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The CT Assessment of Intrasellar Microadenomas

Tomografia komputerowa w ocenie śródsiodłowych mikrogruczolaków

Компьютерная томография в оценке микроаденового гипофиза

For 17 years since prolactin estimation became more widely available, it has commonly been accepted that hyperprolactinemia is responsible in some patients for hypothalamic-pituitary disorder. High prolactin levels are often associated with amenrrhoea and galactorrhoea of varying severity (3).

For this reason an increasing number of patients are being referred for radiological examination of the pituitary fossa. Radiography of the skull and pluridirectional tomography of the sella used to be basic radiographic techniques in the diagnosis of clinical suspected pituitary tumours until the advent of CT (4, 8). High resolution scanners have became a currently accepted method in detecting pituitary microadenomas and have replaced most of the conventional radiographic techniques (9). The value of CT in the diagnosis of pituitary microadenomas has recently been widely discussed (10, 11, 13).

It is commonly accepted that adenomas less than 10 cm in diameter are designated microadenomas and they usually do not extend extrasellarly (2). Pituitary microadenomas less than 5 mm in size which were difficult to detect on early CT scanners can now be imaged on modern CT units with high resolution capabilities (12, 14).

Along with the advance in the diagnosis of pituitary adenomas, several new concepts developed with regard to their treatment. At present the treatment depends on the size of adenoma and on the plasmatic levels of circulating hormones. Since a common present neurosurgical approach to purely intrasellar masses is by the transphenoid route, a neuroradiological investigation is required to show that a suspected tumour is present in the sella, has no or only very limited suprasellar extension, and that there is no herniation of the subarachnoid space into sella (5).

The purpose of this report is to define the relative value of the CT imaging in predicting the presence and location of a clinically suspected intrasellar microadenoma and to assess the advantages and disadvantages of the method.

MATERIALS AND METHODS

Over a one year period (September 1986 – September 1987) over 4500 scans were performed with high resolution third generation equipment (Siemens, Somatom DRH3). Among them 20 patients with purely intrasellar microadenomas were originally referred to the sellar cavity CT investigation because of suspected intrasellar or parasellar lesions. There were 18 females and 2 males with mean age of 33 years. Microadenomas were defined as being less than or equal to 10 mm in size. Adenomas, greater than 1 cm in size, were excluded. In each case, the clinicopathological diagnosis was proved either by direct surgical exploration or by combined endocrinological and radiological evidence of pituitary dysfunction, abnormal sella, and unequivocal demonstration of the intrasellar lesions. All patients had direct coronal CT scans which extended from the anterior clinoid processes of the sella. All scans were obtained after rapid bolus intravenous administration of 60 ml of Uropolinum 75% (POLFA). Axial sections were 2 or 4 mm thick and parallel to the orbitomeatal line. Coronal sections were 4 or 2 mm thick and as close to perpendicular to the orbitomeatal line as possible, given limitations imposed by patient mobility. A scan time of 5 s was chosen and scans were done on a display console by direct enlargement with 512 × 512 matrix. In all cases coronal and sagittal computer reconstruction images were generated to achieve better information.

In CT scans osseous structures of the sella region were analyzed by bone-window while the pituitary gland and lesions by soft-window setting. Plain radiographs were studied for evidence of enlargement, erosion, or asymmetry of the sella.

CT criteria evaluated included height of intrasellar contents, gland homogeneity, stalk position, presence, location, and size of focal lesions, and sellar bony erosion. The concentration of serum PRL was measured with RIA method (2).

RESULTS

The presence of pituitary microadenomas was correctly identified in each patient studied on the basis of CT evidence of abnormal intrasellar attenuation before contrast administration, intrasellar mass effect or abnormal enhancement within the sella after contrast injection. Varying pathological enhancement was observed in 15 of the 20 cases. A focal glandular hypodensity, an upward bulging of the superior surface of the pituitary gland, and a deviation of the pituitary stalk were demonstrated effectively in 5 of the 20 patients on the CT scans made in the coronal and axial plane as well as on postcontrast CT sagittal reconstruction. They were verified by a serum prolactin level of at least 150 μg/ml. Three women had amenorrhoea and galactorhea. The height of the gland on coronal scans over 9 mm, a focal glandular hypodensity, an upward bulging of the superior surface of the pituitary gland, and a deviation of the pituitary stalk — these findings were considered as the most suggestive for microprolactinomas (Figs. 1, 2, 3, 4AB). The nature and degree of contrast enhancements were very variable. Unsatisfactory CT occurred in two cases because of head movements.

Plain radiographs were suggestive of an intrasellar tumour in 3 of the 20 patients. None of them showed increased intrasellar area.

DISCUSSION

Pituitary adenomas are common tumours and constitute approximately 10% of all brain tumours (2). Most pituitary adenomas are slow-growing and tend to grow in an upward direction into the suprasellar cistern. Intrasellar expansion of these adenomas may erode the sella and compress the cavernous sinuses laterally. Most lesions demonstrate a globular configuration regardless of their size. A review of the literature revealed a diversity of opinion with regard to nomenclature connected with pituitary adenomas (1, 16).

Although the abnormal serum levels of hormones produced by functional pituitary tumours generally correlate with the size of the tumour, there are occasions when a small lesion may be related to marked elevations of serum prolactin. Nonetheless, a normal serum prolactin level may be seen with invasive pituitary tumour (1).

Treatment of the lesions with dopaminergic drugs and X-ray therapy influences the size and attenuation after contrast medium injection. Shrinkage of the prolactin cells by dopaminergic agents decreases the tumour (16, 18). There is no rule that facilitates predicting when invasion of the surrounding structures will begin.

Symptoms such as decreased libido, impotence, and perhaps sterility tended to be either ignored by patients or undiagnosed. Therefore, in men the diagnosis of adenoma is more likely to be made later, and consequently, the tumour is usually considerably larger in presentation (16).

The diagnosis of microadenomas in our patients was based on commonly accepted clinical, hormonal and radiological criteria (2, 3, 8, 10, 21, 25). Using plain radiography, polytomography, carotid arteriography, cavernous sinography or cisternography some of the microadenomas may be detected, but the findings elucidated have been secondary changes and not the adenoma itself. Strictly speaking the early detection of microadenomas prior to any secondary changes is possible only by high resolution CT scan (12, 20, 26). For this reason it is necessary to use appriopriate choice of scan angles and slices intervals. We agree with Sacoda et al. (22) that when clinical findings suggest an intrasellar microadenoma, it is better to scan parallel to Reid's base line. We suggest that it would be best to scan parallel to orbitomeatal line initially, and change the angle as findings indicate.

In our observation, nonfunctioning and PRL-secreting tumours all exhibited low density, isodensity or slight density on pre-contrast CT scans. Because their shape is not well-defined, it is necessary to use contrast enhancement to

show these lesions clearly. Prolactin-secreting tumours have the most consistent appearance. The pituitary gland enhances promptly and becomes nearly as the cavernous sinuses because of its incomplete blood-brain barrier. The pituitary tumour seems to enhance more slowly than the normal pituitary gland. After an administration of contrast medium, the density of the adenoma increases slowly and gradually while that of the gland increases rapidly and diminishes promptly as contrast medium excreted. Therefore, a tumour that appears hypodense with respect to the adjacent pituitary gland immediately after intravenous contrast enhancement may later appear isodense or hyperdense (14). Hypodense regions are more readily visible on coronal images than on axial ones.

When the tumour is more than 5 mm in diameter, erosion of the sellar floor and contralateral deviation of the pituitary stalk may be visible (18, 19, 20). Some authors belived that dynamic coronal CT scans and three-dimensional CT reformations of the pituitary gland allow demonstration of the sinusoid vessels of the mid-anterior lobe, the so-called secondary bed of the pituitary gland, which when displaced or compressed ("tuft sign") can be helpful in detecting even the smallest microadenoma (6, 12). Boneville at al. (6, 7) believe that this sign is an important feature in the diagnosis of pituitary microadenomas, but in our investigations we did not observe it.

Sometimes the posterior lobe of the pituitary gland on pre- and postcontrast CT scans was clearly visible as a well-defined oval lucency. This area of low attenuation is located in the posterior part of the sella, just in front of the dorsum. This area of low attenuation must not be confused with a posteriorly located pituitary microadenoma. Low density areas, in the literature considered to be probable incidental microadenomas are, in Boneville's et al. (7) opinion, more likely to represent large but normal neurohypophyses. After contrast medium injection the posterior lobe of the pituitary gland appears less enhanced than the anterior lobe. Therefore, a normal posterior lobe should be added to the list of regions of low density on contrast-enhanced CT scans of the pituitary gland. In case of the presence of a microadenoma of the anterior lobe, the anterior limit of the posterior lobe may be compressed (7).

Our experience and data from literature show that the absorption coefficient of these microadenomas on contrast enhanced scans is not related to the type of the lesion, and is only slighty related to the vascularity within the tumour (3, 4, 9, 11, 14, 24). The significance of detecting low density, non-enhancing regions within the sella remains a problem. Some authors have believed that such areas represent either necrotic microadenomas or an empty sella, and have proposed to rule out such suggestion (13, 20, 21). Others believed that the low density areas within the sella were often proved at operation to be usual microadenomas, not necrotic tumours or empty sellas (22, 24).

Rindlike lesions with dense rims and lucent centres were found in 2 non-functioning and 1 PRL-secreting adenomas. It is stressed that compression

of surrounding normal pituitary gland by a non-enhancing adenoma accounted for the ring blush in the others.

Because adenomas may show either higher or lower density than the adjacent normal pituitary gland on postcontrast scans, images exhibiting non-homogeneous intrasellar density are difficult to interpret. In our observation, when CT demonstrates areas of differing enhancement within the sella, a microadenoma is usually present. In such cases, CT demonstration of focal alteration of the sellar walls indicates the true site of the lesion and, therefore, the density of microadenoma. We could say that the diagnosis of intrasellar microadenomas is based on the fact that they have an attenuation which differs from that of intrasellar content. The critical parts of lesions usually had a low attenuation, frequently surrounded by rim of relatively high attenuation. When this rim of lesion did not enhance on postcontrast scans, the tumour could be entirely cystic. Such adenomas may be difficult to differentiate from an arachnoid cyst.

Generally it has not been possible to establish the histological type of pituitary microadenoma from X-ray attenuation and contrast enhancement patterns. In most instances CT was clearly superior to the other neuroradiological techniques by supplying information regarding the total extension of tumour and demonstrating the solid, vascular, calcified or cystic parts of adenoma. It is now possible also to show recurrences or residual tumour growth in clinically silent cases.

As we know the pituitary gland lies outside the blood-brain barrier and normally shows contrast enhancement. The appearance of eccentric, focal intrasellar tumour blush may be mimicked by a variety of intrasellar arterial or venous variants. Demonstration of intrasellar pathology does not prove a diagnosis of pituitary microadenoma. A wide variety of diseases may produce both intrasellar mass effect and abnormal intrasellar contrast enhancement. In such cases the angiography remains essential for the demonstration of arterial aneurysms and other vascular lesions (17, 25).

Thin-section, high-resolution CT with intravenous or intrathecal contrast material, the current method of choice for evaluating sellar lesions, has limitations, including a degree of invasiveness and patient discomfort. According to Sartor et al. (23) the results of MRI are essentially free of these deficiences. MRI often provided improved lesion delineation in all three dimensions. Major arteries including their morphologic changes were better shown by MRI than by CT. Abnormalities of cancellous bone were also better demonstrated with MRI than with CT. Finally, the lack of radiation of MRI may be regarded as very important factor especially in young patients who need to be followed closely or for long period of time. Diagnostic weaknesses of MRI that became apparent in the literature (23) were primarily linked to the use of rather thick sections (10 mm).

Recently some authors believe that MR technique has become the examina-

tion of choice in patients with pituitary adenomas. MRI is a superior diagnostic method compared with CT in the differentiation of perisellar structures, in the prediction of tumour extension and in the localization of reccurent adenomas (5, 15, 23).

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STRESZCZENIE

Na podstawie własnego doświadczenia i danych z piśmiennictwa autorzy omawiają przydatność tomografii komputerowej w rozpoznawaniu śródsiodłowych mikrogruczolaków. Technika ta jest badaniem z wyboru, bowiem pozwala na nieurazowe, szybkie i precyzyjne ustalenie rozpoznania. W bardzo nielicznych przypadkach zachodzi potrzeba wykonania dodatkowych badań neuroradiologicznych (np. angiografii tt. szyjnych w celu zbadania stosunku naczyń do guza). Największą zaletą tej metody jest możliwość dokładnej oceny umiejscowienia guza, jego charakteru, wielkości i stosunku do sąsiednich struktur mózgu. Określenie tych cech pozwala na wybór metody operacyjnej. Od kilku lat stosuje się metodę operacji guzów przysadki przez dojście od strony zatoki klinowej. Metoda ta jest zabiegiem mniej obciążającym, dobrze znoszonym przez chorych i dającym mniej powikłań. W przypadku, gdy guz rozrasta się ku górze i zajmuje okolicę nadsiodłową, stosuje się klasyczną kraniotomię.

РЕЗЮМЕ

На основании собственного опыта и литературных данных авторы обсуждают пригодность компьютерной томографии в диагностике микроаденового гипофиза. Этот избранный метод дает возможность нетравматически исследовать, быстро и точно поставить диагноз. В очень немногочисленных случаях имеется необходимость дополнительно провести неврорадиологические исследования (нр. ангиография сонных артерий для исследования отношения сосудов к массе опухоли). Найбольшим достоинством этого метода является возможность точной оценки локализации опухоли, ее характера, величины и связи с сосудными мозговыми структурами. Определение этих признаков дает возможность выбрать соответствующий операционный метод. Уже несколько лет применяется метод операции опухоли гипофиза через пазуху клиновидной кости. Метод относительно мало обременительный, хорошо переносится пациентами и дает мало осложнений. В случае, когда опухоль разрастается к верху и занимает область над турецким седлом, применяется классическая краниотомия.

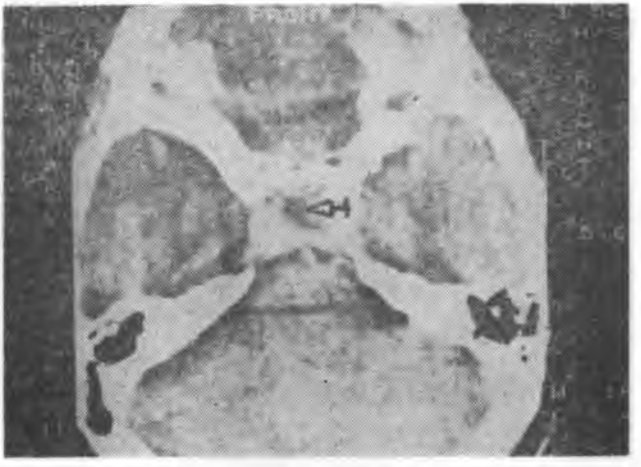

Fig. 1. Precontrast axial CT scan shows focal glandular hypodensity at the left lateral aspect of the sella (arrow); pituitary stalk is deviated laterally

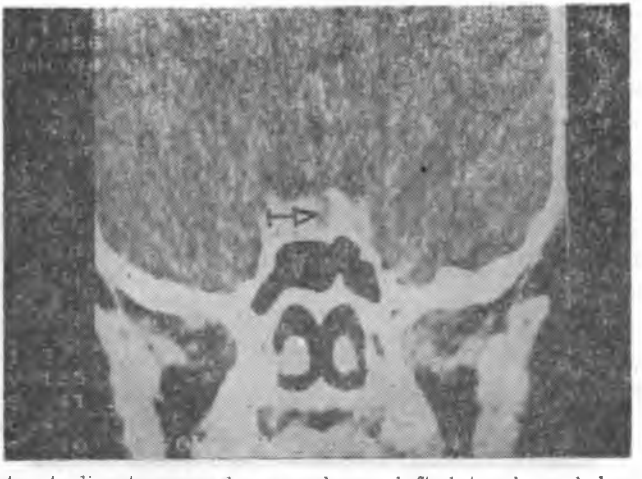

Fig. 2. Precontrast direct coronal scan shows left lateral oval hypodensity area within sellar content (arrow)

Fig. 3. Postcontrast direct coronal scan shows left lateral focal glandular hypodensity (arrow) associated with upward convexity of gland; prolactin-secreting microadenoma with elevated prolactin level (150 μg/ml)

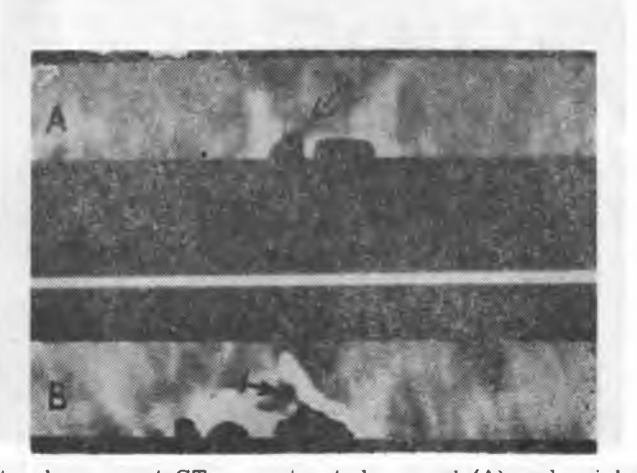

Fig. 4. Contrast-enhancement CT reconstructed coronal (A) and axial projection (B) show posterior left lateral focal glandular hypodensity (arrows) with erosion of the anterior margin of the dorsum sellae