

Original Article

Pituitary Incidentalomas Detected with Technetium-99m MIBI in Patients with Suspected Parathyroid Adenoma: Preliminary Results

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Abstract

Tc-99m MIBI (MIBI) is a cationic lipophilic agent, which has traditionally been used for myocardial perfusion scintigraphy, detection and monitoring of different benign and malignant tumors. The objective of this study was to evaluate the frequency of pituitary incidentalomas detected on MIBI scans performed on patients with suspected parathyroid adenomas and to provide semiquantitative analysis of tracer uptake in the pituitary region. Tomographic images of MIBI scans on 56 patients with suspected parathyroid adenomas (2006–2007) were analyzed retrospectively. Semiquantitative analysis of abnormal uptake was performed by drawing identical regions of interest (ROI) over the pituitary area and the normal brain on one transverse section that demonstrates the lesion most clearly. Pituitary uptake to normal brain uptake ratio was calculated in all cases. We found statistically significant differences of MIBI uptake in patients with pituitary adenomas, mean ratio: 29.78 ± 12.17 (median 29.77, and range 19–41), compared with patients with no pathologic changes in this region, mean ratio was 5.88 ± 1.82 (median was 5.95 and range 2.0–9.2). As the groups are too small for statistical analysis, these results need to be confirmed in a larger cohort and should include more detailed biochemical correlation. MIBI parathyroid scintigraphy should be taken into account as a potential source of identifying pituitary incidentalomas. Clinical significance of these findings needs further evaluation.

Keywords: Parathyroid adenoma, pituitary adenoma, pituitary incidentaloma, Tc-99m MIBI scintigraphy

Introduction

MIBI is a cationic lipophilic agent which was originally developed for myocardial perfusion imaging.^[1] MIBI scans are also used to detect benign and malignant tumors.^[2–5] It has been considered a potential tumor imaging agent for detecting various kinds of brain tumors including pituitary adenomas.^[6–11]

The uptake of this radiopharmaceutical depends on the distribution of regional blood flow and on mitochondrial oxidation capacity, which is an indicator of cell viability.^[12]

In normal controls, faint MIBI uptake was observed in the pituitary gland. Several articles have been published describing MIBI accumulation in pituitary adenomas.^[7,8,10] MIBI scintigraphy is routinely used in clinical practice for the evaluation of patients with hypercalcemia and elevated serum parathormone (PTH) for the localization of parathyroid adenomas before surgery.^[13] In our department, the base of the skull is usually included in the field of view of the single photon emission computerized tomography (SPECT) and easily visualized on three-dimensional (3D) reconstructed images.

The present study evaluates the occurrence of abnormal MIBI uptake in the region of the sellae turcica in patients with suspected parathyroid adenoma. Correlation with other imaging modalities (CT, MRI) and semiquantitative analysis of the pathological findings and local tracer accumulation in subjects with no proven pituitary abnormalities were obtained.

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Materials and Methods

Patients

The study approved by the institutional ethical committee, included a retrospective evaluation of 56 consecutive patients (38 women, 18 men, age range from 29 to 83 years, mean age 61 ± 14.09), with primary hyperparathyroidism. They were referred to our department between September 2006 and September 2007, for MIBI parathyroid scintigraphy, before parathyroidectomy.

Methods

MIBI scintigraphy

Radionuclide imaging was performed 15 and 90 minutes after intravenous injection of 20 mCi (740 MBq) of MIBI into arm vein.

Planar images were performed using a 128×128 matrix with 20% window around 140 keV photopeak, on a dual-head, large field-of-view (LFOV) gamma camera (E-cam., Siemens) equipped with a couple of parallel hole, low-energy ultra-high-resolution collimators.

All patients underwent SPECT imaging of the base of the skull, neck and upper chest. SPECT acquisition was performed 90 min after the injection using the same gamma-camera, with a 128×128 matrix; 120 projections every 3° (360° rotation) and with an imaging time of 20 sec/per projection. Images were reconstructed using iterative reconstruction software. Transverse, coronal and sagittal projections were reconstructed.

The scintigraphic images were interpreted by two nuclear medicine specialists blinded to the clinical information and the results of any other imaging modality. In case of disagreement the final diagnosis was reached by consensus.

Semiquantitative analysis of tracer uptake was calculated by drawing identical regions of interest (ROI) over the pituitary area and the normal brain on one transverse section that demonstrated the pituitary area most clearly. The mean ROI values (total counts/ total pixels) were measured, and the pituitary-to-normal brain (P/B) ratios were obtained in all patients. We prefer to use as background the brain tissue above the sella turcica not attached to the choroid plexus.

At the time of MIBI scintigraphy, 18 patients had brain CT or MRI (11 CT, 7 MRI) scans for different reasons, during two years prior to current examination. In 14 cases no pituitary pathology was initially described. The P/B ratios of this group of patients were used as a normal control.

Statistical analysis

For statistical analysis we used the following: χ^2 test, Kruskal-Wallis non-parametric one way ANOVA test and Spearman non-parametric correlation coefficient. Software SPSS-14 was used for data processing.

As the groups are too small for statistical analysis, we also presented the data by graphic display, plotting a graph of the pituitary to normal brain tissue uptake ratio.

Results

In 14 out of 18 patients who had no abnormal findings in the dorsum sella region on initial interpretation of CT or MRI studies, the mean P/B ratio was 5.87 ± 1.82 (the median was 5.95 and the range was 2.0–9.2) [Figure 1]. One patient, whose CT was interpreted at the beginning as normal, had an extremely elevated P/B ratio. On revised CT scan a pituitary mass was found. Another 2 patients who had increased P/B ratios (20 and 29) with suspected pituitary adenomas were excluded from the study, because they were missed from the outpatient clinic follow-up. In 4 patients with known pituitary abnormalities: two had pituitary macroadenomas, one had partial empty sellae and one had an initially “missed” pituitary adenoma, the mean P/B ratio was 29.77 ± 12.17 (the median was 29.55 and the range 19.0–41.0) [Figure 2].

In the remaining 36 patients (without known pituitary

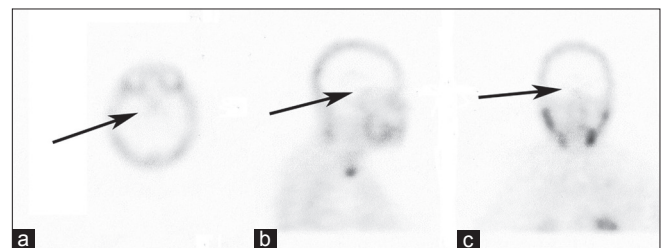


Figure 1: Tc-99m MIBI SPECT in patient with suspected parathyroid adenoma (a) Transverse, (b) Sagittal and (c) Coronal section images). Very faint tracer uptake is noted in Sella Turcica with a normal P/B ratio of 4.2. MRI done subsequently was normal

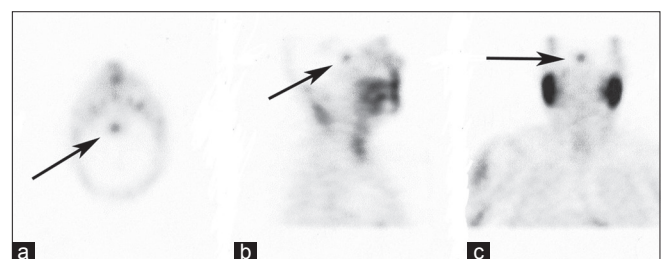


Figure 2: Tc-99m MIBI SPECT in patient with suspected parathyroid adenoma (a) Transverse, (b) Sagittal and (c) Coronal section images). A focus of increased tracer activity is noted in the area of the sella Turcica with a high P/B ratio of 19.5; Confirmed as Pituitary macro-adenoma on MRI

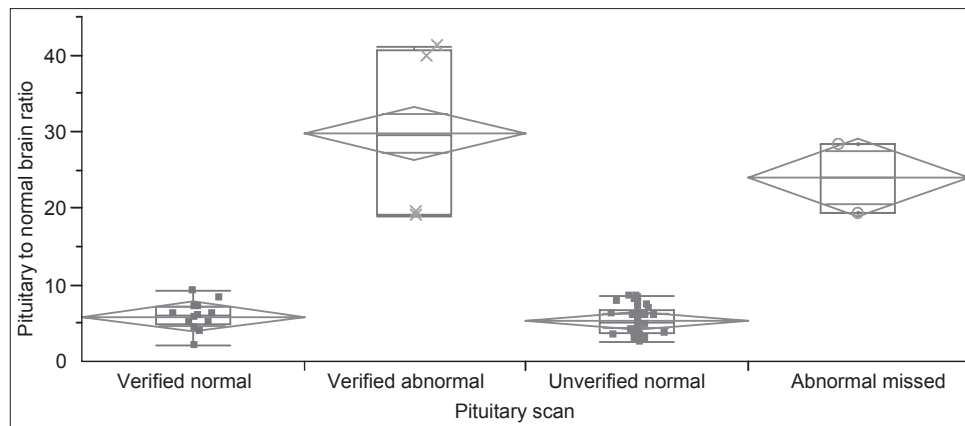


Figure 3: Distribution of P/B ratios in the 4 studied groups

abnormalities), the mean P/B ratio was 5.32 ± 1.82 (the median was 5.15 and the range was 2.6–8.6).

The mean P/B ratio of the pathological group was significantly higher than the mean P/B ratio of the normal group ($P < 0.001$).

As the groups are too small and statistical inference is limited in data, the results were also displayed graphically [Figure 3]. The graph demonstrates the P/B ratios in the 2 control groups and pathological groups. The figure illustrates the P/B ratios in the two control groups and the pathological groups. There is no overlap between the uptake ratios of the normal and the abnormal groups.

The mean age of the verified normal 14 patients was 65.57 ± 16.16 (the median was 62.50 and the range was 40–96). The mean age of the unverified normal 36 cases was 59.40 ± 14.10 (the median was 59.00, the range was 20–80) and for the 4 abnormal patients the mean age was 63.75 ± 7.00 (the median was 63.00 and the range was 57–72).

There were no statistically significant differences between the ages of the patients in the groups.

Discussion

The development of imaging techniques has resulted in the discovery of unsuspected silent pituitary incidentalomas.^[14–20] It is important to distinguish between pituitary adenomas and normal variations in pituitary size. Therefore, comprehensive clinical assessment and long-term follow-up are necessary.

On the other hand, tomographic reconstruction of MIBI scan for detection of parathyroid adenoma performed by a large field of view gamma-camera makes possible the cross-sectional evaluation of the

region including base of skull, neck and thorax. An abnormal tracer accumulation in an unexpected area should be monitored carefully to exclude space-occupying lesions.

Several previous reports demonstrated increased uptake of MIBI in the regions of dorsum sella and clivus. This strongly associates with pituitary adenomas.^[7,8,10,21] Our study supports this data and suggests a simple semiquantitative index to diagnose underlying pituitary abnormalities.

Kunishio *et al.*^[7] reported relatively low P/B ratios in delayed images in two patients with nonfunctioning adenomas, within the range of our normal control. All of them were more than 20 mm in diameter, in one case a cavernous invasion was noted. Lack of hormone production does not explain this discrepancy as in the same study other cases of nonfunctioning pituitary adenomas had high P/B ratios.

In our group, the number of abnormal observations is too small for performing statistical tests. However, the difference in P/B ratios between the abnormal and the normal group is substantial for identifying the pathological cases.

Our result is consistent with the findings of Yokogami *et al.*,^[22] who found some MIBI uptake in normal choroid plexus.

In conclusion, the preliminary result of our study indicates that measurement of P/B ratios, obtained on MIBI SPECT performed on patients with suspected parathyroid adenomas may be helpful to detect underlying pituitary pathology. Clinical significance of routine semiquantitative analysis of MIBI pituitary uptake needs further prospective evaluation.

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