

# An examination protocol with "3D-volume imaging" sequence in MR diagnosis of pituitary microadenomas

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*Magnetic Resonance (MR) imaging, which is an elected method in radiodiagnostic examination of sellar and parasellar regions provides high tissue contrast resolution and enables us to get multiplanar scene and has priority against the other screening methods, especially in revealing pituitary microadenomas. When screening for pituitary adenomas with MR imaging, diagnostic images can not be acquired with slice thicknesses less than 3 mm with the conventional spin echo (SE) sequences limiting the sensitivity of the method in demonstration of microadenomas. Recently, introduction of the high magnetic field MR systems and 3D-Volume imaging sequences, enable us to get very thin slices without detouring the quality of the imaging and by this way, an important improvement in detection of pituitary microadenomas has been provided. In this study, we examined 23 cases with suspected pituitary microadenomas by 3D-Volume imaging sequences in MR imaging. We concluded that the sensitivity of this sequences is very high in the detection of microadenomas with MR imaging and this can be exact sequence which should have been preferred.*

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Key Words: Pituitary gland, Neoplasm, Microadenoma, Magnetic Resonance Imaging

Magnetic Resonance (MR) imaging is presently considered to be the most specific and sensitive technique for the diagnosis of sellar and parasellar pathologies. A true-positive rate of 81 % - 100 % has been reported in MR imaging at 1.5 Tesla in the detection of pituitary microadenomas (1-4). Previous studies also suggest a higher rate of detection after Gadolinium injection intravenously (5-8). In the recent studies high-resolution high-magnetic field MR imaging is becoming widely accepted imaging method in the diagnosis of pituitary microadenomas with the higher capability of these MR units using three-dimensional (3D) acquisitions (9). The use of 3D acquisition is promising in the diagnosis of sellar and parasellar pathologies. Indeed, very small slice thickness (up to 1 mm) and high signal-to-noise ratio of 3D acquisition are important advantages with respect to the conventional spin echo (SE) sequences (minimal slice thickness of 2mm produces poor signal-to-noise ratio. This necessitates four or eight excitations) (9).

The aim of this study is to create an examination protocol using 3D volume sequence that has a short acquisition time and also has a high diagnostic rate in the diagnosis of pituitary microadenomas and evaluate the true -positive rate of this protocol.

## MATERIALS AND METHODS

Twenty-three patients suspected of having pituitary microadenoma on the basis of clinical and computed tomographic (CT) findings were evaluate! in this study. There were 18 women (78.2 %) and 5 men (21.8 %), from 3 to 37 years old (mean: 30.5 years). All the patients were selected cases and had positive clinical and CT findings, and sixteen had positive laboratory findings. The clinical and laboratory findings of the cases are presented on Table 1.

MR imaging examinations were performed with a 1.5 Tesla MR imaging unit (Siemens, Magnetom 1.5 T, Erlangen, GERMANY) and Helmholtz head coil was used as the receiver coil. The patients have been examined in the supine position without any prior preparation. After obtaining a short SE sequence on the sagittal plane, the one on the mid-sagittal plane has been used for localizing the 3D volume sequence images on the coronal plane. This sequence was performed with a 40 flip angle and a 40 mm thick 3D volume and 32 partitions. This provided each slice

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**Table 1.** The clinical and laboratory findings of 23 cases

Clinical Findings	n(%)	Laboratory Findings		
		High Prolactin*	High ACTH**	High GH***
Galactorrhea	3(57 %)	9(69%)	-	-
Irregular menses	6 (26%)	3(23%)	1(25%)	-
Cushing's syndr.	3(13%)		2(50%)	-
Acromegaly	1(4%)	1 (8%)	1 (25%)	1 (100%)
TOTAL	23(100%)	13(100%)	4(100%)	1(100%)

Note: \* Higher than 19.7 ng/ml (females) 115.9 ng/ml (males)  
 \*\* Adreno-corticotrophic hormone, higher than 120 pg/ml  
 \*\*\* Growth hormone, higher than 110 m.IU/L

thickness to be 1.25 mm (40 mm/32). The 3D volume sequence parameters are depicted as follows: Repetition time (TR): 30 mSec, Echo time (TE): 6 mSec, Flip angle (FA): 40, Slice thickness: 1.25 mm, Acquisition: 2, FOV: 200 mm, Matrix: 256 x 256. The duration of this sequence is 8.14 minutes. All patients were initially evaluated without gadolinium injection. After the completion of first coronal sequence; 0,2 ml/kg of Gadolinium-DTPA (Magnevist, Schering, Berlin, GERMANY) has been injected intravenously in less than 60 seconds, and the second coronal 3D sequence with the same parameters was started immediately after it. After the completion of this sequence a sagittal T1W SE (TR/TE: 500/15 mSec, two acquisitions and slice thickness: 2 mm) sequence was also performed. The duration of whole examination was approximately 20 minutes for each patient.

MR imaging studies were prospectively evaluated by three experienced radiologists. The dimensions of the sellar cavity, the pituitary gland and the mass (if there had been any), have been recorded as well as their internal signal characteristics and contrast uptake properties. The dimensions of the sellar cavity and the pituitary gland have been measured both on coronal and sagittal sections. The dimensions, the relations with the neighbouring structures and the internal signal and contrast uptake characteristics of the mass lesions have also been evaluated. MR imaging findings of the cases have been compared with CT findings, and correlated with clinical, laboratory and intraoperative findings in the patient who underwent surgery (14 cases) and confirmed with the histopathologic results to estimate the sensitivity.

## RESULTS

Pituitary microadenoma was diagnosed in 19 cases and 4 cases had normal gland on MR examination. All cases had positive CT findings (reported as pituitary microadenoma). The comparison of MR and CT diagnosis of the cases and correlation with the clinical and laboratory findings are shown on Table 2.

**Table 2.** MR and CT diagnosis of the cases and correlation with the clinical and laboratory findings

Clinical Findings	n(%)	Laboratory	CT	MR
		(+)	(-)	(-)
Galactorrhea	3 (57 %)	9(56%)	13(57%)	12(63%)
Irregular menses	6 (26%)	4(25%)	6(26%)	4(21%)
Cushings syndr.	3(13%)	2(13%)	3(13%)	2(11%)
Acromegaly	1 (4%)	1 (6%)	1 (4%)	1(5%)
TOTAL	23 (100%)	16(100%)	23(100%)	19(100%)

Four cases had normal pituitary gland on MRI had different complaints with positive laboratory and/or CT findings but, the cause of their symptoms was not related to a pituitary pathology. One of these cases had high prolactin level and galactorrhea when she was admitted to the hospital but was learned later that she was using anabolic drugs and all of the laboratory findings returned to normal after stopping the usage of those drugs within two months. Other two cases who found normal on MR had the complaints of irregular menses but they didn't have any hormonal disturbances and the gynecologic evaluation was also normal. These two cases are still under the control of gynecology clinic. For the last patient with cyclic Cushing's disease who had positive CT but negative MR, the pathology was found in the surrenals on the abdominal exploration as bilateral adrenal adenomas.

Fourteen cases with pituitary microadenomas on MR imaging underwent surgery. Eleven of them was operated with transsphenoidal and three was operated with pterygional approach. On the histopathologic evaluation two ACTH-secreting microadenomas, one growth hormone secreting adenoma and eleven prolactin-secreting microadenomas were found.

When surgical and MR diameters of microadenomas have been compared on coronal 3D volume images obtained before administration of Gadolinium; 11 were found with same sizes and 2 were smaller and 1 was bigger than MR on the surgery. After administration of Gadolinium 10 were found to have same size and 3 were smaller and 1 was bigger than MR on the surgery. Number of true positive findings on coronal 3D-MR images obtained before gadolinium is 11 (78.5 %) and after Gadolinium is 10 (71.4 %). Some examples of MR images of the cases are shown on the Figures 1 to 4.

## DISCUSSION

Many investigators reported that precontrast T1-weighted SE sequence images can reliably detect pituitary microadenomas (1,3,4,7). Fewer investigators claimed that postgadolinium T1-weighted SE sequence images are better in showing pituitary microadenomas than precontrast studies (6,8). With the use of special software programs for MR systems, it is possible to

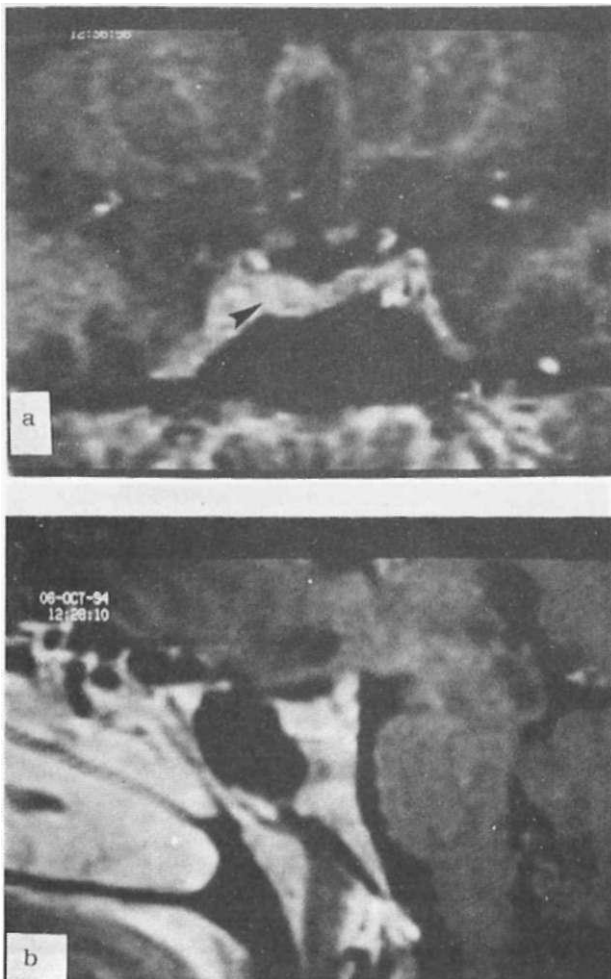


Figure 1. Coronal postgadolinium 3D-volume image (A) and postgadolinium T1W SE right parasagittal image (B) of the case with Cushing disease. An adenoma 4 mm in diameter on the right side of the pituitary gland (arrow). Microadenoma is not appearing in postcontrast T1W SE right parasagittal image which is well-detected in coronal postcontrast 3-D volume image (Histopathology: ACTH-secreting microadenoma)

obtain high resolution images with slice thicknesses less than 1 mm. In this study, it has been shown that with the use of 3D-volume sequence with 40 degrees of FA, it is possible to obtain high resolution images as well as with T1-weighted SE sequence. The advantage of the use of 3D- volume sequence is that it enables us to obtain thin slice thickness which increases the sensitivity of MR imaging in the diagnosis of pituitary microadenomas (9-12).

Stadnik et al., concluded that the combination of pre-and postgadolinium T1-weighted sequences with pre-and postgadolinium 3D-FLASH sequences produced the highest number of true-positive findings (90 %) and lowest number of false-negative findings (5 %) (9). They also pointed out that T1-weighted SE and 3D-FLASH sequences were equally successful in

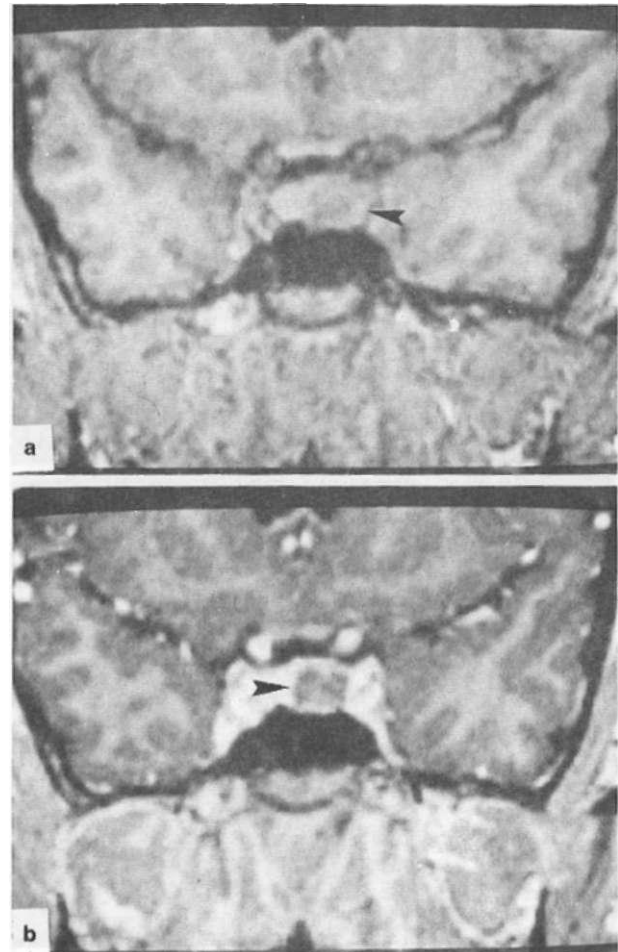
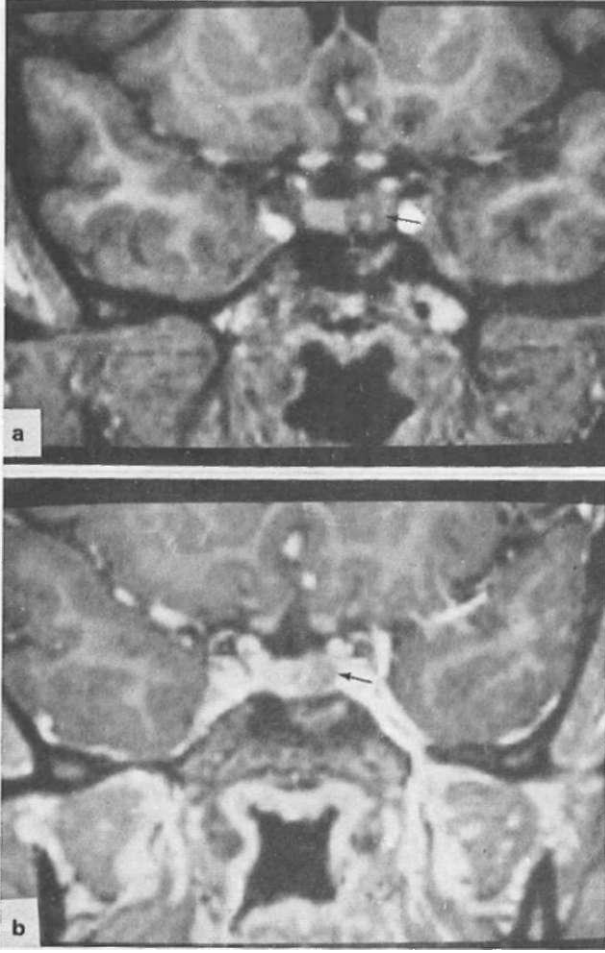


Figure 2. Coronal pregadolinium (A) and postgadolinium (B) 3D-volume images of the case with acromegaly. An adenoma 9,5 mm in diameter on the left of the pituitary gland (arrow). It was detected with both pre and postcontrast images (Histopathology: Growth hormone - secreting microadenoma).

showing pituitary adenomas larger than 9 mm but 3D-FLASH sequences were better than T1-weighted SE sequences in showing pituitary adenomas with a diameter less than 3 mm.

Peck et al. reported that the sagittal T1-weighted SE sequence images are also of limited value because of partial volume artifacts caused by the carotid artery and difficulties in comparing the left and right parts of the hypophysis (1). In our study with the use of SE sequence on the sagittal plane, we were able to show only 4 (21 %) of the 19 microadenomas which were detected on 3D FLASH sequence images.

14 of our patients underwent surgery. We correlated the diameters of the pituitary microadenomas measured of coronal 3D-volume images and the diameters measured at surgery and found our true-positive findings on pre-and postgadolinium 3D FLASH sequence coronal images to be 11 (78.5%) and 10



**Figure 3.** Coronal pregadolinium (A) and postgadolinium (B) 3D-volume images of the case with galactorrhea. An adenoma 7 mm in diameter on the left of the anterior pituitary gland (arrow). Postcontrast images had more diagnostic value than precontrast images (Histopathology: Prolactin-secreting microadenoma)

(71.4%) respectively. The general accuracy of diameters measured on pre- or postgadolinium coronal 3D FLASH images is well correlated with the literature. Stadnik et al. obtained true-positive findings on pregadolinium coronal 3D FLASH images in 71% of cases (9). MR imaging is regarded as an alternative method for pituitary gland examination. 3-D volume imaging increases the detection rate of pituitary microadenomas.

Generally, the long examination time in MR imaging studies is still a serious problem. Recently special software programs and sequences (Fast SE, Turbo-FLASH etc.) are developed to solve this problem. As our study proved, in the pituitary gland studies if the patient has a microadenoma (especially the cases which there is no obvious increase in the height of the pituitary gland) getting pre- and postcontrast coronal series by using 3D-volume imaging sequences gives a



**Figure 4.** Coronal pregadolinium (A) and postgadolinium (B) 3D-volume images of the case with irregular menses. An adenoma 4 mm in diameter on the left of the pituitary gland (arrow). It was detected with both pre- and postcontrast images, but postcontrast images delineated adenoma better (Histopathology: Prolactin - secreting microadenoma)

high accurate diagnostic rate. In conclusion, we believe that this sequence can be used as a routine examination protocol in diagnosis of pituitary microadenomas.

#### Hipofiz mikroadenomlarının MR tanısında "3 boyutlu hacim görüntüleme" sekansları

*Magnetik Rezonans (MR) görüntüleme, sellar ve parasallar alanın radyodiyagnostik inceleme yöntemlerinin en seçkinidir. Yüksek doku kontrast rezolüsyonu sağlaması, multiplanar taramaya olanak tanınması, özellikle hipofiz mikroadenomlarının araştırılmasında diğer tarama yöntemlerine göre öncelik kazanmasına neden olmuştur. MR ile hipofizer patolojiler araştırılırken başlangıçtan beri kullanılan spin eko sekansları ile 3 mm'den az kesit kalınlığı sağlanamaması mikroadenomların ta-*

ı asında, duyarlılığı sınırlayan önemli bir engel oluşturmuştur. Son zamanlarda yüksek magnetik alanlı MR görüntüleme sistemlerinin ve 3 boyutlu hacim görüntüleme sekanslarının kullanımı ile birlikte görüntü kalitesini bozmadan çok ince kesitler alınabilmesi mümkün olmuş ve böylelikle hipofiz mikroadenomlarının tanısında önemli bir gelişme sağlanmıştır. Bu çalışmada, klinik ve bilgisayarlı tomografi bulguları ile hipofiz mikroadenomundan şüphelenilen 23 olgu, MR 3 boyutlu hacim görüntüleme sekansları ile incelenmiş ve mikroadenomların tanısında bu sekansların duyarlılığının çok yüksek olduğu sonucuna varılmıştır. [Turk J Med Res 1995, 13(3): 111-115]

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