

Pituitary magnetic resonance imaging experience in Jordan

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ABSTRACT

الأهداف: تقييم إعتلالات الغدة النخامية في المرضى المحولين إلى مستشفى الجامعة الأردنية كما هو مبين في تصوير الرنين المغناطيسي، ومقارنة هذه الدراسة التطبيقية مع المعلومات والمعطيات المنشورة في الأبحاث العالمية.

الطريقة: تم إجراء تصوير الرنين المغناطيسي مع أو بدون إعطاء مادة ظليلة « غادولينيوم » 1138ل غدة نخامية، وذلك خلال 6 سنوات منذ 2001م وحتى 2007م، في قسم الأشعة - مستشفى الجامعة الأردنية - عمان - الأردن. تم تحويل هذه الحالات المرضية من مختلف الأقسام الطبية من أجل تقييم مختلف أنواع الآفات النخامية، والآفات والتشوهات المرضية لمنطقة السرج التركي ومجاوراته. تمت مقارنة النتائج التي توصلنا لها مع ما نشر سابقاً.

النتائج: خلال الدراسة كان هناك 483 حالة طبيعية تم استبعادها من الدراسة. من بين 655 حالة مرضية من خلال تصوير الرنين المغناطيسي، أظهرت الدراسة وجود 327 حالة غدوم نخامي (49.9%) وكان ضمنها غدوم نخامي صغير الحجم في 213 حالة (32.5%)، غدوم نخامي كبير الحجم في 114 حالة (17.4%)، متلازمة السرج التركي الفارغ جزئياً 157 حالة (24%)، فرط ضخامة الغدة النخامية لدى 98 مريض (14.9%)، الفص الخلفي للغدة النخامية المهاجر في 13 مريض (2%)، وكان هناك إعتلالات مرضية أخرى في 31 مريض (4.7%).

خاتمة: تبين لنا أن هناك تساوي في حالات الغدوم النخامي لكلا الجنسين، وفي الوقت ذاته أبدت الدراسة أن حالات الغدوم النخامي صغير الحجم هو الأكثر شيوعاً من نظيره كبير الحجم وذلك في العينة المرضية للفئة العمرية الشابة، وأصغر حجماً من مثيلاتها والغالبية عند النساء. في حين أظهرت باقي المعايير توافق مع الدراسات المنشورة عالمياً.

Objectives: To assess the pituitary findings as demonstrated on MRI and to compare the results with the data published in the literature.

Methods: One thousand, one hundred and thirty-eight pituitary MRI's with and without intravenous contrast media (gadolinium) were performed over

6 years from 2001 to 2007 in the Department of Diagnostic Radiology, Jordan University Hospital, Amman, Jordan. The patients were referred from various departments and were evaluated for pituitary, other sellar, and juxtaseilar abnormalities. The results were compared with those in the published literature.

Results: Four hundred and eight-three normal scans were excluded from the study. The remaining 655 were abnormal, pituitary adenoma was detected in 327 (49.9%), microadenoma was present in 213 (32.5%), and macroadenoma in 114 (17.4%). Partial empty sella was seen in 157 (24%), diffuse pituitary gland enlargement in 98 (14.9%), ectopic pituitary posterior lobe in 13 (2%), and other findings in 31 (4.7%).

Conclusion: The incidence of pituitary adenoma was equal in both genders; however, microadenoma was more common, affected a younger age group, and was predominately seen in females. The other parameters showed agreement with the published literature.

Neurosciences 2009; Vol. 14 (2): 143-147

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Received 25th October 2008. Accepted 10th January 2009.

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Since the introduction of MRI in the 1980's, it became the modality of choice for evaluating sellar and suprasellar regions, and replaced plain films and conventional CT scans due to their lower sensitivities. However, multidetector CT scan may have an important role in visualizing bony details, calcifications, vascular anomalies, and whenever MRI is contraindicated. The MRI is non-invasive tool, superior in its ability to define small lesions (3 mm) and its high resolution has improved our capacity to identify even smaller lesions. The disadvantages of MRI include: high cost, contraindication in patients with pacemakers

and metallic implants, misdiagnosis of acute pituitary apoplexy presenting as cystic lesions, with pneumatized anterior clinoid, calcified aneurysm, and gadolinium based side effects (nephrogenic systemic fibrosis and nephrogenic fibrosing dermopathy).¹ Previously, many endocrine problems were diagnosed as idiopathic, however, in the era of MRI various structural anomalies and abnormalities can now be identified and diagnosed. The MRI is not just useful in diagnosis, but also in making treatment decisions.² The introduction of MRI at Jordan University Hospital was initiated in 1998, and the aim of this study is to analyze the types and frequencies of abnormalities observed in pituitary MRI in sellar and juxtaseilar regions among Jordan University Hospital patients, and to compare our findings with those cited in the published literature.

Methods. Patient population. From March 2001 to March 2007, 1138 patients were investigated by pituitary MRI in Jordan University Hospital, Amman, Jordan. The MR images were reviewed independently by 3 consultant radiologists experienced in MRI followed by consensus to resolve any differences in interpretation. The patients were referred from clinics and hospitals in Amman, and from various departments in Jordan University Hospital, including, endocrine, neurosurgery, internal medicine, and pediatrics. The institutional review board of our institution did not require its approval or informed patient consent for this retrospective study. Normal pituitary intensity was considered equal to the brain stem, while a published international criterion² was used for evaluation of pituitary size and adenoma classification.³ The clinical presentation for most patients was due to hormonal excess (galactorrhea, amenorrhea, acromegaly, and Cushing's disease) or mass effects upon the optic chiasm or infundibulum, or extension to the cavernous sinuses. Only a small number of patients were diagnosed incidentally on brain MRI.

Techniques. Pituitary MRI was performed on a 1.5 Tesla super conducting MRI unit (Magnetom Vision Plus, Siemens, Erlangen, Germany). A predesigned protocol was carried out using standard head coil: T1 spin echo sagittal and coronal 3 mm thickness images without intersection gap (FOV 135) with and without intravenous contrast 0.1 mmol/kg (gadolinium DTPA), and T2 turbo spin echo coronal images were entertained. Assessment of pituitary gland MRI with and without Gd-DTPA was carried out by the 3 reviewers who evaluated the images for stalk deviation, pituitary gland convexity, and sellar size; they also remarked on the pituitary focal anomalies position and size. Distance measurements were calculated manually.²

Results. Of the 1138 patients investigated, 483 were normal and so were subsequently excluded while the remaining 655 patients were abnormal and included in the study. There were 220 males (33.6%) and 435 females (66.4%) with mean age of 38.1 years (range 1-75 years), the female to male ratio was 2:1. The MRI findings in the sellar and juxtaseilar region are summarized in Table 1, and their percentage was compared with the published data. Analysis of the pituitary adenoma MRI findings and their local complications are summarized in Table 2, and the parameters with expressive disagreement noted are reviewed in Table 3.

Discussion. The pituitary gland has an important central endocrine function as it secretes 8 hormones that are regulated through hypothalamic stimulating factors or molecules, which in turn control the specific target glands.⁴ The shape and configuration of the pituitary gland are affected by age, gender, carotid arteries position, shape of pituitary sella, pneumatization of sphenoid sinus, and intact diaphragma sella.² Diffuse enlargement of the pituitary gland was considered when the upper surface of the gland appears symmetrically convex with median prominence at the insertion of the stalk. Physiologically it enlarges by 34% at birth, puberty (6-7mm),² and during pregnancy (<10mm), however, it achieves its maximum size (<12mm) during the first 3 days postpartum.⁵ Our data shows that diffuse enlargement is seen in 14.9%, with female predominance (F:M - 4.7:1). Empty sella syndrome is a radiographic diagnosis, it is the result of primary or secondary incompetence of the diaphragma sella allowing CSF to enter the sella and flatten the pituitary gland, the pituitary function is usually normal and fertility is not impaired. This was found in 24% of our cohort a with 2.6:1 female to male ratio, it is reported in only 4-16% in the medical literature.^{2,4} The focal spot of hyperintense T1 signal is usually observed at the posterior aspect of the sella turcica and reflects the storage of vasopressin and oxytocin in the posterior lobe of the pituitary gland.⁶ Temporal variation in the posterior lobe high spot in the form of presence then disappearance (25%), absence then appearance (8%), notable change in size (19%), on follow up MRIs were reported, however, it is almost seen in 85% at birth, and there is an annual decline in the rate of visualization of the posterior pituitary high spot of approximately 1% per year.⁷ Relocation of this focal spot in large adenoma cases was reported.⁸ The posterior lobe high spot was absent in 7% of our cases, with a female to male ratio of 1.3:1.

Ectopic neurohypophysis may be associated with isolated growth hormone deficiency or multiple anterior pituitary hormones deficiencies, which have a more

Table 1 - The MRI findings in sellar and juxtaseilar regions (655 patients).

Findings	Male	Female	Total		Literature (%)
			n	(%)	
Macroadenoma	46	68	114	(17.4)	(38.9) ¹⁶
Microadenoma	59	154	213	(32.5)	(15.3) ¹⁶
Ectopic posterior lobe	7	6	13	(2)	(44-70) ^{9,11}
Partial empty sella	43	114	157	(24)	(4-16) ^{4,11}
Diffuse enlargement	17	81	98	(14.9)	(34-82) ⁵
Small pituitary	1	5	6	(0.9)	(33) ¹¹
Absent posterior lobe	20	26	46	(7)	(8-15) ⁷
Double lesions	3	3	6	(0.9)	-
Pars intermedius	1	6	7	(1)	-
Rathke's cyst	2	1	3	(0.3)	(1.5) ¹⁶
Stalk thickening	-	2	2	(0.3)	-
Pineal cyst	2	6	8	(1.1)	(1.3) ¹²
Arachnoid cyst	4	5	9	(1.3)	(2.3) ¹⁶
Meningioma	3	2	5	(0.8)	(10.7) ¹⁶
Others (without adenoma)	8	9	17	(2.5)	-

Table 2 - The MRI findings of 327 pituitary adenomas.

Pituitary adenoma	Macroadenoma 114 (34.9%)		Microadenoma 213 (65.1%)		F:M ratio	Total (327)		Literature (%)
	M (46)	F (68)	M (59)	F (154)		n	(%)	
	Cystic component	10	18	6		17	2:1	
Hemorrhage	15	21	-	4	1.6:1	40	(12.2)	(14-17) ²⁰
Compression of optic chiasm	24	27	-	-	1.1:1	51	(16)	-
Cavernous sinus invasion	28	27	-	2	1:1	55	(16.8)	(10-67) ^{14,19}
Infrasellar extension	8	10	-	2	3:1	20	(6)	-
Internal carotid artery encasement	5	12	-	-	2.4:1	16	(4.8)	(43) ¹⁶
Ballooning of sellar floor	10	19	1	3	2:1	33	(11)	(62) ¹⁷
Infundibulum deviation	17	26	10	31	2.1:1	84	(25.6)	(46-64) ^{16,17}
Double lesion	-	-	3	3	1:1	6	(1.8)	-
Partial empty sella	2	5	3	6	2.2:1	16	(4.8)	(3-4) ²
Suprasellar extension	35	41	-	3	1.7:1	79	(23.8)	(15-67) ^{16,18}
Extension to Meckel's cave	2	2	-	-	1:1	4	(1.2)	-

Table 3 - The prevalence (%) of tumors according to age, size, and gender.

Variable	Adenoma		Macroadenoma		Microadenoma	
	JUH	Literature	JUH	Literature	JUH	Literature
% from positive pituitary MRI	49.92	54.2 ¹³	34.86	66.16 ¹⁷⁻¹⁹	65.14	33.84 ¹⁷⁻¹⁹
Average age (years)	38	46 ²⁰	42.4	49 ¹⁹	33.6	43 ¹⁹
Average size (mm)	14.56	16-23.3 ^{14,18}	24.65	25 ¹⁹	4.48	8 ¹⁹
F:M ratio	1.07:1	2-4:1 ²⁰	1.4:1	1:1.43 ¹⁹	2.6:1	5.66:1 ¹⁹

JUH - Jordan University Hospital

frequent association with hypothalamic-pituitary area abnormalities.^{9,10} In other studies, this was reported in 44-70%,^{9,11} and in our cohort it was very low (2%). Incidental pineal cysts at MRI are not exceptional (1.3%), and mostly appear as benign well defined rounded lesions with fluid signal intensity, more common in females,¹² and its frequency is not essentially different from the above (1.1%). The prevalence of pituitary adenomas reported in the literature varied according to the magnetic field strength, the technique used, and time interval between intravenous administration of contrast and data acquisition.¹³ The normal pituitary stalk and gland shows marked contrast enhancement due to the absence of the blood brain barrier while the adenomas show different appearances.² An average maximum diameter among adenomas in the literature was 23.3 mm,¹⁴ compared with 14.56 mm in our cohort. Our results in pituitary adenoma were different from those reported in the literature,^{2,15} as we showed that there was no consequential difference in the prevalence between genders. Microadenomas showed a female to male ratio of 1.4:1, however, the macroadenomas showed indicative female predominance (2.6:1). Microadenomas (32.5%) are more frequent than macroadenomas (17.4%) in our cohort, which is in contrast to the reported literature that showed 16% for microadenomas, and 40% for macroadenomas.¹⁶ The reported percentage of stalk deviation was 46-64% in adenoma patients,^{16,17} versus 84% in our study, taking into consideration that this abnormality was seen in 13% of normal volunteers.²

When cavernous sinuses were involved, the average size of pituitary adenoma was 34.4 mm,¹⁴ versus 27.9 mm in our cohort, however, the tumor may encircle the intracavernous carotid artery, filling and expanding the sinuses, but in no case was the artery constricted or occluded, which is the case in cavernous meningioma.¹⁷ Previous studies showed that 10-55% of pituitary adenomas involve the cavernous sinus almost always unilaterally,^{15,16} and 43% showed encasement of the internal carotid artery.¹⁶ Our results showed cavernous sinus involvement in 16.8%, bilateral in 2.6%, while in 1.2% the lesion extended to Meckel's cave, however, internal carotid artery encasement was seen in 4.8% only. Suprasellar extension of pituitary adenoma is seen in 50% of adolescents and in 15-67% of adults,^{16,18} and this figure was 23.8% in our cohort, with chiasmal compression in 16% of them. Infraselar extension is seen as asymmetry of the sellar floor or focal downward protrusion of glandular tissue into the sphenoid sinus, it is seen in 11% of adolescents,¹⁸ and in 15% of adults;¹⁹ it was observed in 6% of our cases, and almost always in macroadenomas.

Pituitary apoplexy is a rare complication of pituitary tumors and is not synonymous with hemorrhage into

pituitary adenomas.²⁰ A CT or MRI can confirm the diagnosis of hemorrhage, where the former is most useful in the acute stage (up to 48 hours), while the latter is superior in the subacute stage (3-30 days). Our results were concordant with the available reports and shows that hemorrhage appears in 12.2%, most of them were seen in macroadenoma (11%). Tumor ischemia and necrosis, which are usually caused by vascular compromise at the diaphragmatic sella and has little relation to hormonal activity,¹⁴ was observed in 16% of our cases, and was twice more common in females.

The limitations of this study were that it is a retrospective study, and there were no documented data nor pathological reports on the function status of the pituitary adenomas in some cases, however, our aim in the future, in a prospective study, is to study the correlation between the function and hormone type secreted by macroadenomas and the size, appearances, and extrasellar extension pattern.

In conclusion, when our results were compared with the published literature, it showed that pituitary adenomas were different in this part of the world with nearly equal incidence in females and males with a 1.07:1 ratio. However, microadenoma is more common than macroadenoma and appeared more commonly in females and younger age groups.

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