Contrast-enhanced ultrasound of solitary thyroid nodules - qualitative and quantitative evaluation: initial results

Poster No.: C-2436  
Congress: ECR 2015  
Type: Scientific Exhibit  
Authors: H. Petrasova, J. Foukal, K. Stary; Brno/CZ  
Keywords: Head and neck, Thyroid / Parathyroids, Ultrasound, Contrast agent-intravenous, Diagnostic procedure  
DOI: 10.1594/ecr2015/C-2436

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Aims and objectives

Thyroid nodules are very common. The prevalence of thyroid nodules in autopsies ranges between 8.2 and 64.6 % [1, 2]. However, less than 5.0 - 6.5 % of incidentally discovered thyroid nodules are malignant [3].

Ultrasonography (US) is the most sensitive, non-invasive, widely available imaging modality for examination of the thyroid gland. However thyroid nodules continue to be difficult to evaluate. This is why there has been published large number of guidelines and recommendations by medical societies for the selection of thyroid nodules for fine needle aspiration biopsy, using size criteria or various US features [4-7]. Nowadays fine needle aspiration cytology (FNAC) is the gold standard for thyroid nodules' characterization.

Microbubble contrast agents for ultrasound have gained increasing interest in recent years, and contrast-enhanced US (CEUS) is a rapidly evolving method with extending applications. CEUS as a minimally invasive method allows real-time scanning and assessment of macrovasculature and microvasculature in different tissues [8].

Purpose of this study was to evaluate whether CEUS of solitary thyroid nodules is applicable technique and to determine the potential of this method in the assessment of biological nature of these lesions.

Methods and materials

This prospective study has already covered 19 adult patients with solitary solid or solid-cystic nodules in one lobe/isthmus, 21 lesions in total (17 benign and 4 malignant), diameter 6-70mm. Patients with purely cystic nodule and patients who did not undergo fine needle aspiration cytology (FNAC) or surgery were not enrolled.

Informed consent was obtained from all participants; all examinations were done by the same single experienced examiner.

The examination was performed on Philips iU22 ultrasound machine, using high frequency linear transducer (5-12MHz), in side by side setting with contrast mode
displayed alongside gray-scale US in real-time, with low mechanical index (0.07). 2.4 ml of sulfur hexafluoride contrast agent was applied as intravenous bolus, followed by 10 ml saline solution flush.

Data were recorded in 2 minutes continual video loops and processed in Qlab software. Qualitative evaluation of nodal perfusion consisted of four categories - homogeneous, inhomogeneous, ringed and absent type. Quantitative analysis was based on plotted time-intensity curves within selected ROIs (regions-of-interest). The ROIs of similar size were used, one placed in nodule, second in adjacent parenchyma of normal appearance. Two quantitative parameters, time to peak (TTP) and peak intensity (PI), were compared between nodule and normal parenchyma for each lesion.

**Fig. 1**: A 41 year old female patient with isoechoic nodule in right lobe, diameter 9x10x12mm. In CEUS: qualitative assessment revealed homogeneous perfusion; quantitative analysis- peak intensity of the thyroid nodule (orange ROI) was higher than in surrounding tissue (blue ROI), 6.3dB. Peak intensity in adjacent parenchyma
of normal appearance 4.9 dB. Time to peak equal for both ROIs, 19 s. FNAC result-Bethesda II, benign follicular nodule.

**References:** Department of Radiology, University Hospital Brno and Medical Faculty, Masaryk University Brno - Brno/CZ

**Fig. 2:** A 33 year old male patient with hypoechoic nodule in right lobe, diameter 28x18x44 mm. In CEUS: qualitative assessment revealed inhomogeneous perfusion with hypoperfused area; quantitative analysis- peak intensity of the thyroid nodule (orange ROI) was lower than in surrounding tissue (blue ROI), 6 dB. Peak intensity in entire lesion 7.5 dB (not shown). Peak intensity in adjacent parenchyma of normal appearance 9.2 dB. Time to peak equal for both ROIs, 23 s. Post surgery histopathology result- papillary thyroid carcinoma.

**References:** Department of Radiology, University Hospital Brno and Medical Faculty, Masaryk University Brno - Brno/CZ

Pathological diagnosis was used as a gold standard. The biological nature of all lesions was proved by FNAC; in 6 lesions also histopathological postoperative diagnosis was
established, 1 case was autopsy-proven. The period between the CEUS and FNAC was 1-5 days and time period between ultrasound and surgery was 1-30 days.

Results

Nodules and pathology:

All samples of 21 nodules included in our study were reported by single experienced pathologist using the recommended Bethesda system for reporting thyroid cytopathology. The samples in this system are classified within six different categories, according to their cytological features.

The pathological diagnoses of all our lesions were as follows:

17 benign lesions

- 14 nodules Bethesda II (benign)

- 2 nodules initially Bethesda III (Atypia of Undetermined Significance), after reaspiration both Bethesda II (benign)

- 1 nodule initially Bethesda V (Suspicious for Malignancy), post surgery histology benign follicular nodule

4 malignant lesions

- 3 papillary thyroid carcinomas (post surgery histology)

- 1 diffuse large B-cell lymphoma (autopsy-proven)

Qualitative assessment of perfusion

<table>
<thead>
<tr>
<th>Type of perfusion</th>
<th>Benign</th>
<th>Malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homogeneous</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Inhomogeneous</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Ringed</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
Absent 1

Quantitative assessment of perfusion

<table>
<thead>
<tr>
<th>Peak intensity vs. healthy tissue</th>
<th>Benign</th>
<th>Malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Equal</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Lower</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time to peak vs. healthy tissue</th>
<th>Benign</th>
<th>Malignant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shorter</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Equal</td>
<td>12</td>
<td>3</td>
</tr>
<tr>
<td>Longer</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

* In one malignant case (absent perfusion) no peak was created.

Conclusion

Discussion:

At present, a role of CEUS for studying thyroid lesions is controversial. In 2006 Bartolotta et al. [9] published results of his study, that overlapping findings seem to limit the potential of this technique in the characterization of thyroid nodules. This study has enrolled only 18 patients.

More recent study, covering qualitative analysis of 104 nodules, evaluated the enhancement appearance of thyroid nodules [10]. The paper demonstrated that ring enhancement correlated highly with a benign diagnosis (accuracy 88.5%). Heterogeneous enhancement correlated highly with a malignant diagnosis (accuracy 90.4%) [10]. In our study, so far, inhomogeneous perfusion was present in 6/17 benign nodules, that does not correlate with this study.
Even more recently, Nemec et al. [11] published their experience on quantitative analysis of CEUS for differentiation of benign and malignant thyroid nodules [11]. Between benign and malignant nodules, no statistically significant difference (P>0.05) was found in the absolute peak enhancement and the time-to-peak [11].

Results:

In summary, our results demonstrate that CEUS of focal thyroid lesions is a feasible method, applicable to broaden the spectrum of lesion characteristics.

Quantitative analysis is an objective method for evaluation of thyroid nodules. Qualitative and quantitative perfusion differences can be observed in different types of lesions. Our results so far are based only on a small group of patients and their practical benefit must be verified in a larger number of patients.

This publication was created under a specific research project, number MUNI/A/1001/2013, approved by the Grant Agency of the Masaryk University.

Personal information

hana.petrasova@fnbrno.cz

References


