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This information is current as of July 24, 2025.

*AJNR Am J Neuroradiol* 1991, 12 (3) 529-532  
<http://www.ajnr.org/content/12/3/529>

# High-Intensity Signals Within the Posterior Pituitary Fossa: A Study with Fat-Suppression MR Techniques

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Five different theories have been proposed to explain the high-intensity signals within the posterior pituitary fossa seen on MR: (1) a paramagnetic effect of phospholipids in the posterior lobe, (2) lipid in pituicytes in the posterior lobe of the pituitary, (3) neurosecretory granules in the posterior lobe, (4) fat within the sella but outside the pituitary gland, and (5) fat in bone marrow in the dorsum sellae. Previous reports have contained conflicting evidence on which of these structures is the cause of the high-intensity signals within the posterior sella. The purpose of this study was to examine the high-intensity signals of the normal posterior sella with fat-suppression MR techniques to reevaluate the contribution of fat to those signals. The sellae of 19 normal volunteers and two cadavers were imaged with MR with a commercially available unit and a research fat-water-suppression technique. High-intensity signals in the posterior sella were observed in all 21 subjects on conventional T1-weighted MR images. In two volunteers, the high-intensity signals in the posterior sella were suppressed with fat-suppression techniques; in 17 subjects the signals were suppressed with water-suppression techniques. In two volunteers the results were indeterminate. The high-intensity signals in the posterior sella do not behave like lipid in the majority of cases.

Our study supports the conclusion that high-intensity signals in the posterior sella may have more than one source. It appears that most of these sources do not suppress with fat-suppression techniques.

*AJNR* 12:529-532, May/June 1991; *AJR* 157: August 1991

The high-intensity signals that have been observed near the posterior pituitary fossa on T1-weighted MR images have received different interpretations. On the basis of anatomic, clinical, and experimental observations, there are five hypothetical sources for these signals: a paramagnetic effect of phospholipids in the posterior lobe [1], fat in the sella outside the gland [2], a short T1 substance in neurosecretory granules in the posterior lobe [3-6], lipid in pituicytes in the posterior lobe [7, 8] (Sze G et al., presented at the annual meeting of the American Society of Neuroradiology, May 1987), and lipid in the dorsum sellae and posterior clinoid bone marrow adjacent to the sella. The purpose of this study was to examine the high-intensity signals of the normal posterior sella with thin MR sections and fat-suppression techniques to evaluate the contribution of fat to those signals.

## Subjects and Methods

Twenty-one subjects, including 19 normal volunteers and two cadavers, were studied with a 1.5-T General Electric Signa imager. In each case sagittal spin-echo images, 600-800/20-25 (TR/TE), were obtained with a 256 × 256 matrix, 16- to 24-cm field of view, two averages, and 3-mm slice thickness. Sagittal images of each subject were also obtained with two fat- and water-suppression imaging techniques: (1) a commercially available version of the Dixon method (PREFCMEMP, General Electric) [9-11] and (2) a research technique (hybrid 1331 chopper) [12]. In the former, a frequency-selective pulse is used to suppress the water- or

Received August 22, 1989; revision requested October 16, 1989; final revision received December 11, 1990; accepted December 12, 1990.

Presented at the annual meeting of the American Society of Neuroradiology, Orlando, FL, March 1989.

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0195-6108/91/1203-0529

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fat-proton signal. In the latter, temporally asymmetric imaging is used to distinguish signals from fat and water protons. In some cases, a 1.5-mm slice thickness was used in place of or in addition to a 3.0-mm thickness. The MR images without fat suppression were compared with fat- and water-suppression images of the same subject. All images were evaluated by two interpreters. Classification of each case as suppressing with fat suppression or with water suppression was made by a consensus of the two interpreters. If the interpreters did not agree, or if they were unsure as to how to classify the case, it was called indeterminate.

## Results

Technically adequate fat- and water-suppression images were obtained in 19 of the 21 subjects; technically satisfactory fat-suppression images without technically satisfactory water-suppression images were obtained in two (Table 1). Results with the hybrid 1331 chopper and PREFCMEMP techniques were identical.

Of the 21 studies, 17 (including the two cadavers) showed suppression with water suppression (Fig. 1), two showed suppression with fat suppression (Figs. 2 and 3), and two were judged indeterminate because both interpreters believed the suppression was incomplete with both water- and fat-suppression techniques. With the exception of these two

cases, suppression with water- and fat-suppression techniques were mutually exclusive.

## Discussion

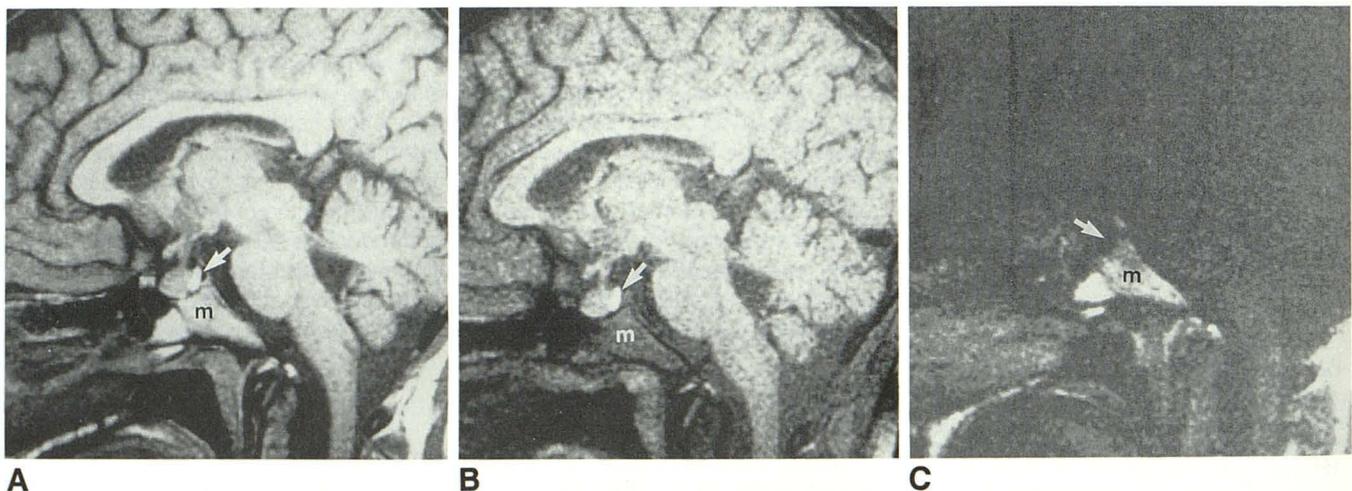
Results of fat and water suppression were not identical in all subjects in this study. In 79% of cases the high-intensity signals in the posterior sella were suppressed with water-suppression techniques but not with fat-suppression techniques. Fat-suppression images were not available for one subject. In these cases, therefore, the high-intensity signals in the posterior sella are likely the result of a short T1 substance that is within the posterior lobe [1], not of fat in pituicytes in the posterior inferior sella, or in bone marrow. In 10% of the subjects studied, the high-intensity signals showed suppression with fat-suppression but not with water-suppression techniques. Water-suppression images were not available in one case. In these cases the high-intensity signals may originate from fat and not a short T1 substance. In 10% of cases, in which neither fat nor water suppression eliminated the high signal intensity in the sella, both a lipid and a paramagnetic (i.e., phospholipid) source might have been present.

The technical limitations of the study do not discount the observation. The signal intensities were studied qualitatively and not quantitatively. Because of the small number of subjects of the study group, the relative proportions of fat- or water-suppressing signals can only be estimated. Although magnetic susceptibility artifacts seen in the suppression techniques may to some degree obscure high-intensity signals in the region of the posterior pituitary fossa, the artifacts observed were not judged to be sufficiently conspicuous to do so completely. Our study supports the conclusions that the source of the high-intensity signals in the pituitary fossa is not the same in all cases and that the source does not behave like fat in the majority of cases.

In previous investigations, a single explanation was as-

**TABLE 1: Results of Fat- and Water-Suppression Studies in 21 Cases of High-Intensity Signal in the Posterior Sella**

No. of Cases	Technique	
	Fat Suppression	Water Suppression
16	No suppression	Suppression
1	No suppression	Not available
1	Suppression	No suppression
1	Suppression	Not available
2	Indeterminate	Indeterminate



**Fig. 1.—Suppression of high-intensity signals in posterior pituitary fossa with water-suppression techniques.**  
 A, Sagittal T1-weighted spin-echo MR image shows high-intensity signals from posterior pituitary fossa (arrow) and sphenoid marrow elements (m).  
 B, Sagittal fat-suppression MR image (hybrid 1331 chopper technique) shows suppression of high-intensity signals from sphenoid marrow elements (m) but no suppression of high-intensity signals from posterior pituitary fossa (arrow).  
 C, Sagittal water-suppression MR image (hybrid 1331 chopper technique) shows suppression of high-intensity signal (arrow) in posterior pituitary fossa. Signals from brain are suppressed also; high-intensity signals from sphenoid marrow elements (m) are not.

Fig. 2.—Suppression of high-intensity signals in pituitary fossa with fat-suppression techniques.

A, Sagittal T1-weighted spin-echo MR image shows high-intensity signals in posterior pituitary fossa (arrow) and sphenoid marrow elements (m).

B, Sagittal fat-suppression MR image (hybrid 1331 chopper technique) shows suppression of high-intensity signals in posterior pituitary fossa (arrow) and sphenoid marrow (m). Partial obscuring of posterior sella signals by susceptibility artifact is shown also. Water-suppression image was not obtained in this case.

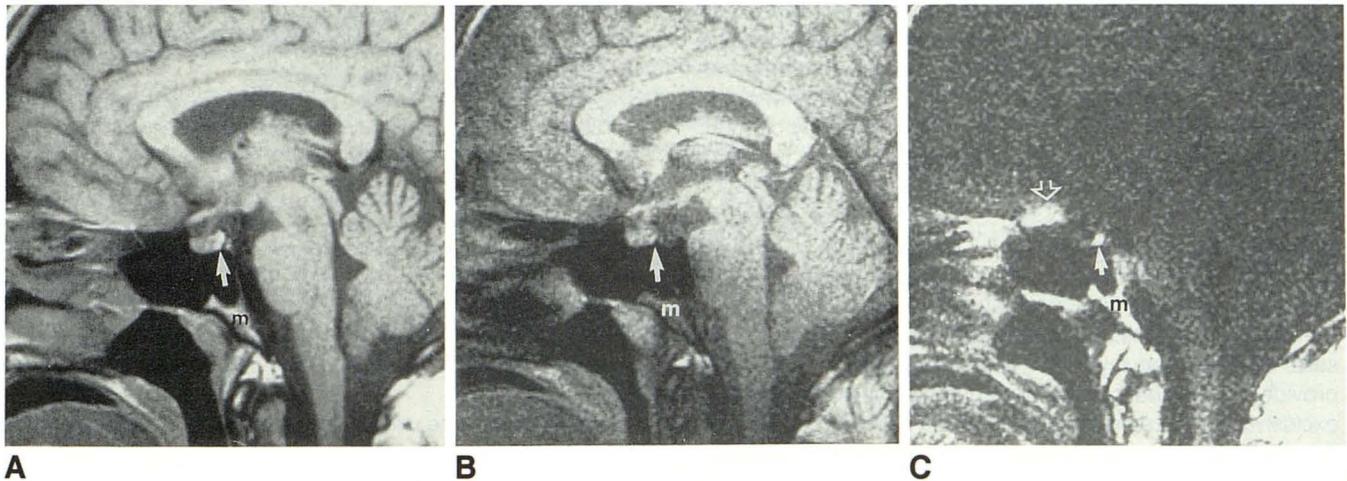
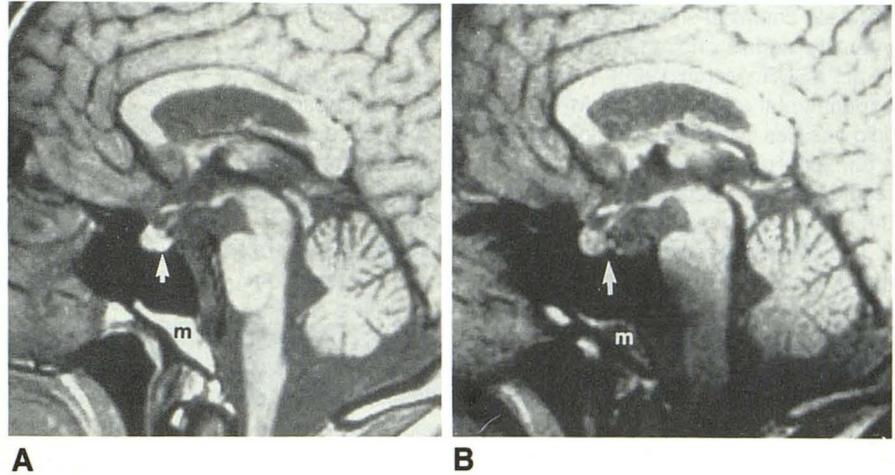


Fig. 3.—Second case illustrating suppression of high-intensity signals in pituitary fossa with fat-suppression techniques.

A-C, Sagittal T1-weighted spin-echo MR image (A), PREFCMEMP fat-suppression MR image (B), and water-suppression MR image (C). High-intensity signals in posterior pituitary (solid arrows) and sphenoid (m) are labeled. Air in sphenoidal sinus causes artifacts (open arrows) and distortion of high-intensity signals in water-suppression study.

sumed for the high-intensity signal in the posterior sella. In one study, high-intensity signals were present in the posterior sella in most of the subjects, and a small crescent-shaped area of extraglandular fat was observed in the posterior sella in anatomic images, especially in paramidline sections. Therefore, the high-intensity signal from the pituitary fossa was assumed to correlate with the extraglandular fat [2]. The study suggested that at least in some cases, a region of high-intensity signal in the posterior pituitary fossa may represent fat inside the sella but outside the gland. Others have documented the presence of a fat pad in the sella (Blatter D et al., presented at the annual meeting of the American Society of Neuroradiology, March 1989).

A possible association between the high-intensity signals in the posterior sella and neurosecretory granules in the pituitary posterior lobe was reported by Fujisawa et al. [3-5] on the basis of observations in normal volunteers [3], patients with diabetes insipidus [4], and patients with idiopathic pituitary dwarfism and pituitary stalk transection [5]. Fujisawa et

al. [6] also performed experimental studies in rabbits that supported the concept of neurosecretory granules with high-intensity signals [6]. Nishimura et al. [14] concluded that the source of the high-intensity signal was not fat because they observed no chemical-shift effect associated with the region of high-intensity signal.

Two investigators who recognized that pituicytes contained lipid bodies suggested that the high-intensity signals in the posterior sella were from lipid in the pituitary posterior lobe [7, 8]. Colombo et al. [7] reviewed the MR images of 200 patients and attributed the high-intensity signals in the posterior sella to the posterior lobe because of the size and position of the hyperintense signal and the changes in the appearance of this signal in various pathologic states. On the basis of MR images in animals and corresponding histologic and electron microscopic studies of the pituitary gland before and after pharmacologic stimulation, Kucharczyk et al. [8] suggested that the pituitary hyperintensity represented intracellular lipid in pituicytes. Others have found an inconsistency

between chemical-shift imaging and the theory that the high-intensity signals originate from intracellular lipid [13] (Blatter et al., ASNR, March 1989). Kucharczyk et al. [1] performed experimental studies on the MR characteristics of phospholipid vesicles. Their observations supported the concept that a phospholipid is a relaxation enhancer of water protons that creates MR characteristics approximating the appearance of the high-intensity signals in the posterior sella.

The majority of our cases showed high-intensity signals in the posterior sella that suppressed with water-suppression techniques but not with fat-suppression techniques. These observations are consistent with those by Kucharczyk et al. [1], Blatter et al. (ASNR, March 1989), and Kim et al. (Kim BJ et al., ASNR, March 1989). The two cases that showed signal suppression with fat-suppression techniques suggest the presence of a lipid source instead of or in addition to a relaxation-enhancing substance in the posterior lobe. No chemical-shift effect [12] was observed to support the suggestion. Nonetheless, the possibility that fat or other substances such as cholesterol, complex proteins, triglycerides, and fatty acids [1] occasionally may be present as a confounding factor in the analysis of the sella should be considered.

Our study supports the conclusion that there may be more than one source of the high-intensity signals in the posterior sella. Sources that do not suppress with fat-suppression techniques appear to account for the majority of cases, as suggested by Kucharczyk et al. [1], Blatter et al. (ASNR, March 1989), and Kim et al. (ASNR, March 1989). Sources that suppress with fat-suppression techniques account for the minority of cases. In these cases, artifact, a fat pad in the sella, or lipid in pituicytes or, less likely, bone marrow may provide the explanation. The two sources may not be mutually exclusive. In future investigations of the sella, more than one source for high-intensity signals may need to be considered.

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**Editor's note.**—See related letters to the editor on pages 579-583.