



● Original Contribution

ULTRASONOGRAPHIC FEATURES OF THE MAJOR SALIVARY GLANDS AFTER RADIOACTIVE IODINE ABLATION IN PATIENTS WITH PAPILLARY THYROID CARCINOMA

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Abstract—The aim of this study was to evaluate the ultrasonographic features of the major salivary glands (MSGs) after post-operative radioactive iodine ablation (RIA) in patients with papillary thyroid carcinoma (PTC). The study population comprised 202 consecutively registered PTC patients who had undergone total thyroidectomy, RIA and follow-up neck ultrasonography. The ultrasonographic features of the MSGs in each patient were retrospectively evaluated by a single radiologist, and the presence of post-RIA changes was determined by direct comparisons of pre- and post-RIA follow-up ultrasonographic scans. Of the 202 patients, 94 (46.5%) had post-RIA changes in the MSGs on follow-up ultrasonography. RIA dose was closely associated with the prevalence of post-RIA changes. Post-RIA changes were more common in the parotid glands ($n = 93$, 46.0%) than in the submandibular glands ($n = 7$, 3.5%). Common ultrasonographic findings representing post-RIA changes in MSGs included coarse echotexture, decreased echogenicity, lobulated margin and decreased gland size. (E-mail: dwultra@lycos.co.kr) © 2015 World Federation for Ultrasound in Medicine & Biology.

Key Words: Major salivary glands, Radioactive iodine ablation, Papillary thyroid carcinoma, Ultrasonography, Computed tomography.

INTRODUCTION

Papillary thyroid carcinoma (PTC) is the most common form of thyroid cancer in children and adults (Loevner 2011). The use of radioiodine ablation (RIA) for the complete removal of remnant PTC after total thyroidectomy is well established (Mandel and Mandel 2003; Samaan et al. 1992), whereas radiotherapy is not commonly used. Although serious complications related to RIA are rare, toxic effects on the major salivary glands (MSGs) is the most common complication (Hyer et al. 2007). According to previous studies, the prevalence of salivary gland dysfunction after RIA ranges from 18.7% to 64.7%, with some patients exhibiting persistent dysfunction (Caglar et al. 2002; Hyer et al. 2007; Malpani et al. 1996; Raza et al. 2006).

Ultrasonography (US) is the primary imaging modality for pre- and post-operative assessment in PTC patients (Ahuja et al. 1995; Kim DW et al. 2013; Kim E

et al. 2008; Kim EK et al. 2002). Previous studies (Imanimoghaddam et al. 2012; Ying et al. 2007) have reported that radiotherapy may change the echotexture, echogenicity and margins of the major salivary glands and may reduce glandular size. To the best of my knowledge, however, no previous study has reported the ultrasonographic features of the MSGs after RIA in PTC patients. Therefore, this study aimed to evaluate the ultrasonographic features of MSGs after post-operative RIA in PTC patients.

METHODS

Patients

This retrospective study was approved by the appropriate institutional review board and obtained a waiver for informed consent. From January 2009 to December 2009, 244 patients (212 women and 32 men, mean age $\pm$ SD: 53.5 ± 11.6 y; age range: 26–84 y) who had undergone total thyroidectomy for PTC underwent their first RIA session. All patients who underwent US examination of the MSGs before RIA and one or more follow-up US examinations after the first RIA session were included. All US examinations were performed by a

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single radiologist. Patients with indeterminate US diagnoses and poor US image quality were excluded. Eventually, 202 patients (172 women and 30 men, mean age $\pm$ SD: 53.2 ± 11.6 y, age range: 26–84 y) were included in this study.

Radioactive iodine therapy

The RIA dose was determined on the basis of clinical status and ranged from 1.11 to 7.4 GBq (30–200 mCi). Levothyroxine (T4) treatment was withdrawn for 4 wk before RIA, and triiodothyronine (T3) was administered for 2 wk and withdrawn for 2 wk before RIA. Furthermore, a low-iodine diet was recommended for 2 wk before RIA. After radioactive iodine administration, patients were instructed to consume sour juice or candies as frequently as possible for 2 d to increase salivation.

Ultrasonography examination and image analysis

For all study patients, a single radiologist with 10 y of experience in neck US performed US examinations using a high-resolution ultrasound scanner (iU 22; Philips Medical Systems, Bothell, WA, USA) with a 5- to 12-MHz linear probe. On the basis of real-time US examinations, the investigator immediately determined the ultrasonographic diagnoses for MSGs. However, routine US examination of the sublingual gland was not performed because of a poor sonic window. At our hospital, follow-up neck US examinations are routinely performed for PTC patients at an interval of 1 or 2 y after total thyroidectomy and RIA.

In March 2015, the same radiologist retrospectively investigated all ultrasonographic features of MSGs before and after RIA using a picture archiving and communication system. The imaging features were analyzed in an unblinded manner for each US diagnosis, whereas the investigator was blinded to the dose and number of RIA sessions. On US, the echotexture, echogenicity, margin and size of MSGs were analyzed. Echotexture was classified as even (fine echotexture) or coarse (uneven echotexture) on the basis of comparisons between pre- and post-RIA findings. Similarly, echogenicity and size were classified as normal (no change after RIA), decreased (decreased after RIA) and increased (increased after RIA). For evaluation of the interval change in gland size, the depth of the MSGs was used, and an interval increase or decrease was defined as a positive or negative interval change of 10% or more in the depth of MSGs between the initial and follow-up US scans. The gland margin was classified as smooth or lobulated.

Statistical analysis

All data were tested for normal distribution using the Kolmogorov–Smirnov test. Continuous variables are

expressed as the mean $\pm$ SD, and mean differences between the two groups were analyzed using independent *t*-tests. Group comparisons of categorical variables were performed using the χ^2 -test. Spearman's rank correlation coefficient was used to assess the correlation between prevalence of post-RIA changes and dose of RIA, number of RIA sessions and number of follow-up US examinations. All statistical analyses were performed using statistical software (SPSS, Version 17.0, SPSS, Chicago, IL, USA; MedCalc, Version 9.0, MedCalc Software, Mariakerke, Belgium). A *p*-value <0.05 was considered to indicate statistical significance.

RESULTS

The initial RIA dose ranged from 30 to 180 mCi (mean $\pm$ SD: 148.3 ± 32.9 mCi) as follows: 30 mCi (*n* = 8), 100 mCi (*n* = 22), 150 mCi (*n* = 102), 160 mCi (*n* = 19), 180 mCi (*n* = 51). The mean number of RIA sessions was 1.1 ± 0.3 (range: 1–2). Among the 202 patients, 94 (46.5%) exhibited post-RIA changes in the parotid (*n* = 93) (Fig. 1), submandibular (*n* = 7) (Fig. 2) or both (*n* = 6) glands on follow-up US. Twenty patients underwent two RIA sessions; no patient underwent three sessions. The correlation between RIA dose and prevalence of post-RIA changes in the MSGs is outlined in Table 1. RIA dose was significantly correlated with the prevalence of post-RIA changes ($\rho = 0.282$, $p < 0.0001$), whereas number of RIA sessions was not ($\rho = 0.072$, $p = 0.305$).

The locations of post-RIA changes in the MSGs with respect to RIA dose are listed in Table 2. The right parotid gland was affected in 14 patients, the left in 26 and both in 54. Bilateral involvement of the parotid gland was the most frequent, with the frequency of involvement being higher for the left parotid gland than for the right parotid gland. Statistical analysis for the parotid gland revealed a significant difference between the frequency of post-RIA changes and the involved side ($p < 0.0001$). With respect to the submandibular gland, the right side was involved in 4 patients and both sides in 3; the left side was not involved in any patient. The correlation between the involved side and the frequency of post-RIA changes could not be determined for the submandibular gland because of the low prevalence of post-RIA changes.

For the 202 patients, the mean number of follow-up US examinations was 3.4 ± 1.7 (range: 1–7), and the mean interval between the initial RIA session and the last follow-up US examination was 40.3 ± 21.1 mo (range: 3–70 mo). For the 94 patients with post-RIA changes, the mean number of follow-up US examinations was 4.0 ± 1.5 (range: 1–7), and the mean interval between the initial RIA session and the last follow-up US examination was 45.7 ± 16.9 mo (range: 8–70 mo).

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