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Prolactin-Secreting Pituitary Adenomas: Correlation of Radiographic and Surgical Findings

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The preoperative hypocycloidal sellar tomograms, angiograms, and pneumoencephalograms of 100 patients being evaluated for prolactin-secreting pituitary adenomas were reviewed and the results correlated with surgical findings at transsphenoidal exploration. The majority (53%) of tumors encountered were microadenomas. Although sellar volume was normal in 72%, sellar shape on tomography was abnormal in 96%; the location of the tumor within the sella could be predicted by means of tomography alone in 88%. Low volume pneumoencephalography was a reliable method for determining suprasellar extension in 19% of cases and in demonstrating arachnoidal diverticulae in 24%, a finding of great importance to the surgeon planning a transsphenoidal exploration. The use of internal carotid angiography to predict lateral tumor extension proved unreliable. Tumor blush was demonstrated only in larger lesions. No vascular anomalies that would contraindicate transsphenoidal exploration were encountered in this group of patients with hyperprolactinemia.

Prolactin-secreting pituitary adenomas represent an increasingly important diagnostic problem to the endocrinologist, gynecologist, neurosurgeon, and neuroradiologist. In most instances, these tumors can be recognized early by the presence of endocrine dysfunction (e.g., galactorrhea and amenorrhea). The clinical diagnosis is usually confirmed by hormonal assays and radiologic findings. This study was undertaken to assess the reliability and usefulness of radiologic studies in the preoperative evaluation of patients with prolactin-secreting adenomas.

Materials and Methods

Tomograms of the sella, pneumoencephalograms, and carotid angiograms of 100 consecutive patients who subsequently underwent transsphenoidal exploration were reviewed. Elevated prolactin levels had been documented in all patients prior to radiologic investigation. The radiologic studies included frontal and lateral hypocycloidal tomograms of the sella, pneumoencephalograms with polytomography of the sellar region, and bilateral internal carotid arteriograms. Computed tomographic (CT) brain scans were performed in about 20% of these patients. Arteriography, usually performed using 2:1 magnification and subtraction techniques, included frontal, lateral, and basal projections. The radiologic studies were reviewed (T. H. N. and I. L. R.) and the predicted location, size, and extent of the tumor were recorded according to the staging criteria of Hardy [1] as modified by Wilson [2]. The operative notes (C. B. W.) were then reviewed and the surgical findings compared with the radiologic prediction.

Results

Of the 100 patients, 97 were women, aged 14–63 years (mean, 29 years). Typically, the clinical presentation was amenorrhea and galactorrhea. On trans-

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sphenoidal exploration [3], 96 of the 100 patients proved to have pituitary adenomas, while 4 proved upon pathologic examination to have pituitary hyperplasia (table 1). The 96 adenomas were found to be totally intradural in 68, while 28 showed extra-dural extension. In 53 instances the tumor measured less than 10 mm in diameter (microadenoma).

Sellar Tomography

Although the sellar volume was normal in 72 patients, the sellar shape as judged by hypocycloidal tomography showed abnormalities in 96 patients. The most frequent abnormality noted was an anteroinferior bulge in the outline of the sella as shown in lateral tomograms (table 2). Although the cortical margin was often thin, it usually remained intact. The location of the lesion within the sella was exactly predicted by tomography alone in 88% of the patients. Moreover, in no instance was there a complete disagreement between the radiologic prediction of tumor location and the surgical findings.

Pneumoencephalography

Examination by pneumoencephalography disclosed suprasellar extension in 19 of the 100 patients. In 10 patients there was encroachment on the suprasellar cisterns only; in nine patients the third ventricle was deformed. Extension of the tumor into the suprasellar compartment was noted in five of the 53 stage I patients with normal sellar volumes and intracapsular tumors less than 10 mm in diameter (table 3), and in 11 of the 15 stage II patients with intracapsular tumors larger than 10 mm and increased sellar volume. There was excellent correlation between the radiographic and surgical staging of the tumor. In all 19 of the patients in whom suprasellar extension was indicated by pneumoencephalography, this finding was confirmed at operation.

Partially empty sellas, with arachnoidal diverticulae ranging from 10% to 80% of sellar volume, were demonstrated in 24 patients (table 4), with about equal frequency in cystic (21%) and solid (29%) tumors (table 1). Such an extension of the suprasellar cistern into the sella was noted in all four patients in whom the only pathologic finding was pituitary hyperplasia; in addition, it was noted in 11 of the 53 patients with stage I tumors, in only one of the 15 patients with stage II tumors, and eight of the 28 patients with extradural extension of the tumor.

Using limited-volume pneumoencephalography with ephedrine and Inapsine medication, no major complications were encountered and morbidity was reduced.

Angiography

Bilateral carotid arteriography proved to be of little diagnostic help in evaluation of prolactin-secreting pituitary adenomas. Arteriography was performed primarily to evaluate lateral extension of the tumor and to rule out vascular anomalies. Even with the use of basal projections, evaluation of lateral extension proved to be unreliable. Of the 21 patients thought to have lateral displacement of the internal carotid artery, 13 proved at surgery to have no such lateral extension. Moreover, lateral extension was found at surgical exploration of an additional 12 patients whose arteriograms appeared normal.

Tumor blush on magnification-subtraction views was

TABLE 1: **Patients with Hyperprolactinemia**

Surgical Stage (after Hardy)	No. Cases	Cystic Component	Solid Component
H. No tumor found, hyperplasia only	4	1	3
Enclosed adenomas:			
I. Less than 10 mm, intracapsular sellar volume normal	53	15	38
II. Greater than 10 mm, intracapsular sellar volume increased	15	6	9
Invasive adenomas:			
III. Floor of sella partially destroyed	23	8	15
IV. Diffusely invasive (more than one direction of dural penetration)	5	0	5
Total	100	30	70

TABLE 2: **Prolactin-Secreting Adenomas**

Abnormal Sellar Shape/Direction	No. Cases
Anterior inferior bulge:	
Right lateral	37
Left lateral	35
Midline	16
Diffuse enlargement	8
Total	96

TABLE 3: **Prolactin-Secreting Pituitary Adenomas: Suprasellar Extension**

Surgical Stage	No. Cases
IA	4
IB	1
IIA	4
IIB	7
IIIA	1
IVB	2
Total	19

Note.—A = encroachment of suprasellar cistern (normal third ventricle); B = elevation/deformity of floor and/or anterior recesses of third ventricle.

TABLE 4: **Prolactin-Secreting Pituitary Adenomas: Partially Empty Sellas**

	No. Cases
No tumor found	4
I	11
II	1
III	7
IV	1
Total	24/100

noted in only seven patients, all of whom harbored large lesions. No aneurysms were encountered. Large dural venous sinuses significantly compromised operative exposure in three patients; however, these venous anomalies were not demonstrated even with bilateral carotid angiograms including basal views and subtraction.

Computed Tomography

CT was not used in the preoperative evaluation of most of the patients in this study, because it was not possible with the CT equipment available to us then (EMI Mark I, EMI 5005, and GE 7800 scanners) to evaluate reliably the presence of intrasellar adenomas, partially empty sellas, cystic tumors, or minimal suprasellar extension.

Discussion

This study demonstrated excellent correlation between radiologic abnormalities and surgical findings in prolactin-secreting pituitary adenomas. With the development in the last decade of a reliable serum assay for prolactin, the diagnosis of prolactin-secreting adenomas is now often made when the tumor is still less than 10 mm in diameter [4]. In most cases, prolactin-secreting pituitary adenomas become clinically apparent by producing galactorrhea and amenorrhea. Although the majority of patients with prolactin-secreting pituitary adenomas have been women, endocrinologic evaluation of men has been prompted by symptoms of impotence, gynecomastia, and, in some cases, galactorrhea. The seemingly low incidence of these tumors in men may well increase as this possibility is more frequently considered in evaluation of male sexual dysfunction.

Determination of sellar volume (or area) on plain skull films has been demonstrated to be of little value in screening for pituitary microadenomas [5, 6]. In contrast, hypocycloidal polytomography of the sella was found to be very useful in confirming the clinical findings and in predicting the size and location of the tumor. This technique was also reliable in predicting extracapsular extension of the tumor into the sphenoid sinus, a finding that is not uncommon even in relatively small tumors. The tomographic findings were comparable to what has been found in previous studies, except that bulging of the lowermost part of the sella floor posteriorly was less common in our series [7].

Pneumoencephalography was used to assess suprasellar extension and to determine the presence of intrasellar arachnoidal diverticulae (empty sella). Using relatively small volumes of gas in combination with polytomography, this study proved to be a sensitive and accurate means of evaluating suprasellar extension. Even though most patients with suprasellar extension are now explored via the transsphenoidal route, knowledge of the position of the chiasm with respect to the suprasellar extent of the tumor is essential because the presence of a post-fixed chiasm or a large subfrontal extension would alter the surgical approach.

We found a partially empty sella in 24% of patients (table 4), which is a much higher incidence than that reported by Sutton and Vezina [8]. Demonstration of intrasellar subarachnoid diverticulae is also especially important to the surgeon because the sellar exposure can often be modified to permit tumor excision without opening the subarachnoid space, inadvertent entry into which is associated with a significantly greater risk of postoperative cerebrospinal fluid leak and meningitis. As our study demonstrated (table 4), a sella that is partially empty—even as much as 80%—is often associated with the secreting pituitary adenoma [9]. One possible cause of this phenomenon may be spontaneous necrosis of the tumor, with subsequent reduction in tumor volume and prolapse of subarachnoid tissue through a previously distorted diaphragm sellae.

Thirty patients were found at exploration to have cystic tumors (table 1). Sellar tomography and pneumoencephalography were not useful in detecting which lesions were cystic.

Angiography was found to be unreliable in determining the lateral extension of the tumor. It is now used only in patients with marked sellar enlargement, extensive suprasellar extension, or prior radiation therapy. The radiologic evaluation of lateral extension of the tumor remains unreliable. Extradural lateral extension beneath the cavernous sinus without any radiologic indications has been encountered in a significant number of patients and is perhaps especially frequent in prolactin-secreting tumors due to their origin in the lateral parts of the adenohypophysis [1]. Perhaps detailed examination by CT scanning will prove helpful in investigating this question in the future.

Although CT brain scans presently available cannot demonstrate intrasellar and parasellar structures in adequate detail, future improvements in spatial resolution [10–12] may provide more useful information. By means of this technique, it may be possible not only to recognize the presence of small intrasellar pituitary microadenomas, but also to demonstrate suprasellar and lateral extension accurately. Furthermore, demonstration of density differences may well allow detection of cystic components of these tumors by means of CT scanning.

Our present radiodiagnostic protocol for patients with clinical and laboratory findings indicating prolactin hypersection is polytomography, followed by pneumoencephalography. In rare instances, angiography is subsequently performed. A study is currently in progress to correlate findings by pneumoencephalography with those of CT scanning both before and after subarachnoid injection of metrizamide.

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