PRIMARY HYPERPARATHYROIDISM: CONTRIBUTION OF ULTRASOUND AND MIBI SCINTIGRAPHY IN THE PREOPERATIVE DETECTION OF PARATHYROID GLANDS

HYPERPARATHYROÏDIE PRIMAIRE : APPORT DE L'ÉCHOGRAPHIE ET DE LA SCINTIGRAPHIE MIBI DANS LA DÉTECTION PRÉOPÉRATOIRE DES GLANDES PARATHYROÏDES

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ABSTRACT

Objective: To evaluate the role of imaging in primary hyperparathyroidism, assessing the contribution of neck ultrasonography and MIBI (methoxyisobutylisonitrile) scintigraphy.
Methods: A retrospective study of 58 patients operated upon for primary hyperparathyroidism who had pre-operative cervical ultrasound and MIBI scintigraphy. None of these patients had undergone previous neck surgery. We studied the sensitivity (Se), the specificity (Sp), the positive predictive value (PPV) and the negative predictive value (NPV) of pre-operative cervical ultrasound and MIBI scintigraphy for the localization of the parathyroid adenoma.
Results: The Se, Sp, PPV and NPV of ultrasonography for localization of the pathological parathyroid glands were respectively 74%, 95%, 83% and 90%.
Concerning scintigraphy Se, Sp, PPV and NPV were 91%, 97%, 91% and 95% respectively.
The associated multinodular goiter decreases the sensitivity and specificity of neck ultrasonography and scintigraphy.
Regarding the scintigraphy, the average rate of PTH (Parathormone) was 562UI / ml for true-negative cases while it was 238UI / ml for false-negative cases (p = 0.021).
Conclusion: MIBI scintigraphy had better sensitivity and specificity than ultrasound for locating a parathyroid adenoma, this is particularly marked when PTH levels are high. The benefit of ultrasonography is essentially exploring the thyroid gland
Keywords: Primary hyperparathyroidism; MIBI scintigraphy, cervical ultrasound

RÉSUMÉ

But: Préciser le rôle de l'imagerie dans l'hyperparathyroïdie primaire, en évaluant l'apport de l'échographie et de la scintigraphie MIBI ((methoxyisobutylisonitrile).
Méthode: Etude rétrospective portant sur 58 patients opérés pour une hyperparathyroïdie primaire ayants eu en pré opératoire une échographie cervicale et une scintigraphie MIBI. Aucun patient n'a eu de chirurgie cervicale préalable. Nous avons étudié la sensibilité (Se), la spécificité (Sp), la valeur prédictive positive (VPP) et valeur prédictive négative (VPN) de l'échographie et de la scintigraphie MIBI pour la localisation de l'adénome parathyroïdien.
Résultats: La Se, la Sp, la VPP et la VPN de l'échographie pour la localisation des glandes parathyroïdes pathologiques étaient respectivement de 74%, 95%, 83% et 90%.
Quant à la scintigraphie, la Se, Sp, VPP et la VPN étaient respectivement de 91%, 97%, 91% et 95%.
Le goitre mutinodulaire associé diminue la sensibilité et la spécificité de l'échographie cervicale et de la scintigraphie.
Concernant la scintigraphie, le taux moyen de la PTH (Parathormone) était de 562 UI/ml pour les cas de vrais positif alors qu'il a été de 238 UI/ml pour les cas de faux négatif (p=0,021).
Conclusion: La scintigraphie MIBI avait une meilleure sensibilité et spécificité que l'échographie pour localiser un adénome parathyroïdien et ceci est d'autant marqué que le taux de PTH est élevé. L'intérêt de l'échographe est essentiellement d'explorer la glande thyroïde.
Mots clés: Hyperparathyroïdie primaire; scintigraphie MIBI, échographie cervicale

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INTRODUCTION

The preoperative location of pathologic parathyroid glands in primary hyperparathyroidism is of great interest to the surgeon and reduces surgical time. Cervical ultrasound and MIBI scintigraphy are the most widely used imaging techniques in this indication. Their preoperative achievements are almost systematic due to technical simplicity, their harmless nature and their acceptable cost [1]. However, their contribution to the localization of the pathological parathyroid gland is a subject of discussion.

The aim of our work was to study the contribution of cervical ultrasound and MIBI subtraction scintigraphy in the preoperative identification of pathologic parathyroid glands in primary hyperparathyroidism.

MATERIALS AND METHODS:

This is a retrospective study of 58 patients operated on for primary hyperparathyroidism in the ENT and head and neck surgery department of the Habib Bourguiba University and Hospital Center in Sfax.

The diagnosis of primary hyperparathyroidism was made on clinical and laboratory data (determination of serum calcium, phosphoremia, PTH 1-84, and Vitamin D).

All the patients included underwent cervical ultrasound and MIBI scintigraphy preoperatively.

The results of the pathological examination of the parathyroidectomy specimen and the imaging data were compared to determine the sensitivity, specificity, positive predictive value and negative predictive value of imaging examinations (ultrasound and scintigraphy). So for each exam:

-the number of true positives corresponds to the number of pathological parathyroid glands detected radiologically.

-the number of false negatives corresponds to the number of pathological parathyroid glands not detected radiologically.

-the true negative number corresponds to the number of normal parathyroid glands not detected radiologically.

-the number of false positives corresponds to the number of parathyroid glands normal but radiologically detected as pathological.

We have determined for each examination:

-the sensitivity: it is the ratio of the number of true positive and the sum of the number of true positive and false negative.

-specificity: it is the ratio of the number of true negative and the sum of the number of true negative and false positive.

- the positive predictive value (PPV): it is the ratio of the number of true positive and the sum of the number of true positive and false positive.

-the negative predictive value (NPV): it is the ratio of the number of true negative and the sum of the number of true negative and false negative.

We studied the factors that could influence the performance of these two investigations: the presence of an associated multinodular goiter (MNG), the size of the pathologic parathyroid gland and the preoperative parathyroid hormone (PTH) level. Statistical analysis of these data was performed using SPSS 18.0 software for Windows. We used Student's test for comparison of means. We considered significant a p-value of less than 0.05.

RESULTS:

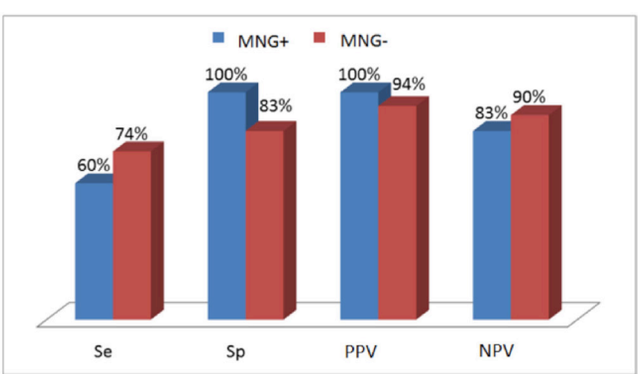
The average age was 66 with extremes ranging from 19 to 89. A female predominance was noted (47 women and 11 men, sex ratio of 0.23).

Ultrasound revealed a parathyroid nodule in 84% of cases with an average size of 19.4 mm (between 7 and 40 mm). It was a single nodule in 46 cases (79%). Ultrasound did not show a pathological parathyroid gland in 7 cases (12%). An associated GMN was observed in 25.8% of cases.

Cervical ultrasound Sc, Sp, PPV and NPV for localization of pathologic parathyroid glands were 70%, 94%, 86% and 89%, respectively. (Table 1)

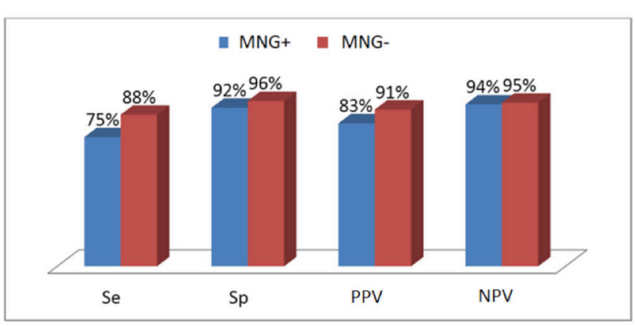
On thyroid subtraction scintigraphy (MIBI), pathological parathyroid fixation was observed in 93% of cases. The Sensitivity, Specificity, PPV and NPV of the scintigraphy were 91%, 97%, 91% and 95%, respectively.

In the presence of a MNG, the ultrasound had a sensitivity of 60% while it was 74% in the absence of MNG (Figure 1). Likewise, the sensitivity of the scintigraphy was reduced from 88% to 75% in the presence of an associated GMN. The scintigraphic specificity also decreased from 96% to 92% in the case of associated MNG (Figure2).



MNG: Multi Nodular Goiter Se: Sensibility, Sp: Spécificity, PPV: Positive Predictive Value, NPV: Negative Predictive Value

Figure 1: Se, Sp, VVP, NPV of ultrasound in the presence and absence of MNG



MNG: Multi Nodular Goiter Se: Sensibility, Sp: Spécificity, PPV: Positive Predictive Value, NPV: Negative Predictive Value

Figure 2: Se, Sp, VVP, NPV of MIBI scintigraphy in the presence and absence of MNG

The mean PTH level was 562 IU / ml when the parathyroid scintigraphy located a pathological parathyroid (true positive) and 238 IU / ml when the pathological parathyroid was not located (false negative) with a significant difference (p = 0.021). However, this difference was not found for ultrasound (p = 0.94) (Table I and Table II).
The study of the mean of the longest axis of the gland did not show a significant difference between the glands detected or not detected by ultrasound (p = 0.58) or by scintigraphy (p = 0.21). (Tables I, II)

Table I: Correlation between gland size, TSH value, and ultrasound results

	Cervical Ultrasound		
	True positif	False negatif	p
Size of parathyroid glande	16mm	20mm	0,58
PTH	599UI/ml	573UI/ml	0,94

PTH: Parathormone

Table II: Correlation between gland size, TSH value and scintigraphy results

	MIBI Scintigraphy		
	True positif	False negatif	p
Size of parathyroid glande	20,8mm	10,8mm	0,21
PTH	562UI/ml	238UI/ml	0,021

PTH: Parathormone

DISCUSSION:

Primary hyperparathyroidism is a frequent condition (incidence of 1 case / 1000 per year) and imaging is of considerable help as it can guide surgery, the only curative treatment [1, 2].
Cervical ultrasound is simple and inexpensive, performed first-line as part of a complete anatomical assessment of the thyroid compartment and cervical lymph node areas. The use of Doppler allows the identification of parathyroid vascular pedicles, mainly for larger adenomas [3, 4].
The principle of MIBI scintigraphy is based on the difference in the elimination kinetics of the product between the thyroid gland and the parathyroid glands [5].
Several studies have found that the sensitivity of ultrasound varies between 51 and 94%, while that of MIBI subtraction scintigraphy is better and varies between 76 and 96% [6-12]. In our series, the sensitivity of the ultrasound was 70% while that of the scintigraphy was 88%. Table III
Table III: Parathyroid ultrasound and MIBI scintigraphy results

	Parathyroid Ultrasound				MIBI Scintigraphy			
Autors	Se	Sp	VPP	VPN	Se	Sp	VPP	VPN
Moghadam and al [6]	80%	77%	-	-	84%	87%	-	-
Xue and al [7]	90%	93%	-	-	95%	98%	90%	-
Salhi et al [8]	91%	66%	-	-	95%	66%	-	-
Poullias and al [9]	69%	96%	-	-	82%	91%	-	-
Ioannis and al [10]	-	-	-	-	96%	97%	98%	91%
Huang and al [11]	-	-	-	-	88%	79%	92%	71%
Elsayed and al [12]	94%	44%	-	-	97%	71%	-	-
Oudoux and al [13]	51%	91%	67%	-	76%	95%	84%	-
Notre série	70%	94%	86%	89%	88%	97%	91%	95%

Oudoux and al [13] have shown that the combination of these two imaging techniques gives a sensitivity of 94.5%. Similarly Elsayed and al [12] found an increase in sensitivity to 95.6%. These results were similar to the results of previous studies who noted improved accuracy, overall specificity, and positive predictive values when the two techniques are combined preoperatively [14-16]. This is the case of Lumachi et al. who reviewed the results of preoperative ultrasound and sestamibi scintigraphy in patients with solitary adenomas and found a combined sensitivity of 95% versus 80% for ultrasound and 87% for scintigraphy alone [17].
The performance of scintigraphy and ultrasound depends on several parameters such as weight, parathyroid gland size and PTH level [12].
Oudoux and al [13] found that ultrasound had a sensitivity of 73% for detecting glands greater than 500 mg and 36% for glands less than 500 mg ($p < 0.01$). The low weight is related to a small size of the parathyroid gland thus reminiscent of the normal gland which can escape their ultrasound markings.
In our study, the size of the parathyroid gland did not influence the imaging results.
Krausz and al [18] found that the high level of PTH increases the sensitivity of the scintigraphy. In our study, true positive scintigraphy cases were associated with a significantly higher mean PTH level. This can be explained by the high activity of the pathological parathyroid glands thus facilitating the uptake of the radioactive isotope.
Rink and al [19] showed that the presence of goiter significantly decreases the sensitivity of parathyroid scintigraphy. This was explained by the fact that the posterior anatomical location of the parathyroid glands thus makes their scintigraphic locations more difficult in the presence of an anterior goiter by attenuation of the radiation emitted by the radioisotope. In another study, Johnson et al [20] found that the presence of a multinodular thyroid may limit the ultrasound evaluation

of parathyroid adenomas. In our study the sensitivity was 88% in the absence of GMN and 75% in the presence of an MNG. Likewise the cervical ultrasound sensitivity dropped from 74% to 60%, this can be explained by confusion between a thyroid nodule and a parathyroid adenoma.

Another advantage of parathyroid scintigraphy is that it can locate ectopic adenomas such as the retrotracheal region, the retrosternal region, the superior mediastinal and intrathymic regions [21].

CONCLUSION

The diagnosis of hyperparathyroidism is biological. A preoperative radiological assessment is necessary, thanks to its good sensitivity and specificity, allows a topographic orientation of the hyperfunctional gland to guide the surgical procedure.

Compliance with ethical standards

Conflict of interest: The authors stated that there is no conflict of interest.

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