

# Phantom Nodules Detected by Ultrasound Examination of the Neck: The Possibility of Ectopic Cervical Thymic Tissue in Adults

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## ABSTRACT

**Purpose** The aim of this study was to investigate the ultrasound characteristics and clinical significance of slightly hyperechoic lesions, referred to as phantom nodules, in the perithyroidal area in patients.

**Materials and Methods** A total of 128 patients who underwent thyroidectomy with central neck lymph node dissection at Kuma Hospital in Hyogo, Japan were included in the study. We detected 16 phantom nodules during preoperative ultrasound examinations, defined as slightly hyperechoic masses located in the perithyroidal areas, in 13 of these 128 patients (10.2%; mean age: 55.6 years, range: 36–75 years).

**Results** All phantom nodules were located in the caudal region of the thyroid gland, and the mean maximum dimension was 7.2 mm. 12 of the 16 nodules were round or oval, while the remaining 4 were fusiform and molded by the surrounding tissue. All nodules were well-defined, solid, homogeneous, hyperechoic masses. No speckled echo pattern, internal linear echo, or vascular flow signal was observed. All 4 nodules subjected to histological examination were composed of ectopic thymic tissue. In 2 of these 4, the parenchyma was severely involuted and almost entirely replaced by adipose tissue.

**Conclusion** To the best of our knowledge, this is the first report wherein some of the detected hyperechoic perithyroidal masses were composed of ectopic thymic tissue, and some were primarily composed of adipose tissue that completely replaced involuted ectopic thymic tissue. The results of the study suggest that these so-called phantom nodules are clinically insignificant and do not require fine needle aspiration cytology or further investigation.

## Introduction

Ultrasonography (US) is frequently used in a variety of clinical settings. With recent advances in technology, it has become possible to detect smaller and more obscure lesions using US. During thyroid US, clinicians may incidentally encounter small lesions in perithyroidal areas, such as aberrant thyroid tissue, parathyroid lesions, enlarged lymph nodes, certain types of cysts, thymic tissue, lipoma, nerve sheath tumor, and vascular malformation [1–6]. All of these lesions are generally hypoechoic or isoechoic [3–5]. However, we have occasionally encountered slightly hyperechoic lesions in the

caudal area of the thyroid gland, although we have been unable to determine what they are, even via histological examination after thyroidectomy with central neck lymph node dissection. Accordingly, we refer to these lesions as phantom nodules. To the best of our knowledge, no study has investigated these phantom nodules. In the present study, we prospectively analyzed these phantom nodules detected via US in perithyroidal areas in adult patients and demonstrated that some of them consisted of ectopic thymic tissue (ETT). The aim of this study was to investigate the US characteristics and clinical significance of these slightly hyperechoic lesions.

## Materials and Methods

A total of 128 patients (106 female and 22 male, age range: 14–80 years) who underwent thyroidectomy with central neck lymph node dissection at Kuma Hospital in Hyogo, Japan between January 2018 and March 2018 were included in the study. The 128 patients that underwent US examination in the study included 3 patients aged < 18 years, and 125 patients aged  $\geq$  18 years. Phantom nodules were defined as slightly hyperechoic masses located in perithyroidal areas. US was performed using the APLIO 500 TUS-A500 device (Toshiba Medical Systems Co., Ltd., Otawara, Japan) with a PLT-805AT probe or a PLT-1005BT probe (both manufactured by Toshiba Medical Systems Co., Ltd.). During preoperative US examination, we detected 16 phantom nodules in 13/128 patients (10.2%), and we analyzed the US characteristics of these 16 nodules. 5 of the 16 nodules were located outside the resected areas. 7 of the remaining 11 could not be confirmed, although the areas in which the nodules were present were resected. We subjected 4 resected nodules to histological analysis.

## Results

The characteristics of the 16 nodules detected in 13 patients are summarized in ► **Table 1**. The patients included 10 women and 3 men, with a mean age of 55.6 years (range: 36–75 years). Relative to the entire study cohort, these patients did not demonstrate sex or age predilections. 10 patients exhibited 1 nodule, and 3 patients exhibited 2. All of the nodules were located in the caudal region of the thyroid, in the right or left paratracheal region. There were no phantom nodules in the cranial region of the thyroid or in the lateral neck compartments. The mean maximum dimension was 7.2 mm (range: 5–13 mm). Of the 16 nodules, 12 were round or oval (► **Fig. 1**) and 4 were fusiform and molded by the surrounding tissue (► **Fig. 2**). Two nodules were of a taller-than-wide shape, with a ratio of the anteroposterior diameter to the transverse diameter of  $> 1$  when measurements were made in the transverse plane. All nodules were well-defined, solid, homogeneous, hyperechoic lesions. No speckled echo pattern, internal linear echo, or vascular flow signal was observed.

After surgery, 4 nodules were subjected to histological examination. The remaining 12 (5 outside the resected areas and 7 within the resected areas) could not be evaluated. All 4 nodules that were histologically examined were determined to consist of ETT (► **Fig. 3**). In 2 of these 4, the parenchyma was severely involuted and almost entirely replaced by adipose tissue (► **Fig. 4**). The US characteristics of the phantom nodules confirmed to be ETT did not differ from those of the other nodules.

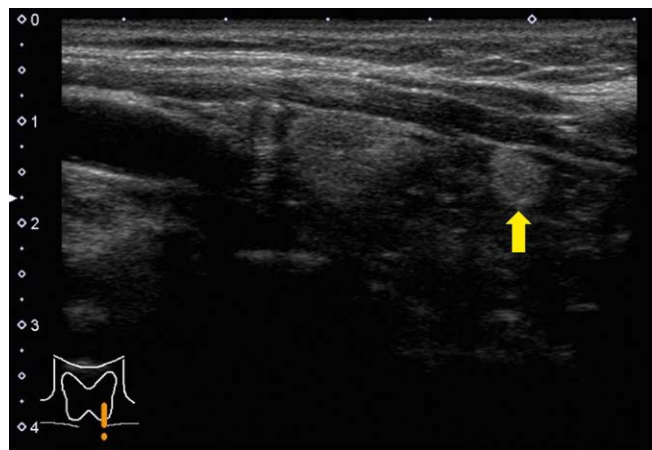
## Discussion

In the present study, we analyzed the US characteristics and clinical significance of slightly hyperechoic lesions, referred to as phantom nodules, located in perithyroidal areas. The prevalence of the nodules was 10.2%, and there was no sex predilection. The nodules were limited to the caudal region of the thyroid. On US, the nodules were characteristically well-defined, solid, homogeneous, hyperechoic, and hypovascular. There were no findings that indicated malignancy. 5 of the 16 detected nodules were located outside

► **Table 1** Characteristics of the 16 phantom nodules detected by ultrasonography in the perithyroidal areas of 13 patients.

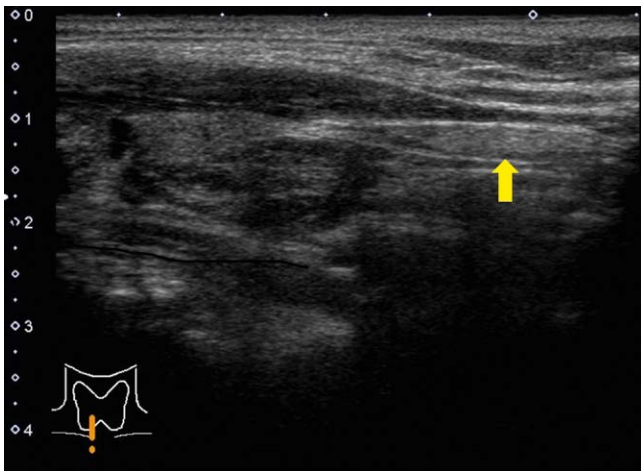
Mean age in years (range)	55.6 (36–75)
Sex (F/M)	10/3
Number (one/two)	10/3
Location in paratrachea (right/left)	6/10
Mean size <sup>#</sup> in mm (range)	7.2 (5–13)
Ultrasound findings	
Shape	
Round or oval	12
Fusiform (angulated or molding)	4
Taller-than-wide <sup>##</sup>	2
Margin	
Well-defined/ill-defined	16/0
Hypoechoic/hyperechoic rim	0/0
Internal structure	
Solid/cystic/focal cystic	16/0/0
Hyperechoic/isoechoic/hypoechoic	16/0/0
Homogeneous/heterogeneous	16/0
Speckled echo pattern	0
Internal linear echoes	0
Vascular flow signal	
No/mild/moderate/severe	16/0/0/0
Histology	
Ectopic thymic tissue	4
Undetected	12

<sup>#</sup>Greatest dimension; <sup>##</sup>Ratio of the anteroposterior diameter to the transverse diameter was  $> 1$  when measurements were performed in the transverse plane.

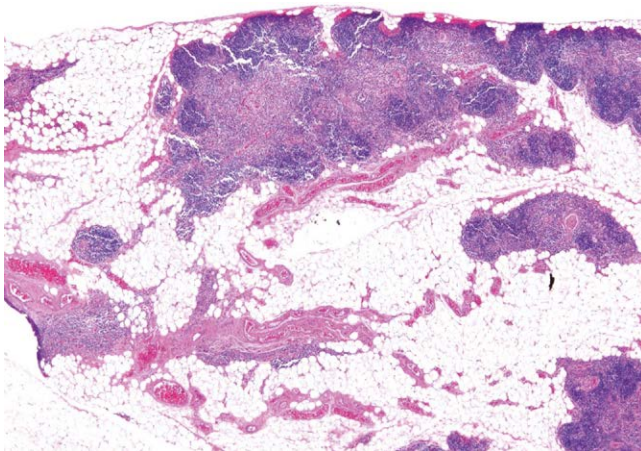


► **Fig. 1** Ultrasound examination of a phantom hyperechoic nodule in the caudal region of the thyroid gland (arrow). It is round, slightly hyperechoic, and homogeneous (B-mode, longitudinal view).

the resected areas, and 7 of the remaining 11 could not be evaluated, although the areas in which they were present were resected. Thus, the nodules were typically “phantom.” All 4 nodules that



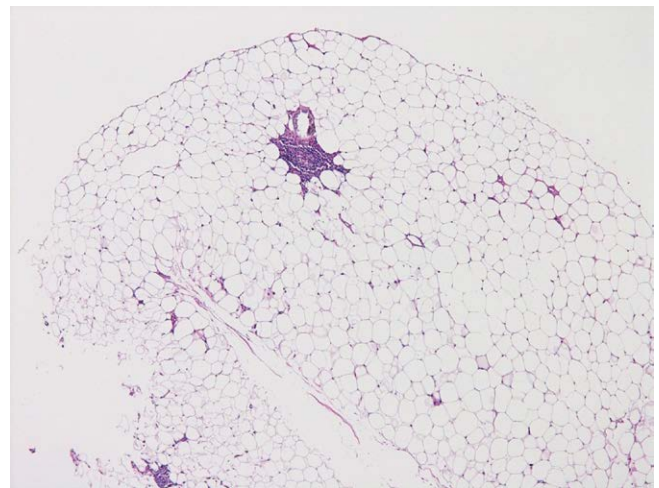
► **Fig. 2** Ultrasound examination of a fusiform phantom hyperechoic nodule in the caudal region of the thyroid gland (arrow). It is molded by the surrounding tissue (B-mode, longitudinal view).



► **Fig. 3** Histological examination of a mounted section of a phantom hyperechoic nodule resected from the thyroid gland (hematoxylin-eosin staining, x4.) The tissue was confirmed to be ectopic thymic tissue composed of lymphoid cells, epithelial nests, and adipose tissue.

were histologically examined were composed of ETT. These results suggest that phantom nodules in perithyroidal areas are clinically insignificant and that further investigations such as fine needle aspiration cytology are not necessary.

When the thymus has not fully descended into the mediastinum, thymic tissue can be found in the neck [7–9]. Several authors have described the US characteristics of ETT [7–17]. According to their reports, the lesions are well-defined, angular, solid nodules with multiple inner echogenic foci and linear structures. The masses may be surrounded by hypoechoic rims. However, US examination of the four phantom nodules found to be ETT in the present study revealed them to be slightly hyperechoic, round, solid nodules without multiple inner echogenic foci or linear structures. Moreover, the aforementioned previous studies investigating ETT using US included children or infants, whereas the patients in which phantom nodules were detected in the present study were all adults. Physiologically, thymic tissue exhibits age-related involution



► **Fig. 4** Histological examination of a mounted section of a phantom hyperechoic nodule resected from the thyroid gland (hematoxylin-eosin staining, x10.) The tissue was confirmed to be ectopic thymic tissue. The parenchyma is severely involuted and almost entirely replaced by adipose tissue.

[18–20]. The reduction in thymic compartments leads to a reduction in size and replacement by adipose tissue [18–20]. Therefore, it can be assumed that the US characteristics of ETT change as a patient ages, and those observed in the present study do not represent thymic tissue observed in children or infants, rather they represent involuted thymic tissue in adults. Unfortunately, we could not perform histological analysis of 12 of the 16 detected phantom nodules. These could have been composed of adipose tissue that had replaced completely involuted ETT, given that their US characteristics and locations were similar to those of the nodules that were histologically confirmed to be ETT. Interestingly, the nodules confirmed to be ETT were limited to the caudal region of the thyroid. This probably explains why intrathyroidal thymic carcinoma, which is believed to originate from ETT, involves the lower pole of the thyroid [21, 22].

Differential diagnoses for small nodules located in the perithyroidal region include an enlarged parathyroid gland, lymph node, accessory thyroid nodule or ectopic thyroid tissue, carotid body paraganglioma, nerve sheath tumor, venous vascular malformation, and lipoma. Enlarged parathyroid glands due to adenoma, hyperplasia, or cysts are hypoechoic lesions [4, 23], as are lymph nodes [24–26]. The presence of an echogenic hilus and hilar vascularity on Doppler imaging assists in the identification of lymph nodes [26]. The echogenicity of accessory thyroid nodules or ectopic thyroid tissues, which exhibit vascular flow, is the same as that of the thyroid [27]. Carotid body paragangliomas are well-defined, solid, hypoechoic masses at a characteristic location, straddling the carotid bifurcation and splaying the internal and external carotid arteries [28]. Nerve sheath tumors are heterogeneously hypoechoic and often demonstrate posterior acoustic enhancement [5]. They are fusiform or ovoid with tapering ends, and continuity with adjacent nerves is a diagnostic feature [28]. Venous vascular malformations appear as soft, compressible, heterogeneous, hypoechoic masses [29]. They may contain multiple serpiginous sinusoidal spaces with vascular flow and phleboliths [30]. Lipomas are well-circumscribed, compressible, elliptical masses [31] that are usually

slightly hyperechoic relative to the muscle echogenicity (75 %), though they can appear isoechoic or hypoechoic (25 %) [31]. No significant vascularity is present, and their characteristics are similar to those of ETT. However, the presence of multiple thin echogenic lines parallel to the transducer, resulting in a “feathered” or “striped” appearance, is characteristic [28]. Thus, we believe that it is not difficult to distinguish phantom nodules from the other small nodules located in the perithyroidal region.

Adenolipoma of the thyroid is a nodule composed of mature adipose tissue surrounded by a fibrous capsule, and it is associated with proliferation of thyroid follicles without cytologic atypia or capsular or vascular invasion. With the exception of location, its US characteristics including an ovoid shape, homogeneity, and hyperechogenicity [32] are similar to those of phantom nodules.

It has recently been reported that semiquantitative elastosonography is a valuable tool for the characterization of thyroid nodules, and it is reportedly more sensitive than contrast-enhanced US [33–35]. However, we did not perform semiquantitative elastosonography in the current study because this new technique is not yet commonly used in Japan. Thus, we did not have access to the required equipment. We expect that such techniques will yield more accurate characterization of the US features of phantom nodules in the future.

In conclusion, to the best of our knowledge, this is the first report describing the US characteristics of the hyperechoic lesions that are occasionally observed in perithyroidal areas, referred to as phantom nodules. The incidence of these phantom nodules was 10.2 %, and all were detected in adults. Some were histologically confirmed to be ETT, while the remaining may have been completely involuted ETT. The results of the study suggest that these phantom nodules are clinically insignificant and do not require fine needle aspiration cytology or any other further investigation. Moreover, it is not difficult to distinguish these phantom nodules from other small nodules located in the caudal region of the thyroid, with the exception of lipoma. Notably, the US features of ETT in children and adults may differ.

## Conflict of Interest

The authors declare no conflict of interest.

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