Comparison Between Ultrasound, Scintigraphy and Cytological Puncture in Diagnostics of Thyroid Gland Nodules

Sanja Sehovic, Amelia Begic, Nina Juric, Maida Celam
Sunce Polyclinics, Agram, Sarajevo, Bosnia and Herzegovina
Clinic for Nuclear Medicine, University of Sarajevo Clinical Center, Sarajevo, Bosnia and Herzegovina

Purpose: The purpose of this study was to compare ultrasound results with results of scintigraphy and targeted cytological puncture of a nodule or nodules of the thyroid.

Material and method: The study analyzed results of 133 patients, men and women, between age of 16 and 75. The patients had a standard ultrasound of the thyroid, scintigraphy and ultrasound guided cytological puncture.

Results: The research showed that nodular diseases of the thyroid are present in 2/3 of women patients, and in 1/3 of men patients. The largest presence of nodules is among the age group of 40-49 years. Nodules are the most common in the lower right lobe of the thyroid. The size increase of nodules also increases probability to be malignant. Furthermore, this research has showed that there is a statistically significant connection between ultrasound results and the cytological puncture test results. Conclusion: Ultrasound is a reliable method of diagnosis for selecting patients to have a cytological puncture. If thyroid scintigraphy shows warm nodules, there is no need for ultrasound guided cytological puncture. Scintigraphy, ultrasound and ultrasound guided cytological puncture are complementary methods in reliable diagnostics of nodular disease of the thyroid.

Keywords: thyroid gland, ultrasound, scintigraphy, cytological puncture

Corresponding author: Sanja Sehovic, MD. Trg medjunarodnog prijateljstva 20 71000 Sarajevo. Bosnia and Herzegovina. Phone: +387 33 755 576. E-mail: sanja.sehovic@bosna-sunce.ba

1. INTRODUCTION

Nodular changes of the thyroid are very common. They are present in 4-7% of case in the general population. Depending on the method of discovery, 4-8% nodules are discovered using palpation, 10-41% with ultrasound and 50% through autopsy. The prevalence depends on variety of factors, including: age, gender, iodine deficiency, diet, and exposure to ionizing radiation in the environment or for therapeutic reasons. The frequency of thyroid gland nodules manifestation is increased with the age, and is present four times more in women than in men. Radiation exposure (2-5 Gy) in childhood increases the chances of developing nodules for 2% in the general population, and incidence is increased between the age 15 and 25. Incidence of thyroid gland diseases after exposure to radiation in adults increases for 16-31% (1). According to the morphological criteria these can be poly-nodular changes in thyroid gland and solitary thyroid nodules; in addition they can be benign and malignant. According to the available data, 5-20% was malignant lesions, and the rest were benign hyperplasia (2, 3). In the USA each year around 12,000 new cases of cancer are diagnosed, and amongst those 1,000 die. Malignant nodules are more common in patients of <20 years and >60 years, than with patients between 20 and 60 years of age. In 75-80% cases it is Papillary Carcinoma, 10-20% Follicular Carcinoma, 3-5% Medullary Carcinoma, 1-2% Anaplastic Carcinoma (1)

The purpose of this study was to compare ultrasound results of the thyroid with scintigraphy and targeted cytological puncture of a nodule or nodules of the thyroid.

2. PATIENTS AND METHODS

A clinical, retrospective-prospective study was done considering the period 2008-2010. The examinees were patients with nodular changes on the thyroid diagnosed in “Sunce” polyclinics (ultrasound and cytological puncture), and in Clinic for Nuclear Medicine – University of Sarajevo Clinical Center (CCUS) (scintigraphy). The study analyzed 133 patients, both genders, age group between 16 and 75 years. A standard ultrasound of the thyroid was performed using Siemens, Acuson X500 with 7.5MHz transducer in a typical position. Scintigraphy was performed in the Clinic for Nuclear Medicine CUSS using Siemens two head gamma camera and Mediso one head gamma camera, according to the standard application protocol Tc-99m. Scintigraphy was done ten minutes after IV application of 20mCi Tc-99m with a high definition wide angle collimator. Ultrasound guided cytological puncture was done in Sunce polyclinics together with a cytologist and radiologist pres-
ent. The procedure was done with a Siemens ultrasound Acuson X500 using 7.5MHz transducer. Cameco syringe holder was used together with thin 21 gauge needles.

2.1. Statistical analysis

Data collection was done through review of medical literature, after it was entered in MS Excel 2007. Upon arranging, controlling and grouping, data was exported into a statistical software package SPSS 16.0 (version 16.0, SPSS Inc, Chicago, Illinois, USA). A statistical analysis was done after defining of variables.

3. RESULTS

Out of the total number of examinees (n=133), 114 (85.7%) were women, and 19 (14.3%) were men. There is a statistically significant difference in frequency between examined women and men (87.7% vs. 14.3%) [χ²(1)=67.857; p<0.001].

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of examinees</th>
<th>Relative frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women</td>
<td>114</td>
<td>85.7%</td>
</tr>
<tr>
<td>Men</td>
<td>19</td>
<td>14.3%</td>
</tr>
<tr>
<td>Total</td>
<td>133</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Table 1. Distribution of examinees by gender

Out of the total number of examinees (n=133), a quarter (24.8%) was between years 40 and 49; 28 (21.1%) were between years 30 and 39; 25 (18.8%) were between years 60 and 69; and 24 (18.0%) were between years 20 and 29. 13 (9.18%) examinees were less than 30 years old, while 10 (7.6%) examinees were ≥70 years of age. There is a statistically significant difference in frequency between examinees of different age groups: <30 years, 30-69 years and ≥70 years (9.8% vs. 82.6% vs. 7.6% statistically significant difference in frequency between examinees of different age groups: <30 years, 30-69 years and ≥70 years (9.8% vs. 82.6% vs. 7.6% successively) [χ²(2)=146.000; p<0.001].

Out of the total number of examinees (n=133), the biggest number, 55 (41.4%), had nodules between 2-3 cm; the size of nodules between 3-4 cm were present in 31 (23.3%) examinees; 27 (20.3%) examinees had nodules smaller than 2 cm; 12 (15.1%) examinees had nodules equal or larger than 4 cm; 82 (61.8%) examinees had nodules smaller than 4 cm.

Out of the total number of examinees (n=133), scintigraphy showed cold nodules amongst 123 (92.5%). It showed warm nodules amongst 7 (5.3%), while 3 (2.3%) examinees had inconclusive thyroid scintigraphy result.

Out of 14 examinees diagnosed with isoechoic nodules using ultrasound, all were diagnosed with thyroid follicular cell proliferations in mixed goiter with a cytological exam. Out of 73 examinees diagnosed with isoechoic nodules with cystic degeneration, 72 were diagnosed with thyroid follicular cell proliferations in mixed goiter using a cytological exam, while five examinees (6.3%) were diagnosed with a thyroid adenoma. Out of 19 examinees diagnosed with an anechoic formation with thickened wall, 14 (73.7%) were diagnosed with thyroid follicular cell proliferations in mixed goiter using a cytological exam, while five examinees (26.3%) were diagnosed with cystic changes in the thyroid. Out of 24 examinees diagnosed with hypoechoic nodules using ultrasound, 23 (95.8%) were diagnosed with a thyroid adenoma using a cytological exam, and one examinee (4.2%) was diagnosed with cancer.

4. DISCUSSION

Nodular thyroid diseases are common. They are present in around 4–7% of the general population. Out of the total number cancer is diagnosed in 5–20% cases (4).

The primary goal in examination of the thyroid is to determine whether it has benign or maligning nodules, in order for patients with cancer to get timely diagnosis and be adequately treated in early stages of the disease, reducing morbidity and mortality and avoiding unnecessary procedures, in-
Concluding unnecessary surgical treatments of benign changes (1, 3). It is known that ultrasound guided FNAB, due to high sensitivity and specificity, is the best individual diagnostic procedure for diagnosing malignant nodules. However, taking into consideration a large percentage of nodule occurrences, it is necessary to make a selection of nodules to be diagnosed through the aforementioned method. Consequently, the purpose of this article was to estimate and define the role of ultrasound in the process of patient selection for ultrasound guided FNAB, independently or jointly with other diagnostic modalities.

This study shows that there is a statistically significant difference in representation of nodular changes with different genders (85.7% women, and 14.3% men). This is fortified with literature review findings, which acknowledge frequency of thyroid nodule occurrence to be four times higher in women than in men. In this study the highest occurrence is with the age group 40-49 and there is a statistically significant difference in nodular occurrence in different age groups. According to the literature review, the average age for getting nodular changes on the thyroid is 51.

In this study, more than half of examinees (74 or 55.6%) nodules were localized in the right thyroid lobe, and in 50 examinees (37.6%) it was localized in the left. The study discovered nodules localized in the thyroid isthmus in six examinees (4.5%). There is a statistically significant difference in frequency of nodule localization between lower and higher thyroid lobe (63.7% vs. 36.3%). There is a statistically significant difference in average values of nodule size according to the cytological exam results. In this study, for cancers diagnosed using the cytological method the size of nodules was above 3 cm. However, the literature review showed different results. According to Rosario et al (2011), the size of nodules above 2 cm is a significant predictor of malignancy (5). Shico et al in their research results stated that the size of nodules did not influence malignant lesions (6). Kovacevic et al stated that in course of their study the average value of nodules with cancer was 28±12 mm, in correlation to benign lesion that were 8±10mm (7). Greek authors Polzos and Kita stated that cancer is more likely found amongst men and solitary nodules larger than 4.5mm (8).

During the study, scintigraphy showed that 92.5% of nodules were cold, while 5.3% were warm, while 2.3% were not clearly shown on scintigraphy. Analyzing the gathered results the study proved that there were no statistically significant connection between scintigraphy exam results and cytology exam results with cold nodules. However, a statistically significant connection has been found amongst warm nodules (all showed thyroid follicular cell proliferations in goiter). Frederico et al in their research stated that 62% of cold nodule cases were malignant and 76.9% benign. Warm cases were not showing presence of cancer. Furthermore, they proved no statistically significant difference (p=0.33) in scintigraphy exam results between benign and malignant nodules (9). Out of the total number of examinees, half, 73 (54.9%), were diagnosed with isoechoic nodules with cystic degenerations. Furthermore, 24 (18.0%) of examinees were diagnosed with hypoechoic nodules; 19 (14.3%) were diagnosed with anechoic formations with thickened wall; 14 (10.5%) examinees were diagnosed with isoechoic nodules; while in 3 (2.3%) examinees was noticed irregular border hypoechoic nodules with calcification. Out of 73 examinees diagnosed with isoechoic nodules with cystic degeneration using ultrasound, 72 were diagnosed with thyroid follicular cell proliferations in mixed goiter using a cytological exam, while one examinee (1.4%) was diagnosed with adenoma. Out of 24 examinees diagnosed with hypoechoic nodules using ultrasound, 23 (95.8%) were diagnosed with adenoma using cytological exam, while one examinee (4.2%) was diagnosed with cancer. Out of 14 examinees diagnosed with isoechoic nodules using ultrasound, all were diagnosed with thyroid follicular cell proliferations in mixed goiter. Out of 19 examinees diagnosed with anechoic formations with thickened wall, 14 (73.7%) examinees were diagnosed with thyroid follicular cell proliferations in mixed goiter using cytological exam, while 5 examinees (26.3%) were diagnosed with thyroid cystic changes.

Out of three examinees diagnosed with irregular border hypoechoic nodules with calcification using ultrasound, all three were diagnosed with cancer using cytological exam. The results of this research show the high statistically significant connection between ultrasound exam and cytological exam results. Aforementioned data are in line with the similar research results. Papiri et al (2002) showed that hypoechoic nodules showing additional ultrasound characteristic (irregular margins, micro calcification), in 87% have confirmed cancer using FNAB method (10). Lee et al in their cystic nodule research showed that eccentric position of solid part and presence of micro calcification were extensively associated with a malignant characteristic (11). Frederico FR Maia et al (2011) in their study stated that ultrasound was proven very effective against differentiation of malignant nodules on the basis of their ultrasound characteristics – irregular margins, hypoechoic, and presence of micro calcification in 82% of cases (9). British scientists Jones et al in their research got the following values for specific diagnostic modalities: FNAB sensitivity, specificity, positive predictive value for thyroid cancer, as follows: 92%, 85%, 41%, scintigraphy 82%, 34%, 11%, ultrasound 75%, 61%, 19% (12). Kovacevic et al in their research showed that ultrasound characteristics related to malignancy are hypoechoic, irregular margins, calcification, absence of hypoechoic margin. The difference in echoic of malignant and benign lesions was not statistically significant (7). Authors from the USA Iannuccilli et al stated that comparison of ultrasound characteristics of benign and malignant nodules resulted in defining of micro calcification as the only statistically significant indicator of malignancy (35.3% sensitivity, 94.4%, p>0.005) (13). Hong et al stated that ultrasound characteristics for cancer are considered positive when the presence of micro calcification, absence of halo sign and hypoechoic lesions were recognized. Sensitivity and specificity of ultrasound in their research is 81% and 70%, and FNAB 87.62% (14). Gul et al in Turkey stated that ultrasound char-
acteristic – hypoechoic, micro calcification and irregular margins were the most important in determining malignancy (15). Kim et al stated that sensitivity, specificity, positive predictive value, negative predictive value of ultrasound were as follows: 93%, 66%, 56%, 95.9% (16). Tramalloni et al stated the importance of ultrasound in estimation of outspread to regional lymph nodes on the basis of ultrasound characteristics of malignancy, being round lymph nodes, loss of normal echogenicity, loss of normal hilar vascularization, microcalcification, cystic component and hyperechogenicity of lymph nodes (17).

5. CONCLUSION

Nodular diseases of the thyroid are present amongst 2/3 of cases amongst women, and in around 1/3 cases amongst men. The highest nodule presence is in age group 40 and 49. It is mostly found in the lower pole of the right thyroid lobe. With the growth in size of nodules, the possibility of malignancy also increases. Amongst all examinees with isoechoic nodules as well as with isoechoic nodules with cystic degeneration the benign diagnosis has been confirmed; while diagnosed hypoechoic nodules mostly were adenoma, while only one examinee had cancer. All cytologically confirmed cancers were cold in scintigraphy, and through ultrasound were identified as hypoechoic with unclear nodular borders irregular margins with calcification or hypoechoic nodules. All examined warm nodules using scintigraphy were diagnosed as isoechoic nodules with areas of cystic degeneration and cytologically confirmed as benign lesions (cystic degenerative goiter). Ultrasound is a reliable diagnostic method for patient selection to have ultrasound guided cytological puncture. Scintigraphy proven warm nodules do not require cytological puncture. Scintigraphy, ultrasound and ultrasound guided cytological puncture are complementary methods for a reliable diagnosis of thyroid nodular disease.

REFERENCES