Original Article

Diagnostic value of nuclear medicine imaging and ultrasonography in subacute thyroiditis

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Abstract: Objective: To analyze and compare the diagnostic value of nuclear medicine and ultrasonography in subacute thyroiditis. Methods: Sixty patients with subacute thyroiditis admitted to our hospital were included into the observation group, and 60 healthy controls who underwent physical examination in our hospital during the same period were enrolled into the control group. Examinations of nuclear medicine and ultrasonography were performed in the neck, and the results were compared between the two groups. Results: There were significant differences in the width and thickness of thyroid bilateral lobes between the two groups (P<0.05), and for patients in the observation group, the detection rates of nuclear medicine technique and ultrasonography were 98.33% and 95.00%, respectively. Both methods showed no significant difference in the detection rate of subacute thyroiditis (P>0.05). Conclusion: Both nuclear medicine imaging and ultrasonography can provide clinical guidance for diagnosis and treatment of subacute thyroiditis.

Keywords: Nuclear medicine, ultrasonography, subacute thyroiditis, diagnosis

Introduction

Subacute thyroiditis is an inflammatory disease of thyroid tissue caused by viral infection, and mainly causes considerable pain in the thyroid gland and regions containing the lower jaw, neck, and ears, along with excessive enlargement of the thyroid gland [1]. It may progress to underactive thyroid, and even permanent hypothyroidism, causing severe adverse effects both physically and mentally [2]. Therefore, early diagnosis and treatment of subacute thyroiditis is of great clinical relevance [3]. Subacute thyroiditis is most likely to be misdiagnosed if the doctors merely focus on clinical manifestations, which necessitates other auxiliary examinations to improve the rate of precise diagnosis. At present, commonly used examination methods assisting the diagnosis of subacute thyroiditis are ultrasonography and nuclear medicine examination. Each method has different advantages [4]. In this study, diagnostic values of these two techniques in subacute thyroiditis were analyzed.

Materials and methods

General data

A total of 60 subjects with subacute thyroiditis diagnosed by clinical pathology from June 2019 to June 2020 in our hospital were included into the observation group. During the same period, another 60 healthy people who underwent physical examination in our hospital and had normal thyroid hormone levels were included into the control group. This study was reviewed and approved by the hospital’s Ethics Committee.

Inclusion and exclusion criteria

Inclusion criteria for the observation group: (1) The diagnosis refers to relevant criteria in the Guidelines for diagnosis and treatment of thyroid diseases in China (2008): subjects who presented obvious symptoms of upper respiratory tract infection and transient hyperthyroidism at admission, had radiating pain in the thy-
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roid region, were accompanied by asymmetric hard enlargement and obvious tenderness, were confirmed by pathological and laboratory tests, and had their initial onset [5]. (2) Subjects had typical clinical manifestations of subacute thyroid; (3) Subjects aged between 20-60 years; (4) Subjects had history of upper respiratory tract infection within the past two weeks; (5) Subjects signed informed consent for the study.

Inclusion criteria for the control group: (1) Subjects whose thyroid function were normal on physical examination, radiological imaging and laboratory tests; (2) Subjects aged between 20-60 years; (3) Subjects signed informed consent for the study.

Exclusion criteria: (1) Subjects had incomplete clinical data; (2) Subjects had various mental diseases or neurological dysfunction, accompanied by severe systemic diseases; (3) Subjects had thyroid malignancy or other suspected thyroid diseases; (4) Subjects were during pregnancy and lactation or those expected pregnancy in the near future; (5) Subjects had allergies to the drugs used in the study.

Methods

After admission, all included subjects received ultrasonography followed by nuclear medicine examination. Philips iU-Elite color Doppler ultrasonic diagnostic apparatus was used for multi-sectional scanning of the thyroid region in the neck at a frequency of 7.5 to 10.0 MHz. The sonogram was observed and recorded for the thickness and width of the left and right lobes of the thyroid gland. Local echo characteristics of blood flow, profile of the lesions and its relationship with surrounding tissues were analyzed. Then diagnosis of thyroiditis disease was made according to the level of relevant indicators.

During nuclear medicine examination, 5 mL venous blood was drawn from the patient under fasting state, let stand for coagulation and then centrifuged at a low speed of 3000 r/min for 10 min. Using an automatic chemiluminescence immunoassay analyzer (Roche Diagnostics cobas® 8000 modular analyzer series-cobas e801 module), the samples were determined and recorded for serum thyroid hormone levels including thyroid-stimulating hormone (TSH), free triiodothyronine (FT₃) and free thyroxine (FT₄). After oral administration of Na¹²¹I (Chengdu Gaotong Isotope Co., Ltd., State Food and Drug Administration No. H10983119; Specification: 925MBq), the iodine uptake rate of the subjects was detected by JXY thyroid analyzer (Hefei Zhongcheng Electromechanical Technology Development Co., Ltd., China). The subjects were then injected intravenously with ⁹⁹ᵐ⁰⁰{Tc-Pertechnetate (⁹⁹ᵐ⁰⁰TcO₄⁻, Shanghai Atom Kexing Pharmaceutical Co., Ltd., State Food and Drug Administration No. 19994149; Unit: vial) in supine position. Subsequently, the thyroid region was scanned for static images using a Siemens Symbia T2 SPECT scanner. Then thyroid function of the subjects was comprehensively evaluated based on the results of various indicators.

Outcome measures

General data and levels of FT₃, FT₄, TSH, radioactive iodine uptake (RAIU) and other indicators were compared between the two groups. Based on pathological results, the detection rate of subacute thyroiditis by nuclear medicine techniques and ultrasonography and the misdiagnosis rate of healthy controls were observed. Detection rate = (number of positive-results patients/total number of patients) *100%. Misdiagnosis rate = (number of misdiagnosed subjects/total number of subjects) *100%. The diagnostic criteria for subacute thyroiditis on ultrasonography were: image of scanning acoustic tomography (SAT) showed marked patchy hypoechoic lesions with irregular margins, and the blood flow signal was abundant within the lesion and surrounding area but was scarce in the thyroid gland. The diagnostic criteria for subacute thyroiditis on nuclear medicine exams were: a significant elevation in T₃ and T₄ levels, and a marked decrease in TSH levels.

Statistical processing

All research data were processed by SPSS 23.0 statistical software. The general data, pathological data and various test results of the patients were described as mean ± standard deviation (X ± sd), or percentage. The comparison of various enumeration and measurement data was performed by independent t test and chi-square test, respectively. P<0.05 was considered to indicate a significant difference.
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Results

General data

The general data exhibited no significant difference in the included subjects between the two groups (P>0.05), which are comparable. See Table 1.

Clinical data

In the observation group, there were 88 lesions in 60 cases, of which bilateral lobes accounted for the highest proportion (46.67%). See Table 2 and Figure 1.

Detection rates

Both methods, ultrasonography and nuclear medicine, showed no significant difference in the rate of detecting subacute thyroiditis (P>0.05). See Table 5.

Discussion

At present, the pathogenesis of subacute thyroiditis is heterogeneous in clinical practice. Patients usually present with significant pain and swelling in the thyroid gland within a few days.
days after onset, and are often accompanied by general malaise, loss of appetite, muscle pain, and disease attack [6, 7]. The disease reaches a peak at around 3-4 days after onset, typically continues for more than 1 week, and then fluctuates within the next 3 to 6 weeks. About half of the patients will develop symptoms of thyrotoxicosis within a few weeks, but will gradually recover as thyroid function decreases [8]. Subacute thyroiditis is characterized by various clinical symptoms, which increases the possibility of missed diagnosis and misdiagnosis [9].

At present, subacute thyroiditis is mainly diagnosed by laboratory examination, radiological imaging and cytologic test, of which radiological imaging is the most commonly used method. The widely used imaging examinations in clinical practice are nuclear medicine and ultrasonography. Presently, nuclear medicine tests for thyroiditis are designed mainly based on the mechanism that thyroid tissue can absorb, concentrate Iodine-131 (131I), and is able to uptake $^{99m}$Tc$^m$-pertechnetate [10, 11]. Iodine or $^{99m}$Tc$^m$ will retain in the tissue for a certain period of time after entering thyroid gland, thus the doctor can effectively acquire the status of this region by observing its local distribution. However, in actual operation, nuclear medicine imaging will be affected by areas adjacent to severe lesions. When the inflammation is severe and the whole thyroid gland is involved, the image will become blur, or even do not display at all. Even with imaging, the contour of the lesion observed is indistinct, causing difficulties in identification [12]. In this study, there was 1 misdiagnosed case resulting from unclear imaging in the observation group when performing nuclear medicine examination, which was basically consistent with relevant report [13]. After the patients recovered significantly from effective treatment, the image will become clear. However, if the inflammation only affects local thyroid gland, the imaging will present diffused and defected masses, the so called “cold nodule” in clinical practice, which will gradually disappear after effective treatment [14, 15]. The results of this study showed that the levels of TSH, FT$_3$, FT$_4$ and RAIU in patients with subacute thyroiditis were significantly different from those in healthy controls, with the former showing increased levels of FT$_3$ and FT$_4$ and decreased levels of TSH and RAIU.

Numerous studies have pointed out that color Doppler ultrasound in thyroid glands is highly valuable in the diagnosis of subacute thyroiditis for patients without typical clinical manifestations [16]. Ultrasonographic scanning revealed irregularly shaped and rounded hypoechoic areas with blurred margin, which is also a typical feature of subacute thyroiditis [17]. At color Doppler ultrasound, no blood flow signal is observed at the lesion site if the patient is in the acute phase, while the signal intensity is normal or slightly increased in adjacent tissues [18, 19]. On the other hand, however, it presents with enhanced microvascular signal during disease recovery. In addition, the lesion is mainly confined to a specific area of the thyroid parenchyma in most patients, which manifests as diffused or localized hypoechoic area of attenuation decreasing from outside to inside. The attenuating hypoechoic zones are basically patchy and irregular, with blurred borders with neighboring tissues, which is consistent with the results of previous study [20]. If the hypoechoic area is pressurized during scanning, it will produce obvious tenderness in the patients, and manifest high specificity. It can be seen that color Doppler ultrasound of the thyroid gland is highly applicable in early diagnosis of subacute thyroiditis.

The results of this study suggested that the detection rate of nuclear medicine imaging and ultrasonography for subacute thyroiditis were 98.33% and 95.00%, respectively, leaving no significant difference between the two techniques but the former showing slight superiority. It can be seen that both techniques have a
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Table 3. Comparison of ultrasonic examination results (±sd, cm)

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Observation group</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left lobe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>1.27±0.23</td>
<td>2.46±0.43</td>
<td>13.945</td>
<td>0.001</td>
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<tr>
<td>Width</td>
<td>1.17±0.27</td>
<td>2.41±0.45</td>
<td>14.045</td>
<td>0.001</td>
</tr>
<tr>
<td>Right lobe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>1.23±0.31</td>
<td>2.47±0.41</td>
<td>13.855</td>
<td>0.001</td>
</tr>
<tr>
<td>Width</td>
<td>1.18±0.26</td>
<td>2.40±0.44</td>
<td>14.058</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 4. Analysis of thyroid function and iodine uptake rate in the two groups (±sd)

<table>
<thead>
<tr>
<th></th>
<th>Control group</th>
<th>Observation group</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSH (mIU/L)</td>
<td>2.00±0.25</td>
<td>0.21±0.06</td>
<td>5.153</td>
<td>0.017</td>
</tr>
<tr>
<td>FT₃ (pmol/L)</td>
<td>6.01±1.57</td>
<td>26.08±1.16</td>
<td>6.074</td>
<td>0.013</td>
</tr>
<tr>
<td>FT₄ (pmol/L)</td>
<td>14.06±3.99</td>
<td>47.53±3.64</td>
<td>6.564</td>
<td>0.010</td>
</tr>
<tr>
<td>RAIU (%)</td>
<td>38.24±4.11</td>
<td>9.26±1.97</td>
<td>7.048</td>
<td>0.006</td>
</tr>
</tbody>
</table>

Note: TSH: thyroid-stimulating hormone; FT₃: free triiodothyronine; FT₄: free thyroxine; RAIU: radioactive iodine uptake.

Table 5. Comparison of ultrasonic and nuclear medicine imaging results (%)

<table>
<thead>
<tr>
<th></th>
<th>Ultrasonography</th>
<th>Nuclear medicine</th>
<th>χ²</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results of the observation group (n=60)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confirmed diagnosis</td>
<td>57</td>
<td>59</td>
<td>1.105</td>
<td>0.411</td>
</tr>
<tr>
<td>Misdiagnosis</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missed diagnosis</td>
<td>2</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Detection rate</td>
<td>95.00%</td>
<td>98.33%</td>
<td>1.034</td>
<td>0.309</td>
</tr>
<tr>
<td>Misdiagnosis rate of the control group</td>
<td>5.00%</td>
<td>3.33%</td>
<td>0.867</td>
<td>0.455</td>
</tr>
</tbody>
</table>

high application value in the diagnosis of subacute thyroiditis. Ultrasonography is easier to operate, and has been popularized in hospitals at all levels in China compared with nuclear medicine technique. As one of the routine clinical examinations, it possesses certain advantages over nuclear medicine imaging in clinical application. In this study, 1 patient who underwent ultrasonography was misdiagnosed, mainly owing to the fact that ultrasonography reveals no or poor images of hypoechoic lesions with internal echoes at the early stage of the disease, and that the patient’s clinical symptoms are subtle.

Ultrasonography is of high value in the initial diagnosis of subacute thyroiditis for two reasons. One is that during the examination, applying pressure on scanning will cause tenderness in the hypoechoic area of patients. Another relates to direct visualization of morphological changes in the lesion [21]. Besides, ultrasonography costs relatively lower than nuclear medicine imaging, and is well tolerated by patients as a noninvasive procedure. Thus, the patients are more likely to choose ultrasonography.

In the diagnosis of subacute thyroiditis, either ultrasonography or nuclear medicine technique, each has their own features and advantages, and can promptly provide doctors with relevant diagnostic guidance. However, ultrasonic equipment is more popularized. Even some local hospitals are able to undertake relevant tests, which enables wider application in personalized examinations for clinical diagnosis of the patients.

Disclosure of conflict of interest

None.

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