

ULTRASONOGRAPHY VERSUS ^{99m}Tc- MIBI SCINTIGRAPHY IN PRE-OPERATIVE LOCATION IN PRIMARY HYPERPARATHYROIDISM IN MOROCCAN PATIENTS

M. Sahli*, B. Hemmaoui, N. Errami, M. Zalagh, A. Jahidi, S.Ouraini F. Benariba
Department of head and neck surgery, Mohamed Vth Military Hospital, Rabat, Morocco.

ABSTRACT

Introduction: The exploration of hyperparathyroidism has been a great progress in recent years thanks in particular to the ^{99m}Tc (Technetium) -MIBI (methoxy isobutyl isonitrile) parathyroid scintigraphy. The objective of our study is to demonstrate the contribution of ultrasound and ^{99m}Tc-MIBI scintigraphy in the exploration for primary hyperparathyroidism. **Materials and methods:** A retrospective study on 8 years between 2010 and 2017 of 26 cases of primary hyperparathyroidism labeled biologically. All our patients underwent a cervical ultrasonography and a ^{99m}Tc-MIBI parathyroid scintigraphy with a double phase acquisition of static images after administration of the radiotracer. **Results:** The average age of our patients was 49 years with a female predominance (sex ratio of 2.71). The sensitivity and accuracy of the MIBI scintigraphy was 90.47% and 84.6%, respectively, compared with 84.21% and 76.9% for cervical ultrasonography. The couple ultrasonography/scintigraphy were more efficient with sensitivity and accuracy of 100%. **Discussion:** ^{99m}Tc-MIBI scintigraphy is a reliable means in the diagnosis of localization and multifocality of parathyroid nodules, especially if it is coupled with ultrasonography; it allows targeted surgery with less risk of morbidity.

Key words: Moroccan; Primary hyperparathyroidism; Ultrasonography; ^{99m}Tc-MIBI scintigraphy

Corresponding Author:

Mohamed Sahli, MD.

Affiliation: Department of head and neck surgery, Military Hospital Mohamed V, Rabat, Morocco.

E-mail: dr.sahli.mohamed@hotmail.fr

Copyright © 2012- 2020 Dr M. Sahli. This is an open access article published under **Creative Commons Attribution -Non Commercial- No Derives 4.0 International Public License (CC BY-NC-ND)**. This license allows others to download the articles and share them with others as long as they credit you, but they can't change them in any way or use them commercially.

*****Published in December 31, 2020.

doi: 10.46327/msrjg.1.000000000000xxx

doi url: <https://doi.org/10.46327/msrjg.1.000000000000xxx>

INTRODUCTION

Parathyroid surgery is a meticulous and delicate surgery, thus requiring a good preoperative exploration in order to orient the surgical strategy. This strategy consisted of a bilateral cervical exploration with inspection of the four parathyroid glands, but currently, targeted unilateral surgical explorations are increasingly carried out in particular thanks to the progress of imaging and intraoperative dosing of parathyroid hormone (PTH). This has reduced the morbidity rate and the cost of this surgery. The objective of our study to demonstrate the contribution of ultrasound and parathyroid scintigraphy in the exploration of parathyroid secretory processes as well as the performance of each of the two methods in targeted surgery.

PATIENTS AND METHODS

This is a retrospective study carried out in the otolaryngology department at the Mohamed Vth Military Hospital in Rabat covering a period of 8 years (2010-2017) and relating to 26 cases of primary hyperparathyroidism. We included in our study the files of patients who presented a biologically confirmed primary hyperparathyroidism and who benefited from a double radiological exploration (ultrasound and scintigraphy). The scintigraphic images were performed in two phases after administration of the radiotracer (20th minute then at the 2nd hour). Any hyperfixation of the radiotracer visible only at an early time (quick washout) or late or clearly visible at two phases but more intense late was considered pathologic.

For each patient, we studied age, sex, biological, radiological and histological data, while emphasizing the contribution of each method of radiological exploration in targeted surgery. To do this, we compared the data from these explorations with the data from intraoperative surgical exploration.

The performances of ultrasound, scintigraphy or their association (sensitivity, specificity, accuracy, positive predictive value (PPV)) were calculated by defining the true positives (TP), the true negatives (TN), the false positives (FP) and false negatives (FN).

RESULTS

The average age of our patients was 49 years with a female predominance (73%) (Sex ratio of 2. 71) (19 F/

7 M). The PTH level varied between 97pg / ml and 1293pg / ml with an average of 258.7pg / ml.

Ultrasound was unable to detect a parathyroid adenoma in four cases (15.3%), all of this cases had multinodular goiter. Ultrasound also wrongly diagnosed 3cases (11.5%) of multinodular goiter with posterior thyroid nodule as a parathyroid nodule (false positive). The 99mTc-MIBI scintigraphy did not detect 3 cases (11.5%) of reduced parathyroid nodule. The combination of the two exploration methods allowed the detection of all parathyroid nodules in our series with 100% accuracy and sensitivity. No ectopic mediastinal localization was highlighted in our series. These results are summarized in **Table I** and illustrations are reported in **figure 1**.

Table I: Performance of different means of exploration in our series.

	True positives	True negatives	False positives	False negatives
Ultrasound	16	4	3	3
Scintigraphy	19	3	2	2
Ultrasound/ scintigraphy couple	23	3	0	0

	Sensitivity (TP/TP+FN) %	Specificity (TN/TN+FP) %	Accuracy (TN+TP)/(TN+TP+FN) %	Positive predictive value (PPV) (TP/TP+FP) %
Ultrasound (US)	84,21%	57,14%	76,9%	84,21%
Scintigraphy	90,47%	60%	84,6%	90,47%
Association US/ Scintigraphy	100%	100%	100%	100%

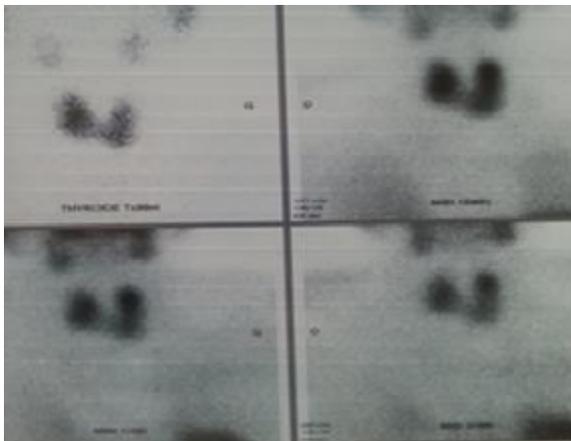


Figure1: 44-year-old woman with primary hyperparathyroidism, 99mTc-MIBI scintigraphy revealed persistent superior left polar delayed fixation in relation to left superior parathyroid adenoma.

The surgical intervention consisted in targeted surgery on the pathologic parathyroid in 20 cases (with single focus on radiological exploration); the intraoperative findings in these cases were consistent with those of the scintigraphy and ultrasound. Bilateral exploration was performed in the other cases. An associated total thyroidectomy was performed in 04 cases and a lobectomy in only 01 case. A modified radical neck dissection removing lymph nodes from levels II to V and including levels

VI was performed offline in a case of parathyroid carcinoma.

The dosage of parathyroid hormone per operatively and postoperatively showed a reduction of 50% in all our patients and no re-intervention was necessary. No complications were noted in the targeted surgery. In contrast, transient hypocalcaemia was noted in 03 cases (11. 5%) of bilateral exploration.

The final histology showed 19 cases of parathyroid adenoma (73.07%), 6 cases of parathyroid hyperplasia (23.07%) and a single case of parathyroid carcinoma (3. 84%) (**Figure 2**).

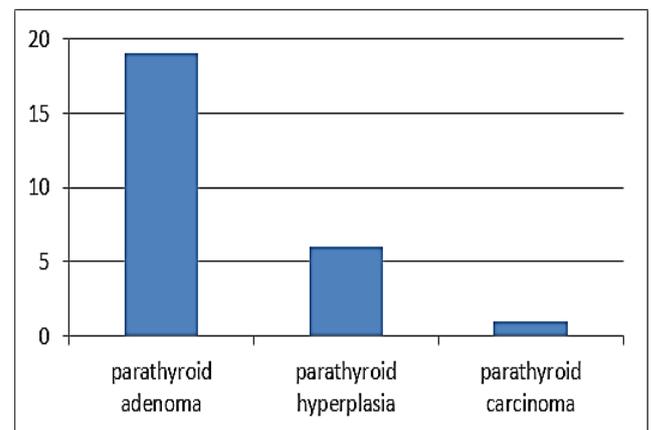


Figure2: definitive histological examination in our series

DISCUSSION

Hyperparathyroidism is a common disease endocrine (3rd after diabetes and hyperthyroidism), the diagnosis is based on the couple hypercalcemia and elevated serum parathyroid hormone. The operating indications are precise and well codified [1]:

- Symptomatic patient.
- Asymptomatic patient if:
 - Age less than 50 years
 - Calcemia $>2.8\text{mmol/l}$
 - Calciuria $>10\text{mmol/24h}$
 - Reduced bone density (T-score ≤ -2.5)
 - Unexplained decrease in creatinine clearance by more than 30%
 - Existence of a threatening hypercalcemia episode

The diagnosis of localization is based on ultrasound and $^{99\text{mTc}}$ -MIBI scintigraphy, which will either orient towards targeted surgery or bilateral cervical exploration. Indeed, targeted surgery directed by preoperative localization examinations has developed a lot in recent years. This targeted surgery requires precise preoperative localization as well as the possibility of intraoperative dosing of the PTH serum concentration in order to ensure the effectiveness of the surgical procedure [2].

The $^{99\text{mTc}}$ -MIBI scintigraphy represents the most sensitive imaging method in the exploration of hyperparathyroidism (in front of ultrasound, computed tomography and magnetic resonance imaging). It is necessary before any re-intervention or if limited surgery is planned [3]. A meta-analysis by Ruda [4] on 20225 cases of primary hyperparathyroidism shows that scintigraphy is generally efficient compared to ultrasound and that sensitivity drops significantly in the case of multi glandular disease (MGD) (sensitivity for a single adenoma: 88.44%, for hyperplasia: 44.46%, for double adenoma: 29.95%). In Haber's study [5] of 74 cases of primary hyperparathyroidism who underwent parathyroid surgery and having benefited from a double exploration (ultrasound and scintigraphy), there was no statistically significant difference in the exact preoperative location (74% respectively for ultrasound versus 82% for scintigraphy) or in the positive predictive value (respectively 93% for ultrasound versus 90% for scintigraphy). However, MIBI scintigraphy was clearly more sensitive compared to ultrasound for ectopic localizations with correct location in 8/8 cases. Our results are concordant with those described in the literature with a better sensitivity for $^{99\text{mTc}}$ -MIBI scintigraphy of 90.4% against 84.2% for cervical ultrasound. However, we insist on the combination of the two exploration methods, which considerably improves the sensitivity and accuracy of operative approach. These results are summarized in **Table II**.

Table II: Performance of scintigraphy and ultrasonography in the literature

	Number of cases	Sensitivity		Accuracy		PPV	
		US	Scintigraphy	US	Scintigraphy	US	Scintigraphy
Chung Yau Lo et al. [6]	100	57%	89%	56%	85%	97%	94%
Haberet al. [5]	74	74%	82%	-	-	93%	90%
Ibrahim et al. [7]	40	94,6%	89,5%	92,5%	90%	97,2%	100%
Our Study	26	84,21 %	90,47%	76,9%	84,6%	91,6%	92,3%

Ultrasound is less effective in MGD and in ectopic localizations (retropharyngeal, retro tracheal, retro-esophageal) due to the interposition of air [5, 8]. Multi nodular goiter can also influence the sensitivity of ultrasound in the detection of parathyroid nodules; this was noted in our series in 4 cases.

Scintigraphy and ultrasound performance is also modest in secondary hyperparathyroidism [3].

Therefore, scintigraphy should be reserved only for the search for supernumerary glands and / or ectopic parathyroid thus reducing the risk of surgical failure. In the literature, studies based on the double phase method show a sensitivity of 54% to 91% and a specificity of 88% to 97% in cases of secondary hyperparathyroidism [9]. The sensitivity of scintigraphy and ultrasound is also reduced in the context of re-intervention. A complementary MIBI

SPECT Scan acquisition is necessary in this context given the high risk of ectopia and for good preoperative anatomical precision [10].

CONCLUSION

The performance of ultrasound and scintigraphy is better in cases of primary hyperparathyroidism and even more so if they are coupled as described in our study and in the literature. This allowed an evolution in the surgical strategy with the realization of more and more minimally invasive targeted surgery and thus allowing decreasing the postoperative morbidity.

CONFLICT OF INTEREST:

All authors declare no conflict of interest.

ABBREVIATIONS:

F: Female

M: Male

MIBI: methoxy isobutyl isonitrile

SPECT: Single photon emission computed tomography

REFERENCES

1. Bilezikian JP et al. Summary statement from a workshop on asymptomatic primary hyperparathyroidism: a perspective for the 21st century. *J Clin Endocrinol Metab.* 2002; 87 (12):5353-61.
2. Udelsman R, Donovan P, Sokoll L. One hundred consecutive minimally invasive parathyroid explorations. *Ann Surg* 2000; 232(3): 331-9.
3. Lai ECH, Ching ASC, Leong HT. Secondary and tertiary hyperparathyroidism: role of preoperative localization. *ANZ J Surg* 2007; 77(10):880-2.
4. Ruda JM, Hollenbeak CS, Stack Jr BC. A systematic review of the diagnosis and treatment of primary hyperparathyroidism from 1995 to 2003. *Otolaryngol Head Neck Surg* 2005; 132(3):359-72.
5. Haber RS, Kim CK, Inabnet WB. Ultrasonography for preoperative localization of enlarged parathyroid glands in primary hyperparathyroidism: comparison with (99 m) technetium sestamibi scintigraphy. *Clin Endocrinol (Oxf)* 2002; 57(2):241-9.
6. Lo CY, Lang BH, Chan WF, Kung AW, Lam KS. A prospective evaluation of preoperative localization by technetium-99m sestamibi scintigraphy and ultrasonography in primary hyperparathyroidism. *Am J Surg.* 2007; 193(2):155-9.
7. Ibrahim EAG, Elsadawy ME. Combined Tc-99m sesta MIBI scintigraphy and Ultrasonography in preoperative detection and localization of parathyroid adenoma. *Egypt J Radiol Nucl Med* 2015; 46 (4): 937-41.
8. Roy M, Mazeh H, Chen H, Sippel RS. Incidence and localization of ectopic parathyroid adenomas in previously unexplored patients. *World J Surg* 2013; 37(1):102-6.
9. Amouri W and al. Performances de la scintigraphie parathyroïdienne au 99mTc-Sestamibi dans l'hyperparathyroïdie secondaire (à propos de 20 cas). *Médecine Nucléaire* 2013 ; 37(10-11) : 420-8.
10. Hindié E, Taïeb D. Scintigraphie parathyroïdienne dans l'hyperparathyroïdie primitive : quelques considérations récentes. *Médecine Nucléaire* 2014 ; 38 (3): 208-15.