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RESEARCH ARTICLE

MR IMAGING AND EVALUATION OF THE PITUITARY STALK: SIZE, SHAPE, AND ENHANCEMENT PATTERN

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Abstract

Background: Knowing the normal imaging appearance of the pituitary stalk is essential for diagnosing pituitary infundibular lesions and a more accurate assessment of the stalk.
Objective: We aimed to evaluate the normal pituitary stalk using high-resolution magnetic resonance imaging(MRI) at 1.5T.
Materials and Methods: All images were obtained with a 1.5 T MR scanner using a dedicated pituitary MRI protocol. A total of 50 patients, with a gender distribution of 32 men and 18 women, were included in the study. Their ages ranged from 18 to 70 years, averaging 43 years. The diameter and length of the pituitary stalk were measured. The signal intensity and enhancement of the stalk were visually evaluated on pre- and post-contrast T1-weighted images.
Results: The average anterior-posterior (AP) and transverse diameters of the pituitary stalk at the optic chiasm level were 3.19 ± 0.48 mm and 3.25 ± 0.46 mm, respectively. The average AP and transverse diameters of the pituitary stalk at the pituitary gland insertion were 1.93 ± 0.38 mm and 1.95 ± 0.40 mm, respectively. The length of the pituitary stalk was 6.35 ± 1.63 mm. Compared to the optic chiasm and neurohypophysis,the stalk demonstrated hypointensity on unenhancedMR images. The enhancement of the pituitary stalk is observed in all cases.
Conclusions: The study pinpointed key MRI criteria for evaluating the normal pituitary stalk's size, shape, and how it takes up contrast dye. These details act as a roadmap for spotting and understanding pituitary gland issues.

Introduction:-

The pituitary stalk, also called thepituitary infundibulum, acts as a bridge between the hypothalamus and the pituitary gland, particularly its posterior part. It is shaped like a funnel, wider at the top and narrow as it goes down. The signal intensity of a normal stalk on T1-weighting is usually less than that of the optic chiasm and is less than that of normal neurohypophysis in all cases. Because the pituitary stalk doesn't have a blood-brain barrier, it demonstrates avid enhancement on post-contrast T1-weighted images. While the stalk often deviated or shifted to one side, this observation is normal[1].

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The typical hyperintensity of the posterior pituitary gland on T1-weighted sequences is believed to be related to vasopressin neurosecretory granules or lipoid bodies (lysosomes) in pituicytes that are normally located in the neurohypophysis [2].

The pituitary stalk contains a wide spectrum of different cell types with many signaling pathways [3]. Therefore, the spectrum of pathology involving the pituitary infundibulum includes tumors and inflammatory and infectious processes, resulting in stalk thickening. Examples include germinoma, Langerhans cell histiocytosis (LCH), lymphocytic infundibuloneurohypophysitis (LINH), and neurosarcoidosis. The pituitary infundibulum thickening may be a diagnostic imaging challenge because of its small size coupled with the diverse range of diseases affecting it[1, 4-7].

Several studies have investigated the normal pituitary stalk using various imaging modalities. Peyster et al. [8] focused on measuring its diameter on CT, while Simmons et al. [9] assessed its transverse dimension, shape, signal intensity on T1-weighted MR images, and pattern of contrast enhancement at 1.5T. Araki et al. [10] evaluated the signal intensity on FLAIR images, and Satogami et al. [11] conducted a high-resolution MRI study at 3T. They analyzed the signal intensity on T2-weighted images and measured the stalk length and the infundibular recess depth.

This study investigated the pituitary stalk's normative dimensions, morphology, and contrast enhancement characteristics utilizing high-resolution magnetic resonance imaging at 1.5T.

Materials and Methods:-

Subjects

A total of 50 patients, with a gender distribution of 32 men and 18 women, were included in the study. Their ages ranged from 18 to 70 years, averaging 43 years. As this study aimed to investigate normal pituitary stalks, strict exclusion criteria were employed. The study excluded individuals with pituitary macroadenomas, microadenomas, prior pituitary surgery, sellar-suprasellar masses, empty sella, an incomplete MRI study, or patients with hydrocephalus.

MR Imaging

All images were obtained with a 1.5T MRscanner (MAGNETOM Aera, Siemens,Germany)in the radiology department of Al Hada Armed Forces Hospital at Taif. In all patients, a dedicated pituitary MRI protocol was used: spin-echo (400/12 [TR/TE]) sagittal and coronal images through the sella were obtained before and after injection of contrast media. Four excitations were used: a 16-cm field of view, 3-mm slice thickness, and 1-mm interslice gap. In addition, axial spin-echo images at 600/20 with one excitation and a 20- cm field of view were obtained. CoronalT2-weighted axial images (2500/30 and 2500/ 80) were also obtained. The focused coronal and sagittalnon-enhanced and enhanced T1-weighted images were used to evaluate the stalk’s diameters, lengthand enhancement pattern (Fig 1), and the focusedsagittal non-enhanced and enhanced T1-weighted images were used to evaluate the stalk’s signal characteristics (Fig 2).

Ethical approval

Ethical approval for the study was obtained from the Research Ethics Committee of Armed Forces Hospitals at Taif (No. 2023-826), dated December 10, 2023.

Imaging Analysis

Two neuroradiologists reviewed the MR examinations. The electronic calipers at the physician's console measured the stalk's maximal dimensions to the nearest 0.01 mm.

The pituitary stalk's anteroposterior (AP) and transverse diameters were measured at two distinct anatomical levels on coronal and midsagittal T1-weighted pre- and post-contrast MRI images. The first level is near the stalk's origin from the median eminence, at the level of the optic chiasm, while the second level is at the stalk's insertion point on the pituitary gland.

The length of the pituitary stalk was evaluated on midsagittal T1-weighted post-contrast images. This parameter was defined as the distance from the tip of the infundibular recess to the junction of the pituitary stalk and the pituitary

gland, traced along the pituitary stalk's trajectory. The maximum dimension was established using electronic calipers at the physician's console.

The visual assessment of the pituitary stalk's signal intensity and enhancement characteristics was compared to the neurohypophysis and optic chiasm on pre- and post-contrast T1-weighted sequences.

Statistical Analysis

Data was entered into Microsoft Excel (Microsoft Corporation, Redmond, WA) and then transferred to IBM SPSS Statistics for Windows, Version 23.0 (IBM Corp, Armonk, NY) for analysis. Descriptive statistics were used to summarize categorical variables.

Results:-

Table 1 summarizes key dimensions, including mean, standard deviation, and range. Analysis of both AP and transverse diameters at the pituitary insertion and optic chiasm levels showed no statistically significant differences. The pituitary stalk diameter slightly decreased near the stalk's insertion on the pituitary gland, demonstrating a smoothly tapered morphology devoid of abrupt size or contour variations(Fig 1).

Feature	Mean (mm)	Standard Deviation (mm)	Range (mm)
Diameter at the pituitary insertion			
Anteroposterior	1.93	±0.38	1.3 – 2.3
Transverse	1.95	± 0.40	1.26 – 2.4
Diameter at the optic chiasm			
Anteroposterior	3.19	± 0.48	2.20 – 4.11
Transverse	3.25	± 0.46	2.4 –4.08
Length of Stalk	6.35	± 1.63	4.28 – 8.56

Table 1:- Measurements of the normal pituitary stalk.

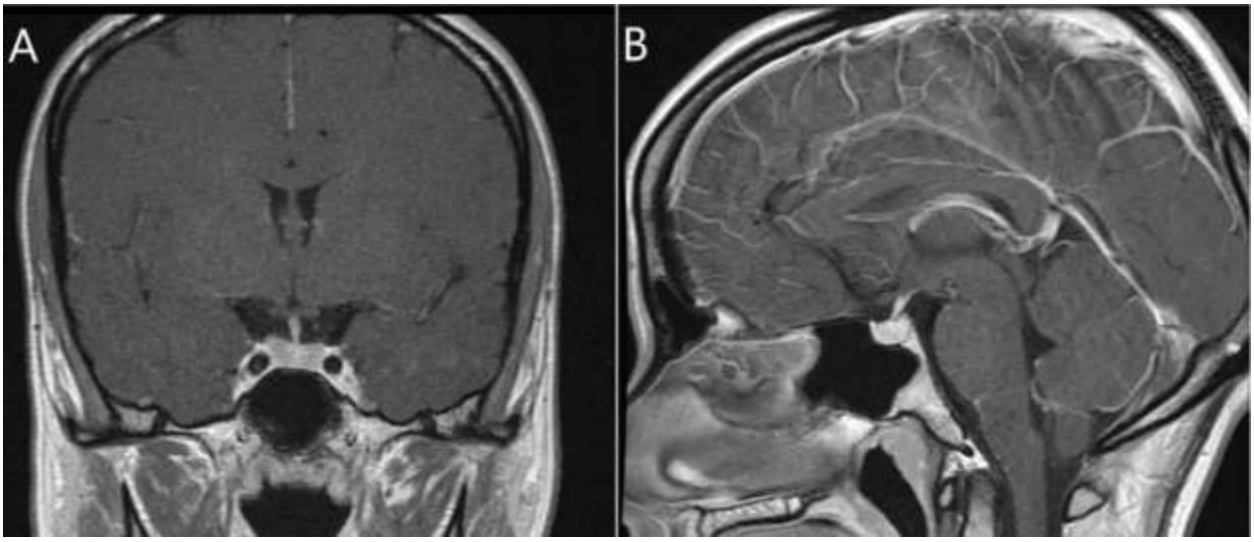

Figure 1:- Contrast-enhanced coronal (A) and sagittal (B) T1-weighted image of the pituitary gland.The study demonstrated smooth tapering of the enhanced pituitary stalk. The AP and transverse of the pituitary stalk are made at the optic chiasm and its insertion with the pituitary gland.

The pituitary stalk showed uniform signal intensity on MRI,with no discernible variation in signal intensity observed along the stalk's course. The stalk demonstrated hypointensity on unenhanced MR images relative to the optic chiasm. Additionally, it consistently exhibited hypointensity compared to the neurohypophysis on unenhanced MR images (Fig 2).

Figure 2:- Non-enhanced sagittal T1-weighted image of the pituitary gland.The study shows that the pituitary stalk is hypointense relative to the optic chiasm (arrow) and neurohypophysis.

After contrast administration, all subjects exhibited enhancement of the pituitary stalk (Fig 1). In addition, enhancement of the tuber cinereum and the median eminence of the hypothalamus were noted. The enhanced MR images revealed the stalk to be hyperintense relative to the optic chiasm and hypointense to the neurohypophysis. Moreover, a central area of low T1 signal, corresponding to the infundibular recess, was consistently observed on pre- and post-contrast images.

Discussion:-

Our study employed high-resolutionMRI at 1.5 Tesla to meticulously examine the normal pituitary stalk. MRI offers a superior signal-to-noise ratio (SNR), leading to enhanced spatial resolution and image quality. Consequently, MRI proves more effective for evaluating the anatomy of the pituitary gland and surrounding structures, facilitating improved surgical planning for lesions in the region [12].

The average AP and transverse diameters of the pituitary stalk were larger at the level of the optic chiasm (3.19 ± 0.48 mm and 3.25 ± 0.46 mm, respectively) compared to the average AP and transverse diameters of the pituitary stalk at the pituitary insertion (1.93 ± 0.38 mm and 1.95 ± 0.40 mm, respectively). This finding is consistent with the expected gradual tapering of the stalk as it descends. However, this study found no significant differences in AP and transverse diameters at both levels.

A study by Peyster et al. [8] used axial CT scans to measure the size of the pituitary stalk. They found that the largest diameter was 4.0 mm at the level of the dorsum sella and 4.5 mm at the suprasellar level. Tien et al. [5] reported that the widest part of the normal pituitary stalk on 1.5T MR images was 2.8 mm at the midpoint and 3.5 mm near the median eminence. Simmons et al. [9] found the transverse diameter of the normal pituitary stalk on coronal MRI images to be 1.91 ± 0.40 mm and 3.25 ± 0.56 mm at its insertion on the pituitary gland and at the optic chiasm level, respectively.

A study by Satogami et al. [11] measured the diameter of the normal pituitary stalk using oblique-axial images. The average diameter at the pituitary insertion was 2.32 mm for the AP direction and 2.16 mm for the transverse

direction. At the level of the optic chiasm, the AP diameter was measured 3.25 mm, and the transverse diameter was 3.35 mm.

This current study's pituitary stalk thickness measurements at the optic chiasm level support the earlier observation. However, compared to our results and those of Simmons et al. [9], the observed slight discrepancies in pituitary stalk thickness measurements at pituitary insertion compared to the study conducted by Satogami et al. [11] may be attributable to variations in spatial resolution between 1.5T and 3T MR imaging and potential differences in the chosen imaging plane.

In the current study, the average length of the pituitary stalk was 6.35 ± 1.63 mm. Satogami et al. [11] found that the length of the pituitary stalk was 5.91 ±1.24 mm. There is a wide range of variations in the form and dimensions of the infundibular recess. The extent to which it extends downward along the pituitary stalk might influence the size and shape of the stalk's proximal portion, potentially mimicking stalk thickening [13]. Knowledge of the typical infundibular recess size is critical to accurate pituitary stalk length assessment, which is essential for identifying infundibular lesions.

The pituitary stalk showed uniform signal intensity on MRI, with no discernible variation in signal intensity observed along the stalk's course. The stalk demonstrated hypointensity on unenhanced MR images relative to the optic chiasm. Moreover, it consistently exhibited hypointensity compared to the neurohypophysis on unenhanced MR images.

Previous studies have explored the appearance of the normal pituitary stalk on MRI. On T1-weighted images, Simmons et al. [9] observed the stalk to be hypointense compared to the posterior pituitary lobe in all cases and hypointense and isointense relative to the optic chiasm in 85% and 16%, respectively. Araki et al. [10] found that the stalk appeared hyperintense in 73% of cases on FLAIR images, likely due to its longer T2 relaxation time. Nevertheless, accurately assessing the stalk on T2-weighted images using standard 1.5T MR scanners has been challenging due to limitations in spatial resolution. Using high-resolution T2-weighted MRI scans, Satogami et al. [11] observed a central hyperintensity within the pituitary stalk surrounded by a rim of isointensity compared to the cerebral white matter in 69% of the study participants.

As the pituitary stalk lacks a blood–brain barrier [1], enhancement of the pituitary stalk is observed in all cases. In addition, a central area of low T1 signal, corresponding to the infundibular recess, was consistently observed on pre- and post-contrast images.

The present study contributes to the development of standardized criteria for pituitary stalk evaluation, ultimately improving the accuracy of infundibular pathology diagnosis and fostering effective therapeutic interventions.

Conclusion:-

The study established well-defined criteria for assessing the normal pituitary stalk's size, contour, and enhancement patterns on MR images. These parameters serve as essential reference values for detecting and characterizing pathological processes. Notably, the pituitary stalk typically exhibits hypointensity relative to the neurohypophysis on both unenhanced and enhanced T1-weighted images. Compared with the optic chiasm, the stalk demonstrates hypointensity on unenhanced images, showing contrast enhancement on enhanced MR images. This differential signal intensity behavior holds crucial diagnostic significance in evaluating potential pituitary pathologies.

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