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Comparison of Prevalence and Ultrasonography Features of Thyroglossal Duct Cyst in Adults According to Radioactive Iodine Ablation

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Background: This study aimed to evaluate the prevalence of thyroglossal duct cysts (TGDCs) on ultrasonography (US) and US features of TGDCs in adults, and to assess whether the prevalence or size of TGDCs increases after radioactive iodine ablation (RIA).

Material/Methods: Between July and December 2018, 2820 patients underwent thyroid or neck US examination, performed by 2 radiologists, at our center. On the basis of real-time US, the presence or absence of TGDCs was prospectively investigated by 2 radiologists. Among the 2820 patients, 54 patients who were <19 years of age or had a radiation therapy history to the neck were excluded. Eventually, 2766 patients were included.

Results: Of the 2766 patients, 160 (5.8%) showed a TGDC on US. The mean size of TGDCs in RIA history (+) (n=36) and RIA history (–) (n=124) groups was 0.92±0.41 cm and 0.86±0.45 cm, respectively. There was no significant difference in size of TGDCs between RIA history (+) and RIA history (–) groups (p=0.684). Between the TGDC (+) and TGDC (–) groups, there was no significant difference in patient age, gender, reason for thyroid/neck US, type of thyroid surgery, and session number and application/no application of RIA (p>0.05). The prevalence rate of TGDCs in radiologist A and B was 4.9% (70/1427) and 6.7% (90/1339), respectively. TGDCs were more common in the suprahyoid neck, and the common shapes of TGDCs were flat-to-ovoid and round.

Conclusions: RIA may not be associated with the prevalence or enlargement of TGDCs.

MeSH Keywords: Prevalence • Radioisotopes • Thyroglossal Cyst • Thyroidectomy • Ultrasonography

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Background

Thyroglossal duct cyst (TGDC) is the most common congenital abnormality in the neck, accounting for 70–75% of midline neck masses [1–3]. TGDCs are originated from remnants of the thyroglossal duct after the thyroid gland migrates from the foramen cecum to its final site in the anterior lower neck [1–5]. In general, the thyroglossal duct disappears by the 8th to 10th week of gestation, but the persistent secretory epithelium may form a cyst when it fails to completely involute [4]. TGDCs are typically located near the hyoid bone and thyrohyoid membrane [1,2]. High-resolution ultrasonography (US) is a useful tool in the diagnosis and management of neuromuscular pathology and abnormalities in the surrounding structures [6]. On US, TGDCs are usually observed as thin-walled, unilocular, anechoic cystic masses with posterior enhancement [5]. Enlargement of TGDCs is a well-documented finding after an infection [1–3].

Several investigators have reported enlargement of TGDCs after radiation therapy [5,6]. They suggested that repeated inflammation due to radiation therapy may have caused an undetected, subclinical thyroglossal duct to secrete fluid and/or to obstruct the duct, thereby causing it to manifest as a cystic mass [5,7]. However, the relationship between TGDCs and radiation therapy is still unclear. Furthermore, cystic enlargement of a neck mass or a new cystic lesion should be differentiated from cystic metastasis of thyroid cancer or other head and neck cancer [1,8]. To our knowledge, no previous studies have determined the association between TGDCs and radioactive iodine ablation (RIA), nor have they investigated the prevalence and US features of TGDCs according to whether RIA was performed in adults. Therefore, this study aimed to assess the prevalence of TGDCs on US and US features of TGDCs in adults, and to assess whether the prevalence or size of TGDCs increases after RIA.

Material and Methods

Study population

The Busan Paik Hospital Institutional review board approved this study (IRB 18-0056), and they waived written informed consent. Between July and December 2018, 2820 patients (2176 female and 644 male patients, mean age ± standard deviation (SD): 52.6±13.3 years; age range: 1–91 years) underwent thyroid or neck US examination at the Thyroid and Head & Neck Cancer center of our hospital. Among them, 54 patients (28 female and 26 male patients, mean age±SD: 10.5±10.7 years; age range: 1–58 years) were excluded owing to young age (<19 years; n=52) and a history of radiation therapy to the neck (n=2). Eventually, 2766 patients (2148 women and 618 men, mean age±SD: 53.4±11.9 years, age range: 19–91 years) were included.

Ultrasonographic examination and image analysis

US examination was done using a high-resolution ultrasound scanner (iU 22, Philips Medical Systems, Bothell, WA, USA; and Aplio 400, Toshiba Medical Systems, Tokyo, Japan) with a 5–12-MHz linear probe by 2 experienced radiologists (with 7 and 16 years of experience, respectively, in performing thyroid or neck US). The patients were randomly allocated to be examined by either one of 2 US instruments. Both the radiologists prospectively investigated the midline neck from the tongue base to the thyroid isthmus on real-time US during the study period. Only one radiologist performed thyroid or neck US for each patient.

On US, TGDCs were defined as thin-walled, anechoic cystic lesions with posterior enhancement in the anterior upper midline neck when it could be differentiated from adjacent muscular or vascular structures. In addition, when the cystic lesion showed atypical content owing to the proteinaceous material or hemorrhage, it was considered as a TGDC [3,5]. The presence or absence, location, largest diameter, and shape of the TGDCs were investigated. The location of TGDCs was divided into the suprahyoid or infrahyoid neck level by the hyoid bone. When a TGDC was located in both the suprahyoid and infrahyoid neck levels, the location was determined according to which level included the greater component of the TGDC. The shape of the TGDC was classified into flat-to-ovoid, round, amorphous, or tubular (longitudinally arranged).

Radioactive iodine ablation

In our hospital, the RIA dose was determined depending on the patient's clinical status, and in patients with papillary thyroid carcinoma, the RIA dose was ranged from 1.11 to 7.4 GBq (30–200 mCi) for the complete removal of remnant cancer after total thyroidectomy [9]. The presence or absence of RIA therapy, the number of RIA sessions, and the highest dose of RIA were evaluated in all patients.

Statistical analysis

The data were analyzed for normal distribution by using the Kolmogorov-Smirnov test. Normally distributed variables were expressed as the mean±SD and compared by the independent t-test. Group comparisons of categorical variables were tested by the χ^2 test or, for small cell values, the Fisher's exact test. Spearman correlation analysis was used to evaluate the relation between the maximum dose of RIA and size of TGDC. All statistical analyses were conducted using SPSS, Version 24.0 (IBM, Armonk, New York). A p value of <0.05 was statistically significant.

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Table 1. Comparison of clinical and ultrasonographic findings of the total 2766 patients according to the presence or absence of of thyroglossal duct cysts on ultrasonography.

Items	TGDC (+) (n=160)	TGDC (–) (n=2606)	p Value
Age (mean±SD, yr)	53.9±11.8	53.4±11.9	0.653
Gender			0.24
Female	118 (73.8)	2030 (77.9)	
Male	42 (26.2)	576 (22.1)	
Reason for thyroid/neck US			0.553
Postoperative follow-up	87 (54.4)	1344 (51.6)	
Preoperative staging	8 (5)	57 (2.2)	
Health screening	23 (14.4)	441 (16.9)	
Anterior neck discomfort	1 (0.6)	17 (0.7)	
Abnormal thyroid/parathyroid serology	4 (2.5)	80 (3.1)	
Patient request	0	4 (0.2)	
US follow-up of known thyroid nodule	29 (18.1)	534 (20.5)	
Known thyroid nodule in CT or MRI	2 (1.3)	47 (1.8)	
Palpable neck mass	6 (3.8)	82 (3.1)	
Type of thyroid surgery			0.24
No thyroid surgery	73 (45.6)	1262 (48.4)	
Total thyroidectomy	62 (38.8)	840 (32.2)	
Hemithyroidectomy	24 (15)	494 (19)	
Isthmusectomy	1 (0.6)	6 (0.2)	
Nodulectomy	0	4 (0.2)	
Session number of RIA			0.403
0	124 (77.5)	2113 (81.1)	
1	31 (19.4)	438 (16.8)	
2	5 (3.1)	54 (2.1)	
3	0	1 (0)	
Application of RIA			0.263
No	124 (77.5)	2113 (81.1)	
Yes	36 (22.5)	493 (18.9)	
Location of TGDC on US			NA
Suprahyoid	124 (77.5)	NA	
Infrahyoid	36 (22.5)	NA	
Size of TGDC (mean±SD, cm)	0.9±0.4	NA	NA
Shape of TGDC			NA
Round	67 (41.9)	NA	
Tubular	8 (5)	NA	
Amorphous	15 (9.4)	NA	
Flat-to-ovoid	70 (43.8)	NA	

Data are number of items, with percentage in parentheses. TGDC – thyroglossal duct cyst; SD – standard deviation; US – ultrasonography; CT – computed tomography; MRI – magnetic resonance imaging; RIA – radioactive iodine ablation; NA – not applicable.

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Table 2. Comparison of clinical and ultrasonographic findings of thyroglossal duct cysts according to 2 investigators.

Items	Radiologist A (n=1427)		Radiologist B (n=1339)		*p* Value
Age (mean±SD, yr)	53.8±11.0		53.1±12.8		0.137
Gender					0.001
Female	1070	(75.0)	1078	(80.5)	
Male	357	(25.0)	261	(19.5)	
Reason for thyroid/neck US					<0.0001
Postoperative follow-up	781	(54.7)	650	(48.5)	
Preoperative staging	27	(1.9)	38	(2.80	
Health screening	368	(25.8)	96	(7.2)	
Anterior neck discomfort	6	(0.4)	12	(0.9)	
Abnormal thyroid/parathyroid serology	51	(3.6)	33	(2.5)	
Patient request	4	(0.3)	0		
US follow-up of known thyroid nodule	174	(12.2)	389	(29.1)	
Known thyroid nodule in CT or MRI	7	(0.5)	42	(3.1)	
Palpable neck mass	9	(0.6)	79	(5.9)	
Type of thyroid surgery					<0.0001
No thyroid surgery	647	(45.3)	688	(51.4)	
Total thyroidectomy	476	(33.4)	426	(31.8)	
Hemithyroidectomy	299	(21)	219	(16.4)	
Isthmusectomy	5	(0.4)	2	(0.1)	
Nodulectomy	0		4	(0.3)	
Session number of RIA					0.019
0	1125	(78.8)	1112	(83)	
1	269	(18.9)	200	(14.9)	
2	32	(2.2)	27	(2)	
3	1	(0.1)	0		
Application of RIA					0.005
No	1125	(78.8)	1112	(83)	
Yes	302	(21.2)	227	(17)	
TGDC on US					0.042
Absence	1357	(95.1)	1249	(93.3)	
Presence	70	(4.9)	90	(6.7)	

Data are number of items, with percentage in parentheses. TGDC – thyroglossal duct cyst; SD – standard deviation; US – ultrasonography; CT – computed tomography; MRI – magnetic resonance imaging; RIA – radioactive iodine ablation.

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Table 3. Comparison of clinical and ultrasonographic findings of thyroglossal duct cysts in 160 patients according to radioactive iodine ablation application.

Items	RIA application (n=36)	RIA non-application (n=124)	*p* Value
Age (mean±SD, yr)	55.6±10.7	53.3±12.1	0.274
Gender			0.287
Female	24 (66.7)	94 (75.8)	
Male	12 (33.3)	330 (24.2)	
Radiologist			0.128
A	20 (55.6)	50 (40.3)	
B	16 (44.4)	74 (59.7)	
Location of TGDC on US			0.182
Suprahyoid	31 (86.1)	93 (75)	
Infrahyoid	5 (13.9)	31 (25)	
Size of TGDC (mean±SD, cm)	0.92±0.41	0.86±0.45	0.684
Shape of TGDC			0.713
Round	14 (38.9)	53 (42.7)	
Tubular	2 (5.6)	6 (4.8)	
Amorphous	5 (13.9)	10 (8.1)	
Flat-to-ovoid	15 (41.7)	55 (44.4)	

Data are number of items, with percentage in parentheses. TGDC – thyroglossal duct cyst; SD – standard deviation; US – ultrasonography; RIA – radioactive iodine ablation.

Results

During the study period, 2766 patients underwent thyroid or neck US examination for various clinical reasons: postoperative follow-up (n=1431), preoperative staging (n=65), health screening (n=464), anterior neck discomfort (n=18), abnormal thyroid or parathyroid serology (n=84), patient request (n=4), US follow-up of known thyroid nodules (n=563), further evaluation of known thyroid nodules on computed tomography or magnetic resonance imaging (n=49), and palpable neck masses (n=88). However, no patient underwent 2 or more sessions of thyroid or neck US. Of the 2766 patients, 1431 (51.7%) had a history of previous thyroid surgery; total thyroidectomy was performed in 902 patients (63.0%), hemithyroidectomy in 518 (36.2%), isthmusectomy in 7 (0.5%), and nodulectomy in 4 (0.3%). Among the patients who underwent total thyroidectomy, 529 (58.6%) underwent one or more sessions of RIA. In these patients, the mean number of RIA sessions was 1.1±0.3 (range: 1–3) and the highest dose of RIA ranged from 30 to 200 mCi (mean±SD: 127.8±34.0 mCi). The highest dose of RIA was 30 mCi in 17 patients, 60 mCi in 1, 80 mCi in 6, 100 mCi in 208, 130 mCi in 35, 150 mCi in 179, 160 mCi in 34, 180 mCi in 44, and 200 mCi in 5 patients.

Of the 2766 patients, 160 (5.8%) showed a TGDC on US (mean size: 0.9±0.4 cm, range: 0.3–3.3 cm). Among 160 patients, 36 underwent one or more sessions of RIA after total thyroidectomy, whereas 124 did not underwent RIA. The mean size of TGDCs in RIA history (+) and RIA history (–) groups was 0.92±0.41 cm and 0.86±0.45 cm, respectively. There was no significant difference in size of TGDCs between RIA history (+) and RIA history (–) groups (p=0.684).

The clinical and US findings of the study patients according to the presence or absence of TGDCs are shown in Table 1. There was no significant difference in patient age, gender, reason for thyroid/neck US, type of thyroid surgery, and session number and application/no application of RIA between the patients with TGDC and those without TGDC (p>0.05). Of the 529 patients who received RIA, the mean highest dose of RIA was 111.1±41 mCi in patients with TGDC (n=36) and 129.0±33.2 mCi in those without TGDC (n=493; p=0.002).

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Table 4. Comparison of clinical and ultrasonographic findings of thyroglossal duct cysts in 160 patients according to 2 investigators.

Items	Radiologist A (n=70)	Radiologist B (n=90)	*p* Value
Age (mean±SD, yr)	53.0±10.6	54.6±12.7	0.388
Gender			0.858
Female	51 (72.9)	67 (74.4)	
Male	19 (27.1)	23 (25.6)	
Session number of RIA			0.148
0	50 (71.4)	74 (82.2)	
1	16 (22.9)	15 (16.7)	
2	4 (5.7)	1 (1.1)	
3	0	0	
Application of RIA			0.128
No	50 (71.4)	74 (82.2)	
Yes	20 (28.6)	16 (17.8)	
Location of TGDC on US			0.183
Suprahyoid	58 (82.9)	66 (73.3)	
Infrahyoid	12 (17.1)	24 (26.7)	
Size of TGDC (mean±SD, cm)	0.92±0.52	0.84±0.36	0.262
Shape of TGDC			0.424
Round	34 (48.6)	33 (36.7)	
Tubular	4 (5.7)	4 (4.4)	
Amorphous	6 (8.6)	9 (10)	
Flat-to-ovoid	26 (37.1)	44 (48.9)	

Data are number of items, with percentage in parentheses. TGDC – thyroglossal duct cyst; SD – standard deviation; US – ultrasonography; RIA – radioactive iodine ablation.

The clinical and US findings of TGDCs according to the 2 investigators are compared in Table 2. The number of patients who underwent thyroid or neck US by radiologist A and B was 1427 (51.6%) and 1339 (48.4%), respectively. The prevalence rate of TGDCs on US performed by radiologist A and B was 4.9% (70/1427) and 6.7% (90/1339), respectively. The prevalence rate of TGDCs was higher on US performed by radiologist B than on US performed by radiologist A. There were significant differences in gender, reason for thyroid/neck US, type of thyroid surgery, session number of RIA, application/no application of RIA, and the prevalence of TGDCs on US between the patients with TGDC and those without ($p<0.05$). In particular, the percentage of health screenings performed was higher for radiologist A, whereas the percentage of US follow-up of known thyroid nodules was higher for radiologist B. Of the 529 patients who underwent RIA, the mean highest dose of RIA was 125.8±33.1 mCi for patients who underwent US performed by radiologist A (n=302) and 129.6±37.1 mCi for patients who underwent US performed by radiologist B (n=227; $p>0.05$).

The comparison of clinical and US findings of TGDCs for 160 patients according to RIA application is shown in Table 3. There were no significant differences in patient age and gender; radiologists; and location, size, and shape of TGDCs between the RIA application and non-application groups ($p>0.05$). Moreover, no significant correlation was observed between the maximum dose and size of TGDCs (rho=0.084, p=0.293).

The comparison of clinical and US findings of TGDCs for 160 patients according to the 2 investigators is shown in Table 4. Of the 160 patients, the location of TGDCs was the suprahyoid neck (77.5%) (Figure 1) and infrahyoid neck (22.5%) (Figure 2).

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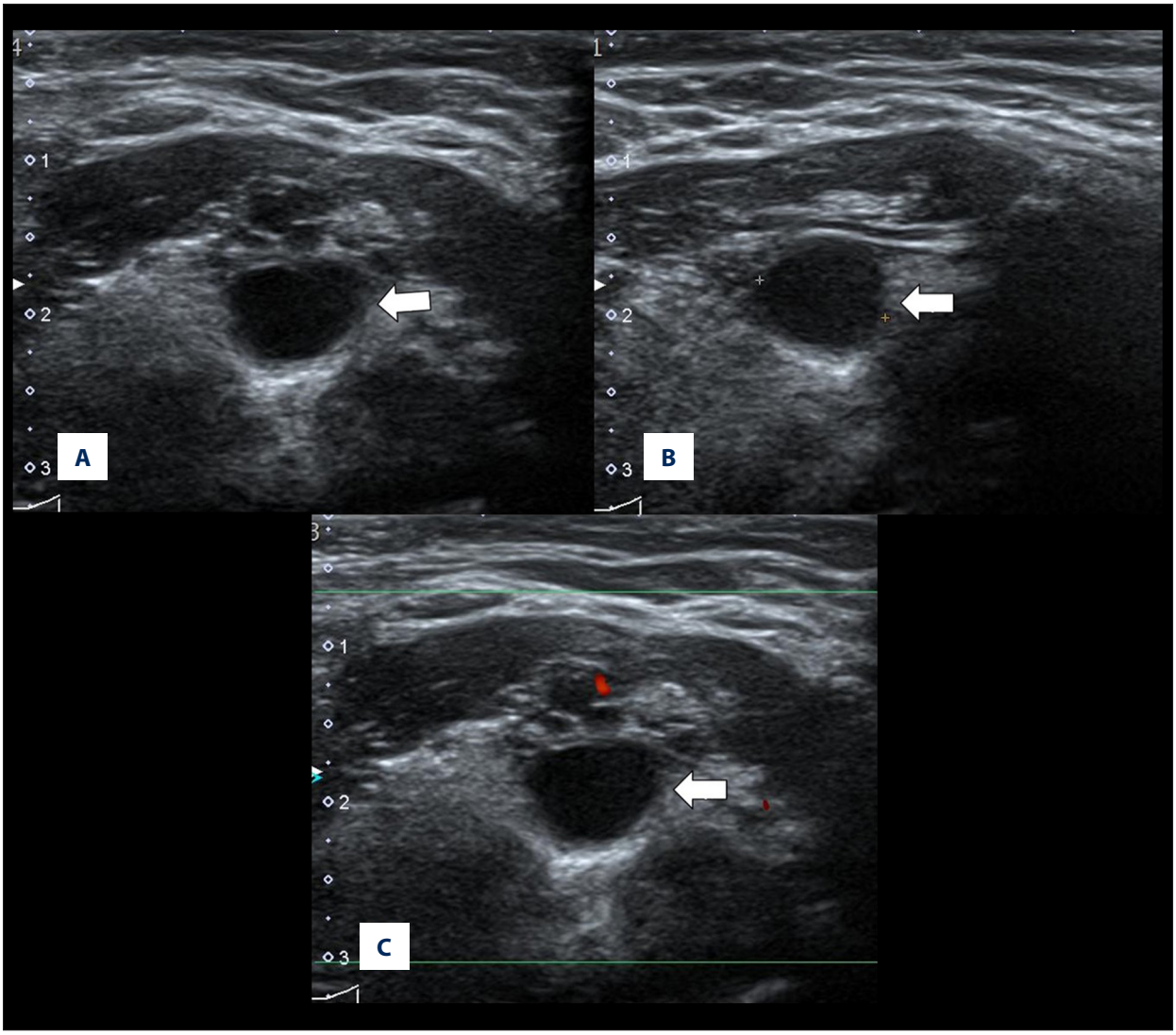

Figure 1. A 33-year-old woman who underwent total thyroidectomy but no radioactive iodine ablation for papillary thyroid carcinoma. On the follow-up neck ultrasonography (US), transverse gray-scale (**A**), longitudinal gray-scale (**B**), and transverse color Doppler (**C**) ultrasonograms show a well-defined cystic lesion with a round shape in the suprahyoid, anterior upper midline neck (arrows, 0.9 cm).

All TGDCs were found around the hyoid bone. The mean size of TGDCs was 0.9±0.4 cm (range: 0.3–3.3 cm). The shape of the TGDCs was flat-to-ovoid (43.8%, 70/160), round (41.9%, 67/160), amorphous (9.4%, 15/160), and tubular (5%, 8/160). Between radiologists A and B, there was no significant difference in patient age and gender; number of RIA sessions; application/no application of RIA; and location, size, and shape of TGDCs on US (p 0.05). No case of undetermined TGDCs were found considering the presence of solid components.

Discussion

In the present study, we assessed whether there was a difference in the prevalence of TGDCs according to RIA application. However, there was no significant difference in the session number of RIA or history of RIA between the TGDC (+) and TGDC (–) groups. In addition, the mean size of TGDCs was 0.9 cm, and there was no significant relationship between size of TGDCs and RIA. In the previous studies [5,7], radiation therapy may be associated with enlargement of TGDCs. The reason for this difference is unclear, but the following factors can be considered. Our study included patients who underwent RIA, whereas previous studies evaluated those who underwent radiation therapy. In the previous studies on radiation therapy,

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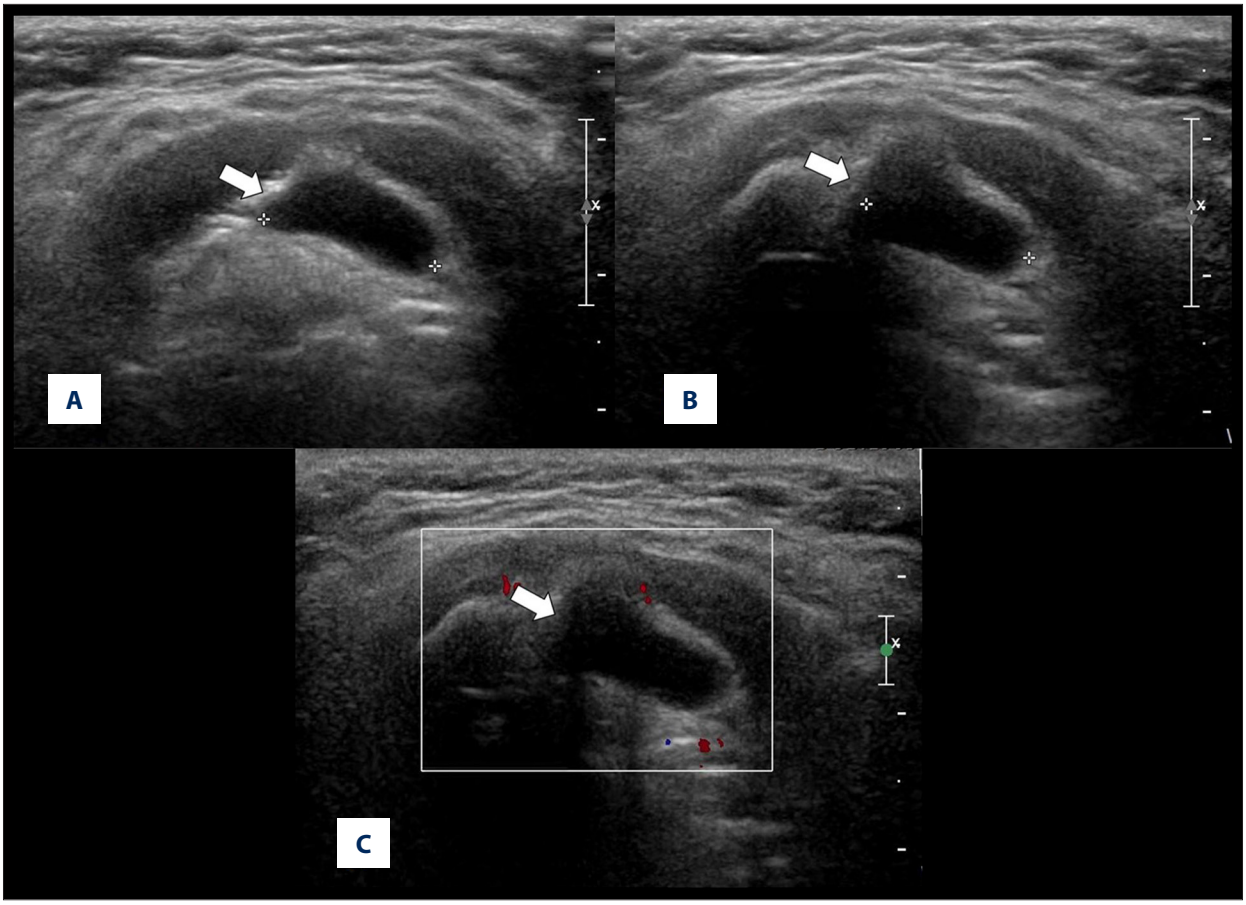

Figure 2. A 53-year-old woman who underwent total thyroidectomy and 2 sessions of radioactive iodine ablation (150 and 180 mCi) for papillary thyroid carcinoma. On the follow-up neck ultrasonography (US), transverse gray-scale (**A**), longitudinal gray-scale (**B**), and longitudinal color Doppler (**C**) ultrasonograms show a well-defined cystic lesion with an ovoid shape in the infrahyoid, anterior upper midline neck (arrows, 1.3 cm).

all the TGDCs were observed to be large on the immediate post-therapeutic computed tomography scan after radiation (interval ranging from 4 to 14 weeks after completion of radiation therapy) [7]. All TGDCs became smaller and less conspicuous over time because inflammatory changes had long since resolved [7]. However, in our study, we did not evaluate interval change of TGDCs. Furthermore, our study made indirect comparisons regarding the prevalence of TGDCs according to whether RIA was performed. For a more accurate evaluation of the relationship between the presence of TGDCs and the application of RIA, a direct comparison using US before and after RIA may be required. Further studies are required to clarify this issue.

In previous cadaveric studies, the prevalence rate of TGDCs was 7–15% [10,11]. In our study, the prevalence rate of TGDCs was 5.8% (160/2766), which was similar or lower than the rate in the previous cadaveric studies [10,11]. The reason for the lower rate may be associated with the use of different detection methods. Moreover, in our study, the prevalence rate of TGDCs was different for both radiologists. The reason for this difference may be associated with the inclusion of heterogeneous study patients, including differences in patient age, gender, reason for thyroid/neck US, type of thyroid surgery, and number of RIA sessions and whether RIA was performed. In addition, interobserver variability should be considered. However, we could not calculate interobserver variability because both radiologists did not investigate TGDCs in the same patients by using US.

The typical US features of TGDCs include thin-walled, unilocular, anechoic cystic masses with posterior enhancement [1,2,5]. In our study, all TGDCs showed typical US features. TGDCs are found in varying locations across studies [5,12–14]. In our study, most TGDCs were located in the suprahyoid neck (77.5%). Regarding the shape of TGDCs, our study findings were similar to those obtained in a recent US study of TGDCs that reported a round/ovoid shape (56%) [15]. In our study, there was no difference in the location or shape of TGDCs between the 2 radiologists.

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This study has several limitations. First, young patients (<19 years) were not included. Second, neither biopsy nor surgery was performed for TGDCs. Furthermore, synchronous movement of a TGDC and the hyoid bone on dynamic US while swallowing may be helpful for diagnosis of a TGDC [16], but this method was not performed. Third, US follow-up for TGDCs was not performed. Thus, the interval change of TGDCs could not be evaluated. Fourth, although the interval between RIA and US examination was variable, this interval was not investigated. Furthermore, the total dose of RIA was not evaluated. Finally, the interobserver variability was not calculated because the 2 radiologists did not perform US examinations for the same patients.

Conclusions

The application of RIA may not be associated with the prevalence or enlargement of TGDCs. In addition, the main location of TGDCs was the suprahyoid neck, but all TGDCs were found around the hyoid bone and the shape of TGDCs was variable.

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