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● *Original Contribution*

PRE-OPERATIVE DETECTION OF THYROID PYRAMIDAL LOBES BY ULTRASOUND AND COMPUTED TOMOGRAPHY

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Abstract—This study aimed to assess the diagnostic accuracy of pre-operative ultrasound (US) and computed tomography (CT) for detecting thyroid pyramidal lobe (TPL). A single radiologist prospectively performed thyroid US and retrospectively reviewed neck CT to detect TPLs in 135 consecutive patients scheduled for thyroid surgery. The location, size and superior extent of each TPL and its separation or continuity with the main thyroid gland were assessed by thyroid US, neck CT and surgery. The prevalence of TPLs as diagnosed by thyroid US, neck CT and surgery was 58.5% (79/135), 56.3% (76/135) and 60% (81/135), respectively. We compared US and CT detection of TPLs with surgical data to determine their sensitivity (85.2% and 91.4%), specificity (81.5% and 94.4%), positive (87.3% and 96.1%) and negative (78.6% and 87.9%) predictive values and accuracy (83.7% and 92.6%). For detecting TPLs, both neck CT and thyroid US have good diagnostic value, although neck CT is more accurate than thyroid US. (E-mail: dwultra@lycos.co.kr) © **2014 World Federation for Ultrasound in Medicine & Biology.**

Key Words: **Thyroid, Variation, Pyramidal lobe, Ultrasound, Computed tomography.**

INTRODUCTION

The thyroid pyramidal lobe (TPL) is an accessory lobe of the thyroid gland that is reported at various frequencies ranging from 15%–75% in cadaver and computed tomography (CT) studies (Marshall 1895; Braun et al. 2007; Joshi et al. 2010; Kim et al. 2013; Ozgur et al. 2011; Park et al. 2012; Prakash et al. 2012; Sultana et al. 2008). The TPL can cause problems in thyroidectomy, because surgeons have to ensure that they do not leave residual thyroid tissue during total thyroidectomy (Braun et al. 2007). Remnant thyroid tissue in a patient with papillary thyroid carcinoma can influence the outcome of radioisotope ablation because the radioisotope preferentially targets remnant normal thyroid tissue over malignant thyroid cells (Braun et al. 2007; Pacini et al. 2005). Further, TPL can be a primary or recurrence site of thyroid cancer (Ogawa et al. 2009; Lee et al. 2011). Thus, pre-operative imaging-based evaluation of TPL is necessary in thyroid cancer patients.

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Two recent studies have shown that neck CT is a useful tool for determining the prevalence and size of TPLs (Kim et al. 2013; Park et al. 2012). However, CT has not been widely used in patients with thyroid lesions because of the inherent radiation hazard and limited information; meanwhile, US has been established as the first-choice method for diagnosis of thyroid lesions. However, to the best of our knowledge, no studies comparing thyroid ultrasound (US) and neck CT or using thyroid US for the detection of TPLs have been published. Therefore, the purpose of this study was to assess the detection of TPLs by pre-operative US and CT and to compare detection rates by using subsequent surgical findings as the reference standards in patients undergoing thyroidectomy.

MATERIALS AND METHODS

Patients

From January 2013 to April 2013, consecutive patients who were scheduled for thyroid surgery underwent pre-operative neck CT within 1 wk before thyroid surgery and pre-operative thyroid US on the morning before surgery at Haeundae Paik Hospital. Exclusion criteria for this study were endoscopic or robotic thyroid surgery,

previous thyroidectomy, recent neck trauma, inflammatory neck lesion and patient refusal. Finally, 135 consecutive patients (106 women and 29 men; age, 20–77 y; mean age ± standard deviation, 45.1 ± 10.3 y) were included in this study. Patients underwent thyroid surgery because of suspicious thyroid malignancy in cytology (n = 128), indeterminate cytology (n = 6) and patient request despite benign cytology (n = 1). This study was approved by the Institutional Review Board before patient selection began, and written informed consent was provided by all study patients before their participation.

Thyroid ultrasound

Thyroid US was prospectively performed using a high-resolution ultrasound instrument (iU 22; Philips Healthcare, Andover, MA, USA) equipped with a 5–12-MHz linear probe; the sonographic examinations for detecting TPLs were performed by a single radiologist with 7 y of experience in thyroid US. In real-time US, a TPL was defined as follows: a longitudinally arranged accessory thyroid lobe (1) protruding from the upper margin of the isthmus or the medial aspect of the right or left thyroid lobe, regardless of its continuity with the main thyroid gland, and (2) showing the same echogenicity and vascularity as the main thyroid gland on gray-scale and color Doppler images, respectively. Short pyramidal lobes less than 9 mm in length may be confused with a simple glandular projection or undulation and these were thus excluded from the study.

The location, anteroposterior (AP) and transverse diameter, length, superior extent and separation or continuity of TPLs with the main thyroid gland were recorded: all measurements were performed on the basis of real-time US. The TPL location was classified in accordance with its origin, *i.e.,* right, left, midline or bilateral. The values of the largest AP diameter, largest transverse diameter, and length of TPLs were measured directly. The pyramidal lobe was also classified into one of four categories in accordance with the location of its upper end (*i.e.,* superior extent): tongue base, hyoid bone, thyrohyoid membrane or thyroid cartilage. Separation of the pyramidal lobe was defined by the absence of continuity from the main thyroid gland to the TPL.

Computed tomography

Neck CT scans (slice thickness, 3 mm; reconstruction increment, 3 mm) were conducted using contrast medium [Pamiray 370 (Iopamidol), Dongkuk Pharm., Seoul, Korea] using a 128-channel multi-detector CT scanner (LightSpeed; General Electric Medical Systems, Milwaukee, WI, USA). A total of 100–120 mL of contrast medium was injected at a rate of 2.5 mL/s. Non-enhanced axial, contrast-enhanced axial and contrast-enhanced coronal reformatted CT images were acquired in all cases.

Using a picture archiving and communication system, all CT image analyses were retrospectively carried out by the same radiologist who was blind to the sonographic and surgical findings. In the neck CT, the pyramidal lobe was defined as longitudinally arranged thyroid tissue protruding from the upper margin of the thyroid gland proper on three or more serial axial images. In the cases with TPLs of sufficient size or volume, Hounsfield unit values were measured by using regions of interest to compare the degree of parenchymal attenuation between the TPL and the main thyroid gland. In the cases with small or thin TPLs, however, the parenchymal attenuation of TPL was subjectively determined by the radiologist. The presence, location, size and superior extent of the pyramidal lobe and its separation or continuity with the main thyroid gland were recorded as for thyroid US: all measurements were performed on a picture archiving and communication system.

Thyroid surgery

Thyroid surgery with low-collar incision was performed after thyroid US and neck CT examination by a single surgeon with 10 y of experience in thyroid surgery, who was blinded to the thyroid US findings and neck CT results. The surgeons directly recorded the presence, location, size and superior extent of the pyramidal lobe identified in surgery and noted the separation or continuity of the TPLs with the main thyroid gland. As with thyroid US and neck CT evaluations, the largest AP diameter, the largest transverse diameter and length were directly measured in the surgical field using a caliber. As with the thyroid US, short pyramidal lobes less than 9 mm in length were excluded.

Statistical analysis

A conclusive finding of TPLs was based on surgical observations, and diagnostic indices were calculated for US and CT detection of TPLs. The differences in US, CT and surgical results for AP diameter, transverse diameter and length were compared by Fisher's exact test or Kruskal–Wallis test. The comparison between thyroid US and neck CT results for the detection of TPLs was analyzed by X^2 test. Statistical analysis was performed using SPSS (version 17.0.1; IBM, Armonk, NY, USA), and $p < 0.05$ was considered statistically significant.

RESULTS

The types of thyroid surgeries performed in the 135 patients included total thyroidectomy (n = 65), subtotal thyroidectomy (n = 11) and hemithyroidectomy (n = 59). Histopathological examinations revealed papillary thyroid carcinoma (n = 123), follicular thyroid carcinoma (n = 4), medullary thyroid carcinoma (n = 1),