth and seventh section, respectively. This chapter finalizes with a section dedicated to hematologic malignancies.

Though quite extensive, we consider this section of the book very complete. There is a description of the epidemiologic and clinical manifestations for most brain tumors, and there is mention of the histological features that are distinctive of each pathology, such as of glioblastoma multiforme. The presentation of the imaging findings was impressive, since there were cases of brain tumors in areas that are otherwise very infrequent. An example of this was a case of a supratentorial pilocytic astrocytoma, which is rare in occurrence. This broadens the considerations of physicians to be vigilant of possible tumors that are infrequent in other areas of the brain. Overall, this is a comprehensive chapter that is helpful in classifying the broad spectrum of tumors that are present in the pediatric population using the available radiographic techniques.

**Chapter 3: Intracranial Infection**

The pediatric population is susceptible to infectious diseases and pathogens that target the brain tissue, and they represent a great burden for families and physicians alike. In this chapter, the authors display multiple cases related to diseases that affect the brain and the overlapping features these may share with non-infectious processes. The authors mention that there is a myriad of pathogens that can begin their invasion of the brain well before birth, such as the TORCHes infections (toxoplasmosis, others as syphilis and hepatitis B, rubella, cytomegalovirus, and herpes simplex), many of which have characteristic findings on computed tomography (CT) and MRI. The authors mention that acquired infections of the central nervous system (CNS) in pediatric patients are still a danger due to the known lifelong sequelae these can inflict in development. It is to note that many autoimmune diseases that target the brain, though rarer in pediatric patients, can mimic both clinically and in radiographic imaging infectious diseases. This should be taken into consideration when establishing differential diagnoses.

The authors in this chapter begin discussing a case of congenital intracranial infection. Cases of acquired bacterial and viral infections were then presented, such as tuberculosis. Two cases of brain parasitic

infections of neurocysticercosis were discussed, one in the colloidal vesicular stage and the other in the nodular calcified stage. In the next section of cases, there was a discussion of autoimmune diseases that target the CNS, and one of primary CNS vasculitis. The autoimmune diseases presented in this section included multiple sclerosis, anti-N-methyl-D-aspartate (NMDA) receptor encephalitis, acute disseminated encephalomyelitis, and neuromyelitis optical spectrum disorders.

This chapter serves as a general overview of how many infectious processes may give characteristic findings on MRI. Furthermore, there is an emphasis on how different types of pathogens may have predilections that affect certain areas of the brain, and how radiographic features may vary with these, depending on the stage of the disease. There is a thoughtful process of describing how non-infectious pathologies, such as endocrine and metabolic disorders, need to be considered when evaluating these patients. Nevertheless, to have a more in-depth appreciation of these cases, it would have helped to include different case examples for both the congenital and the acquired infections. For example, when there was a mention of the TORCHes infections, a comparison between a case of brain infection with cytomegalovirus (CMV) and one of toxoplasma gondii (TG) adds a background when performing a diagnostic workup. Congenital CMV and toxoplasmosis both can demonstrate hydrocephalus on an MRI imaging. However, toxoplasmosis more commonly demonstrates diffuse intracranial calcifications, while congenital CMV is known to cause periventricular calcifications observed on MRI, and intraventricular hemorrhage seen on ultrasound.

This chapter also has the benefit of demonstrating exemplary cases of autoimmune disease such as acute disseminated encephalomyelitis. In our judgment, the title of this chapter then does not represent the totality of the content demonstrated. It would be more appropriate to add to the title "and autoimmune diseases" or relocate these cases to another chapter. Besides this observation, this is a very informative chapter that can give, in a broad manner, the important considerations to make both clinical and radiographic imaging diagnoses when working with infectious cases of the brain.

**Chapter 4: Vascular Diseases**

Just like in adults, children are also at risk of suffering brain insults due to vascular compromise, though due to different risk factors that should be considered (Anderson et al., 2011). In this chapter there is a discussion on the different mechanisms by which neurovascular compromise may occur and affect these patients. There are many ways blood flow in the brain may be at risk in children. Image modalities provide a clearer visual representation of the causes behind the clinical symptoms manifested by pathologies such as hemorrhage, vascular malformation, or thrombo-embolism, making them essential tools for diagnosing these conditions.

This chapter begins by discussing intracerebral hemorrhages, which are common occurrences in babies born prematurely. Stroke is subsequently described, with demonstrations of different pathologies that give rise to the cerebrovascular insult, such as arterial ischemic stroke and venous sinus thrombosis. Moyamoya disease and Takayasu arteritis are also discussed, both conditions common in the Asian population. The Vein of Galen malformation, other developmental venous anomalies and cavernous malformations are also discussed in this chapter. Intracranial

aneurysms and dural arteriovenous fistulae are the last two cases described.

This chapter is comprehensive in its presentation of cerebrovascular pathologies in children, discussing both common and exceedingly rare pathologies. There is thoughtful consideration of the risk factors, disease epidemiology and etiologies clinicians should consider for most of the vascular diseases discussed. Besides MRI, there is an appropriate and necessary display of CT angiography (CTA) for specific cases. For example, for aorto-arteritis, also known as Takayasu arteritis, a CTA was provided in which a patient suffered severe stenosis of the common carotid artery. Though not demonstrated, it would have provided excellent visual aid to demonstrate ultrasound imaging for some of the pathologies discussed in this chapter. For instance, there was a mention of the Transcranial Doppler (TCD) ultrasound as the first choice in neonates for the diagnosis of venous sinus thrombosis. Nevertheless, the case discussed regarding this pathology was referring to a five-year-old patient, and a display and analysis of a Magnetic Resonance Venography (MRV) was instead used. Overall, this chapter provides a detailed discussion of the important image findings that need to be considered when there is high suspicion of a vascular process affecting a pediatric patient.

**Chapter 5: Metabolic Encephalopathies**

The fifth chapter focuses on the clinical manifestations and neuroimaging of metabolic encephalopathies (ME). These neuropathologies are characterized by a dysfunction in the body's metabolism process, causing either an accumulation or a failed production of metabolites that are essential for optimal brain functioning. Most of the ME are present early in childhood; therefore, the cases discussed in this chapter are mainly children under ten years of age. According to the authors, the general incidence of ME is stated as being one in every 2,500-5,000 people. Differential imaging characteristics are provided which is a very useful reference in clinical settings. Diagnostic measures for ME include genetic screening, laboratory analyses, clinical evaluation, and radiological findings, with MRI being the most used imaging study.

In this chapter, only the most common pathologies regarding ME are discussed despite there being hundreds of ME. The disorders are divided by those that are genetic or caused by the absorption of a toxic substance, for example, carbon monoxide poisoning. The genetic ME are subdivided by the areas affected by the disease, either grey matter, white matter, mixed or multiple organs affected. In the white matter pathologies, clinical findings with their correlated neuroimaging manifestations are detailed for eight genetic MEs, some of them being X-linked adrenoleukodystrophy, metachromatic leukodystrophy, Alexander's disease, Canavan disease and phenylketonuria.

Continuing with the genetic MEs, five grey matter pathologies are discussed in this chapter, including Leigh disease, Wilson disease, Fahr's disease and others. Overall, the selection of the grey and white matter genetic MEs exposed were relevant in terms of their prevalence in the pediatric population. Of the genetic MEs that affect both grey and white matter in the brain, disorders like maple syrup urine disease, Cockayne syndrome and glutaric acidemia type I are presented. For toxic ME, Wernicke's encephalopathy, caused by a thiamine deficiency is reviewed, as well as toxic encephalopathy by carbon monoxide poisoning and pseudohypoparathyroidism.

Overall, this chapter presents the clinical, imaging findings and differential radiological markers of ME in a clear and concise format. However, there are a few unclear terms used to describe the clinical symptoms that we believe can be expressed in a more precise terminology. For example, in the Wilson disease case, instead of saying the patient may present *intelligent degeneration*, the term *cognitive deterioration* may be used alternatively. Other than that, this chapter serves as a good reference to correlate neuroimaging studies of ME with clinical behavioral manifestations and other diagnostic tests.

**Chapter 6: Craniocerebral Trauma**

This section highlights neuroimaging findings in infants and children who have sustained traumatic brain injury (TBI). According to the authors, craniocerebral trauma, in combination with other injuries, is the most prevalent cause of death in children, either by accident or by abuse. For infants, accidental drops and child maltreatment are the main culprits of most TBI, and about 80% of deaths in this age group. Craniocerebral trauma in infants are mostly presented by skull fractures, subdural hematomas, cerebral edema, and parenchymal contusions. According to the authors, for older children, the most common types of traumatic brain injuries (TBIs) result from falls, sports-related incidents, and car accidents. Radiological findings are most frequently skull fractures, parenchymal contusions, and diffuse axonal injury (DAI).

A total of five cases of TBI in minors were presented, one of a neonate, two of infants and two of children ages three or older. For neonates, the most common type of head injury is caused by the use of mechanical instruments (e.g., forceps during delivery), because of this, the case discussed in this chapter was of this nature. Extracranial trauma, like scalp hematomas, subaponeurotic hematomas and head hematomas are described on page 181. However, in this section, there is a grammatical error that should be noted. On two occasions, it refers to *subaponeurotic hematomas* as *subarachnoid hematomas*, which are two very different clinical manifestations and may confuse the reader as subarachnoid hemorrhages are of intracranial nature in the subarachnoid space. Therefore, we recommend it should be corrected in future editions. This segment also describes that linear and depressive skull fractures are most common in neonates and presents CT scan findings of both extra and intra-cranial hemorrhages after forceps used.

TBI cases, both accidental and resulting from child maltreatment, are presented in infants and older children. Most infant and children cerebral trauma have similar characteristics to those of adults in neuroimaging, and the most common clinical presentations are discussed. Shaken baby syndrome, infant abuse syndrome and sequalae of post-head injuries are some of the cases analyzed in this chapter. In general, this chapter completed its purpose by presenting a brief yet informative case presentations of craniocerebral injury in children. It highlights that abuse head injury cases in minors are difficult to identify because of their concealment by the perpetrators. Because of this, an in-depth assessment of clinical presentations and family history by clinicians is of utmost importance in child TBI cases, in conjunction with the radiological findings.

**Chapter 7: Brain Damage, Destructive Diseases**

This chapter covers brain damage in neonates and infants related to hypoxic-ischemic brain injury or corporal imbalances, such as a vitamin K deficiency or

hypoglycemia. A total of seven clinical cases with their radiological findings are presented. As stated by the authors, most hypoxic-ischemic encephalopathies in neonates are caused by lesions during the third trimester of pregnancy or childbirth. The most notable cases in this chapter are kernikterus, hydrocephalus, hydranencephalies and intracranial hemorrhage due to vitamin K deficiency. Overall, the radiological imaging findings of both CT scans and MRI in this chapter are impressive and provide useful information on the characteristics of each pathology. However, in a case relating to an intraventricular hemorrhage, the authors use the term *hair layer* to describe a left ventricular hemorrhage in the Axial T1-weighted image finding. This term is confusing and must be an error since it does not reference a known anatomical area in the brain, and it does not reference the outer protective hair layer of the scalp. The reader should take this into account when reading this case as it is mentioned in the title and in more than three occasions. Overall, this chapter continued to discuss brain injury caused by hypoxic-ischemic injuries and metabolic imbalances in a complete and informative format.

**Chapter 8: Neurodegenerative Diseases**

The eighth chapter describes the clinical characteristics and neuroimaging of two common types of neurodegenerative disorders in children: olivopontocerebellar atrophy (OPCA) and Wallerian axonal degeneration (WD). The authors state that the pathogenesis of OPCA is unknown, and may cause progressive cerebellar ataxia, cognitive impairment, first order neuron pyramidal signs and paralysis. In CT and MRI scans, prominent pontine and cerebellar atrophy are prevalent in OPCA. However, to confirm the diagnosis, an emphasis on the clinical symptoms should be noted. WD is defined as the structural and neurochemical degeneration of the axon after suffering a trauma (e.g., cerebrovascular accident or concussion). In CT scans, WD is detected at its later stage as focal atrophy, while MRI can detect hyperintensities of the affected region after about four weeks post-trauma. Overall, we consider that this chapter does not cover the full scope of neurodegenerative disorders prevalent in children, as the authors indicate at the start of the section. Also, WD is a consequence of brain injury which could be included in Chapter 6 or 7. Generally, we agree with the authors' statements and further improvement needs to be taken into consideration in this chapter for future revisions.

**Chapter 9: Other Brain Diseases**

This chapter demonstrates three unique cases of brain phenomenon that are more common in the pediatric population. The first case is mesial temporal lobe sclerosis. As the name implies, this pathology mainly affects the medial portion of the temporal lobe, specifically the hippocampus. In this case, imaging results of Arterial Spin Labeling (ASL) and Magnetic Resonance Perfusion (MRP) are correlated with the more commonly used MRI. The second case presented was of a rare and reversible condition called reversible splenial lesion syndrome (RESLES). Although rare, this syndrome is more commonly seen in pediatric populations of East Asia. The third and last case concerns a Rathke cleft cyst, which is a pathology that should be considered in the differential diagnosis of patients with precocious puberty. The cases presented are very descriptive, consistent with previous chapters, and provide an adequate background for healthcare professionals working with patients with these neuropathologies.

## Conclusion

Overall, this first edition of *Pediatric Neuroimaging: Cases and Illustrations* (Liu & Zhang, 2022) is an excellent resource on pediatric neuroradiological findings and provides a useful reference pediatricians, radiologist, neurologist, neuropsychologist, and students. The clinical cases correlate well with their radiological images and are valuable for reviewing common and rare neuroradiological findings through case presentations in the pediatric population. For future considerations, some chapters need to update more sensible language terms and grammatical errors in their case discussions. Also, we believe Chapter 8 should be further improved to offer a more comprehensive review of pediatric neurodegenerative diseases findings.

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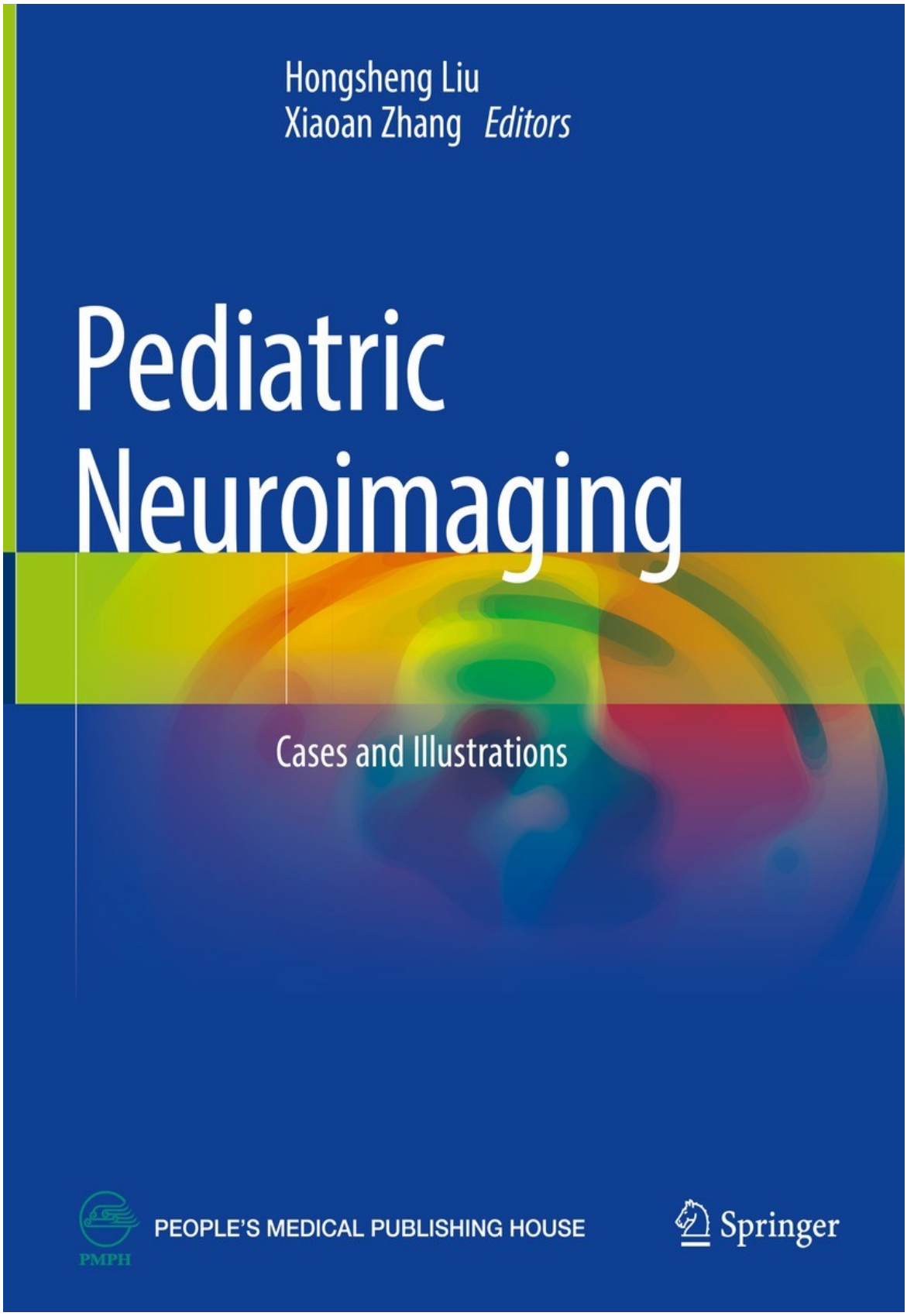
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