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Canadian Association of Radiologists Journal xx (2013) 1−10

CANADIAN ASSOCIATION OF RADIOLOGISTS JOURNAL

www.carjonline.org

Neuroradiology / Neuroradiologie

Magnetic Resonance Imaging of the Temporal Lobe: Normal Anatomy and Diseases

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Abstract

Objective: This pictorial essay will review the magnetic resonance imaging anatomy of the temporal lobes and describe the major pathologic processes of this complex area.
Conclusions: Magnetic resonance imaging is an essential tool in the investigation of a patient with suspected temporal lobe pathology. Various conditions may affect this anatomic region, and, therefore, classification of imaging findings into specific groups may help provide a more focused differential diagnosis.

Résumé

Objectif: Cet essai illustré a pour but de passer en revue l'anatomie des lobes temporaux en imagerie par résonance magnétique et de décrire les principaux processus pathologiques qui touchent cette région complexe.
Conclusions: L'imagerie par résonance magnétique joue un rôle essentiel dans l'examen du patient que l'on soupçonne de présenter une pathologie du lobe temporal. Diverses affections peuvent toucher cette région anatomique; c'est pourquoi les résultats d'imagerie doivent être classifiés selon des catégories précises afin de favoriser l'établissement d'un diagnostic différentiel ciblé.

Key Words: Temporal lobe; Magnetic resonance imaging anatomy; Magnetic resonance imaging findings; Temporal lobe pathology

Throughout the history of medicine, the temporal lobe has been considered an enigmatic region. Presently, there is a well-described group of diseases that affect the temporal lobe. Common clinical presentations include seizures, dementia, and memory impairment, followed by a spectrum of behavioral disturbances. Technical improvements in diagnostic imaging have certainly improved our ability to make more-specific diagnoses. Computed tomography is often the initial examination; however, magnetic resonance imaging (MRI) is almost always required for further workup. MRI provides excellent spatial and soft-tissue contrast resolution that helps demonstrate normal anatomic landmarks and tissue abnormalities. This pictorial essay aims to review normal imaging anatomy of the temporal lobes and demonstrate various pathologies that affect this region of the brain primary based on conventional MRI.

Anatomy

The upper surface of the temporal lobe is delimited from the frontal and parietal lobes by the sylvian fissure. No clear boundary is defined posteriorly, where it is separated from occipital and parietal lobes by an imaginary lateral parietotemporal line running downward from the posterior edge of the sylvian fissure (Figure 1). The medial border is delimited by a line that connects the inferior fork of the sylvian fissure to the superior-lateral aspect of the choroidal fissure−temporal horn complex [1]. The temporal lobe is composed of neocortex and mesial temporal lobe structures, including the uncus, parahippocampal gyrus, amygdala (located superiorly and anteriorly to hippocampal head),

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http://dx.doi.org/10.1016/j.carj.2013.05.001

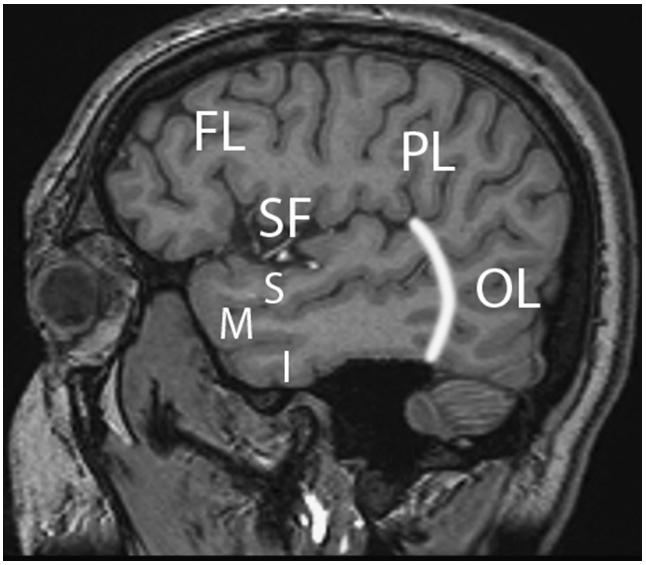

Figure 1. Imaging anatomy of temporal lobe. The temporal lobe is delimited from the frontal (FL) and parietal lobes (PL) by the sylvian fissure (SF). The posterior border is delimited from the occipital lobe (OL) by the imaginary temporo-occipital line (white line). Superior (S), medial (M), and inferior (I) temporal gyri are divided by corresponding superior and inferior sulci.

and hippocampus (composites of head, body, and tail) (Figure 2).

Imaging Protocol

This MRI protocol excludes quantitative MRI (hippocampal volumetry or T2 relaxometry) and functional (spectroscopy, perfusion) MRI, which are beyond the scope of this review. In our institution, sagittal T1-weighted (W) spin echo sequence is initially obtained to demonstrate gross brain anatomy and to ensure the optimal acquisition plane of the coronal oblique images perpendicular to the long axis of hippocampus. Coronal T2W and fluid attenuated inversion recovery (FLAIR) sequences oriented to the hippocampus reveal morphology and optimally demonstrate signal characteristics of the mesial temporal lobe. Thin, 1-mm, 3-dimensional, fast spoiled gradient-echo recalled (FSPGR) T1W inversion recovery sequence avoids partial volume averaging and provides high-contrast resolution between grey and white matter. Diffusion weighted images (DWI) are included in our routine ‘‘temporal epilepsy’’ protocol, which may provide information in the peri-ictal phase in patients with epilepsy [2]. Contrast enhancement is not routinely needed, unless tumour is suspected.

Anatomic Variants and Developmental Abnormalities of Temporal Lobe

Anatomical Variants

When temporal lobe asymmetry is recognized, the right side is usually larger than the left. Therefore, a smaller right temporal lobe is worth special attention in symptomatic patients [3]. Asymmetry of collateral white matter is uncommon but might be seen in normal individuals and should be considered a supportive finding rather than primary sign of hippocampal sclerosis [4].

Developmental Abnormalities

Hippocampal developmental abnormalities are found in a high percentage of patients with congenital malformations. Arrest of the normal hippocampal inversion is found bilaterally in association with congenital malformations (ie, agenesis of the corpus callosum, lissencephaly, holoprosencephaly, or Dandy-Walker complex) (Figure 3). However, the presence of unilateral hippocampal abnormality should prompt a reader for searching of cortical disorder (ie, heterotopia, polymicrogyria, schizencephaly) located on the same side [5].

Focal thickening of cerebral cortex >4 mm is compatible with cortical dysplasia often associated with increased T2 signal in the abnormal cortex and underlying white matter [6]. Grey matter heterotopia is another well-recognized developmental abnormality, which reflects collections of dysplastic neurons in unusual locations. This arrested neuronal migration lies between the ependymal surface of the ventricles and subcortical fibers (Figure 4); heterotopias must parallel the signal intensity of grey matter on all MRI sequences.

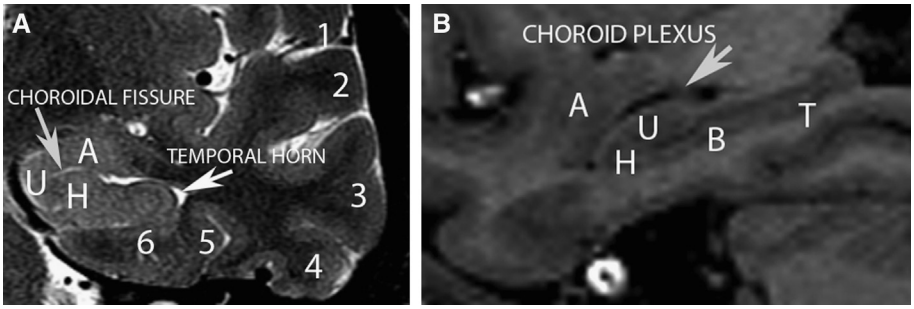

Figure 2. Imaging anatomy of temporal lobe. Coronal T2-weighted (A) and sagittal T1 3-dimensional inversion recovery (B) images, showing mesial temporal lobe structures: sylvian fissure (1); superior (2), medial (3), inferior (4) temporal gyri; parahippocampal gyrus (5); collateral white matter (6); uncus (U); amygdala (A); and head (H), body (B), and tail (T) of the hippocampus.