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The Application of NMR Imaging to the Evaluation of Pituitary and Juxtasellar Tumors

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Nuclear magnetic resonance (NMR) imaging was used to evaluate pituitary and juxtasellar tumors in 37 patients representing a wide range of pathology. The value of the multiplanar facility of NMR is emphasized in providing accurate volumetric information and establishing the topographical relation of tumors to adjacent structures. Current limitations of the method and possible future developments to improve diagnostic precision are discussed.

Investigation of pituitary and parapituitary lesions can be particularly exacting because clinical manifestations, including visual failure and endocrinological disturbances, may occur when the lesion is in its early stages. Appropriate management demands precise localization and a distinction among various pathologies so that the appropriate operative route or field for irradiation can be chosen [1]. Early detection of suprasellar extension of pituitary adenomas is particularly important in preventing visual loss in patients undergoing medical treatment, especially when pregnancy occurs in women with prolactinomas, where there is a risk of accelerated tumor expansion [2]. Follow-up studies are valuable in assessing the effects of radiotherapy or drug therapy on tumor size. After plain skull radiography, computed tomography (CT) in the transverse axial plane is usually used to diagnose and evaluate tumors in the pituitary region [3–5]. Despite the high quality of images now available, it is sometimes difficult to determine the precise extent of extrasellar extension of pituitary tumors and to diagnose microadenomas. Invasive procedures are often required to confirm a suspected diagnosis of empty sella syndrome and to establish the relationship of any mass to the optic chiasm [6, 7].

Subjects and Methods

Proton nuclear magnetic resonance (NMR) scans using steady-state free precession (SSFP) techniques were performed with a Picker resistive NMR unit on 10 normal volunteers and 37 patients with known pathology in the pituitary region at the Queen's Medical Centre, Nottingham. The cases studied comprised 12 chromophobe pituitary adenomas; five acromegalies; four craniopharyngiomas; three cases each of prolactinoma, juxtasellar aneurysm, and empty sella syndrome; one case each of recurrent chordoma, hypothalamic glioma, and nasopharyngeal carcinoma; and four colloidal cysts of the third ventricle.

Procedure

The normal pituitary gland is isodense with brain and is best seen on sagittal section. It is our practice to obtain a midline sagittal scan and complement this with transverse and coronal scans as appropriate, using a slice thickness of 1 cm and an image time of 2 min. A typical examination of about eight sections takes 25 min. It is usually possible in no more than three attempts to obtain a section in which at least part of the third ventricle is included with the pituitary gland below. The normal gland is seen contrasted against a variable quantity of marrow and air within the basisphenoid. The optic chisam and optic nerves can be identified within the suprasellar cisterns on sagittal and coronal sections. The anatomy of the suprasellar cisterns shown on transverse section matches that seen with CT.

Results

NMR demonstrated clearly the presence and size of pituitary adenomas. Its multiplanar facility was most valuable in delineating extrasellar extension. All tumors visualized by NMR were denser than brain tissue and all except one were homogeneous in texture. Although the bone of the fossa could not be seen, the degree of expansion of the floor could be observed from the configuration of the inferior margin of the tumor on sagittal and coronal sections. As

A B

Fig. 1.—Sagittal (**A**) and axial transverse (**B**) NMR scans of massive invasive chromophobe pituitary show extrasellar extension.

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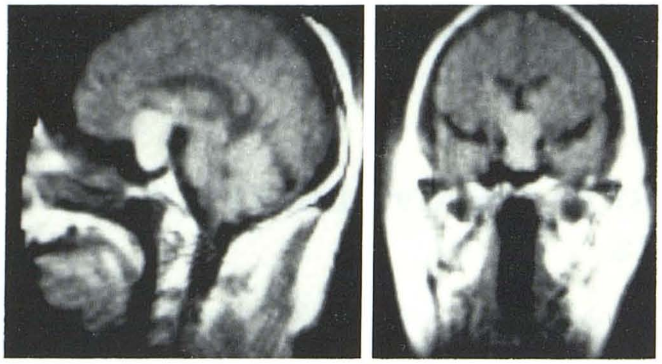
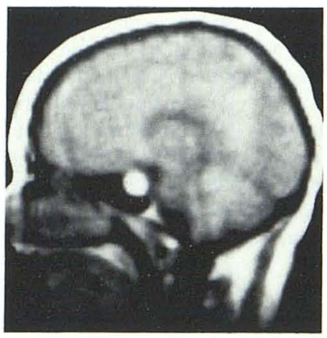


A B

Fig. 2.—Sagittal (**A**) and coronal (**B**) NMR scans of chromophobe pituitary adenoma show suprasellar extension.



3 4

Fig. 3.—Sagittal NMR scan of chromophobe pituitary adenoma encroaching on suprasellar cisterns.

Fig. 4.—Sagittal NMR scan of bilobed craniopharyngioma encroaching on foramen of Monro. Low-density area is seen in each lobe; heavy peripheral calcification is invisible.

5 6

Fig. 5.—Axial transverse NMR scan of large suprasellar aneurysm.

Fig. 6.—Sagittal NMR scan of empty sella syndrome shows suprasellar cisterns extending into upper part of pituitary fossa.

with CT, suprasellar extensions were seen in transverse axial sections as a filling defect within the suprasellar cisterns. In larger tumors the cistern was completely obliterated or only the peripheral cerebrospinal fluid extensions were visible. Smaller degrees of encroachment on the suprasellar cistern were easily recognized in the sagittal plane. Parasellar extensions were clearly shown on both coronal and transverse sections.

Figure 1 shows the NMR scans of a patient who presented with visual failure and headaches attributable to invasive chromophobe pituitary adenoma. The sections demonstrate massive extrasellar extension of tumor upward, obliterating the front end of the third ventricle and blocking the foramen of Monro with consequent ventricular enlargement; forward into the ethmoid sinuses, laterally displacing the left temporal lobe; and backward, causing compression and displacement of the brain stem. Figure 2 shows a chromophobe adenoma with a much smaller degree of supra- and parasellar extension, and in figure 3 the tumor is virtually intrasellar.

In all four cases of craniopharyngioma, the tumor encroached on the foramen of Monro and resulted in hydrocephalus. NMR scans of all four showed one or more discrete low-density areas within the lesion (fig. 4). However, the inability of NMR to show calcification is a handicap, considering the value of this sign in diagnosing craniopharyngioma.

Our experience with three juxtasellar aneurysms indicated that these can probably be diagnosed with certainty using flow-dependent NMR sequences. The presence of rapidly flowing blood produced a zero signal on the flow-dependent (SSFP) scan (fig. 5).

The three cases of empty sella syndrome showed enlargement of the pituitary fossa. Two had no visual or endocrine symptoms; the third had profound hypopituitarism presumed secondary to infarction of a pituitary tumor. NMR scans of all three showed the suprasellar cisterns extending into the pituitary fossa (fig. 6). No normal pituitary tissue was seen in the patient with hypopituitarism.

In a patient with recurrent chordoma the anterior parasellar extension of the tumor was clearly shown on coronal NMR section. The upward extension of a hypothalamic glioma in a patient who presented with gigantism and precocious puberty was better demonstrated on NMR than on CT scans. As with CT, colloidal cysts were visualized by NMR as areas of very high density within the anterior portion of the third ventricle. The midline sagittal scans were useful in defining the topographical relation of tumors to adjacent structures.

Discussion

We believe that with thinner sections, high-resolution scanning, and the use of spin sequences based on individual parameters NMR imaging will rival CT in the assessment of pituitary disease. The multiplanar facility of NMR and its avoidance of ionizing radiation may then make it the preferred method of primary investigation.

REFERENCES

1. Danoff BF, Pripsteine S, Croce N, Kramer S, Lees KF. The value of computerized tomography in delineating suprasellar extension of pituitary adenoma for radiotherapeutic management. *Cancer* **1978**;42:1066–1072
2. Geinzell C, Wang CF. Outcome of pregnancy in women with pituitary adenoma. *Fertil Steril* **1979**;31:363–72
3. Reich NE, Zelch JV, Alfidi RJ, Meaney TF, Duchesneau PM, Weinstein MA. Computed tomography in the detection of juxtasellar lesions. *Radiology* **1976**;118:333–335
4. Banna M, Baker HL, Houser OW. Pituitary and parapituitary tumours on computed tomography. *Br J Radiol* **1980**;53:1123–1143
5. Kuuliala I. Computed axial tomography of pituitary adenomas. *Clin Radiol* **1981**;32:259–264
6. Hall K, McAllister VL. Metrizamide cisternography in pituitary and juxtapituitary lesions. *Radiology* **1980**;134:101–108
7. Gross CE, Binet EF, Esguerra JV. Metrizamide cisternography in the evaluation of pituitary adenomas and the empty sella syndrome. *J Neurosurg* **1979**;50:472–476