Ultrasonographic Findings of Foreign-Body Granulomas after Endoscopic Thyroidectomy via an Axillo-Breast Approach

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Purpose

To assess the ultrasonographic (US) findings of foreign body granulomas detected after endoscopic thyroidectomy mimicking tumor recurrence.
Methods and Materials

Study Population

The institutional review board approved the present retrospective study and informed consent was waived. From January 2007 to June 2011, 268 cases of unilateral or total endoscopic thyroidectomy were performed at the Department of Otolaryngology-Head and Neck Surgery at Soonchunhyang university Bucheon hospital. In postoperative clinical follow-up of patients who underwent endoscopic thyroidectomy, we encountered two patients complaining of palpable lesions in the anterior chest wall. We performed PET-CT with concern regarding recurrence or seeded tumors, and those lesions showed increased fluorodeoxyglucose (FDG) uptake on PET-CT. Diagnostic US was performed and lesions were confirmed to be foreign body granulomas by gun biopsy. On screening PET-CT scan of another patient, we detected a lesion in surgical bed showing increased FDG uptake. The lesion was confirmed to be foreign body granuloma by fine needle aspiration biopsy. Next, we included chest wall scanning in the follow-up US of patients who underwent endoscopic thyroidectomy.

Subsequently, 11 additional lesions that demonstrated US findings similar to biopsy-proven foreign body granulomas were detected in 10 other patients who underwent endoscopic thyroidectomy. One lesion of patient whose underlying pathologic diagnosis is papillary thyroid carcinoma was excluded from the study because it has no follow-up US nor CT scan. Other 9 patients were clinically diagnosed by characteristic US findings and serum Tg and Tg antibody levels. Three pathologically proven lesions and 10 additional lesions—a total of 13 lesions from 12 patients (three men and nine women; mean age, 38 years; age range, 27-55 years)—were included in the current retrospective study.

Serum Tg and Tg antibody levels of four patients who underwent total or completion thyroidectomy were assessed at the time of follow-up US (same day as US in 3 patients, 10 days before in 1 patient). The pathologic diagnosis of the underlying lesions of eight patients was papillary thyroid carcinoma (seven of eight were microcarcinomas) and that of the other three patients was nodular hyperplasia.

Endoscopic Thyroidectomy

The surgical method was performed as follows: a 4.5- to 5.5-cm skin incision was made parallel to the skin crease in the axillary fossa, into which the rigid endoscope and endoscopic instruments were inserted. The skin was elevated above the pectoralis major muscle exclusively under direct vision using monopolar cauterization through the axillary skin incision until the anterior border of the sternocleidomastoid muscle was exposed. A second 1.0-cm skin incision was made along the upper margin of the mammary areola on the tumor side for insertion of a 12-mm trocar, which was directed to the midline of the sternal notch. The anterior border of the sternocleidomastoid muscle was dissected.
from the sternohyoid muscle, and in some cases, divided the omohyoid muscle. In all cases, only the harmonic scalpel (HS; Harmonic Ace 36P®; Johnson & Johnson Medical, Cincinnati, OH, USA) was used for vascular control of the thyroid gland and strap muscles.\(^1,7\)

**US and Other Imaging Studies**

US was performed using an IU22 US, an HDI 5000 with an L12-5 (5-12 MHz) linear array transducer (Philips Medical Systems, Bothell, WA, USA), a LOGIQ 700MR with an LA39 (6-13 MHz) linear array transducer, and a LOGIQ E9 system with an ML6-15-D (5-16 MHz) linear array transducer (GE Healthcare, Milwaukee, WI, USA). A head and neck radiologist with 20 years of experience in thyroid sonography had scanned all patients and reviewed the US findings for lesion echogenicity, shape, and size. Color Doppler US was available in 11 lesions, and the presence or absence of vascular flow signals within the lesions was assessed. No evaluation was performed on the flow patterns in the other two lesions. The color gain was adjusted until background noise first became apparent.

US-guided gun biopsy was performed on two lesions using a needle biopsy gun (Acecut; TSK Laboratory, Tochigi-shi, Japan) with an 18-gauge × 7.5-cm needle and a 22-mm notch. Fine needle aspiration biopsy was performed on one lesion with a 22-gauge needle attached to a 10-mL plastic syringe, using a freehand technique. The mean time from thyroidectomy to lesion detection on US was 481 days (range, 182-815 days). Eleven lesions underwent follow-up US for an evaluation of evolitional change over time. The mean interval time from lesion detection to follow-up US was 275 days (range, 45-494 days).

Additionally, four lesions were evaluated by CT, three by PET-CT, and one by both CT [(n=3; LightSpeed VCT; GE Healthcare) and (n=1; Somatom Sensation 16; Siemens Medical Solutions, Erlangen, Germany)] and PET-CT (Biograph2 scanner; Siemens Medical Systems, Forchheim, Germany).

**Statistical Analysis**

Foreign body granulomas were divided into two groups based on the echogenicity and shape of the lesions (group I: hyperechoic linear lesions with posterior acoustic shadowing, n=7; group II: oval lesions, iso- to slightly hypoechoic relative to the adjacent strap muscle or pectoralis major muscle, n=6). The time from thyroidectomy to lesion detection was compared between the two groups using the Mann-Whitney test. The relationship between the largest diameter of the lesion and the time from thyroidectomy to lesion detection was examined using Spearman's correlation coefficient. Nonparametric tests were applied to ensure that small sample sizes were properly handled. A p-value less than 0.05 was deemed to indicate a statistically significant difference. Statistical analysis was performed using Stata 11 software (Stata, College Station, TX, USA).
Results

Ten patients underwent endoscopic hemithyroidectomy and two patients had endoscopic total thyroidectomy. Two of ten patients who underwent endoscopic hemithyroidectomy had undergone completion thyroidectomy due to papillary thyroid cancer with lymph node metastasis.

The time of first US after endoscopic thyroidectomy was variable because it depended on multiple factors, including the type of underlying lesion, presence of symptoms, abnormal laboratory findings, and clinical follow-up loss. Ten of 13 lesions were detected on first US after surgery. However, two others (lesion no. 9 and no. 10) were detected on the second US; we believed that we had missed the lesions on the first US because the lesions were ill-defined and isoechoic compared with the adjacent muscle at the time of the first US. Additionally, the other (lesion no. 11) was detected on the fourth US because the lesion was located in the anterior chest wall and three previous US scans did not include the chest wall. Two lesions didn't undergo follow up US. One lesion had been followed up by contrast enhanced neck CT after 625 days from initial US. And it showed no evidence of recurrence nor seeded neoplasm. Another lesion has no clinical need to follow up because the underlying pathology was nodular hyperplasia.

On US, seven lesions were curved or straight hyperechoic linear lesions with posterior acoustic shadowing (Figs. 1A and 2A); six other lesions were oval, well-defined masses, which were isoechoic (n=3) (Fig. 3A) or slightly hypoechoic (n=3) relative to the adjacent muscle. The lesions were located in the anterior chest wall (n=6), sternocleidomastoid muscle (n=4), and strap muscle (n=3).

Color Doppler US in 11 lesions revealed no blood flow (Figs. 1B, 2B, and 3B). In the other two lesions, color Doppler US was not available. The mean largest diameter of the lesions was 17 mm (range, 10-20 mm). The size of the lesions was inversely correlated with the time to lesion detection (Spearman's correlation r = #0.6528; P < .02). Thus, we could presume that the lesions had decreased in size over time. The mean time from thyroidectomy to lesion detection on US was 318 days for hyperechoic lesions and 672 days for solid lesions. Solid lesions had a significantly longer time to lesion detection than hyperechoic lesions (Mann-Whitney test, P = .01).

The histopathologic findings showed a foreign body granuloma with multiple empty spaces and remnant amorphous material in a case with a hyperechoic linear lesion with posterior acoustic shadowing on US (Fig. 1E). A well-defined, oval iso- to slightly hypoechoic solid lesion without posterior acoustic shadowing on US revealed a foreign body granuloma with dense fibrosis and only a few empty spaces (Fig. 3E). On follow-up US, hyperechoic linear lesions (n=6) with posterior acoustic shadowing showed decreased in size only (n=4) or became oval, iso- to slightly hypoechoic lesions and decreased in size (n=2, Figs. 1B and 2B). Evolutional change of the oval, iso- to slightly hypoechoic lesions (n=5) was disappearance (n=3), decrease in size (n=2). One lesion
followed up by contrast enhanced neck CT without follow-up US (No. 2) shows decreased in size. US findings are summarized in Table 1.

All five lesions of four patients who underwent enhanced CT were well-defined enhancing nodular lesions without calcifications; three lesions were slightly hyperdense compared to muscle (Figs. 2C and 3C), and the other two lesions were isodense compared to muscle.

On PET-CT, all four lesions showed increased FDG uptake [peak standardized uptake value (SUV) = 4.0; range, 2.3-6.0] (Figs. 1D and 3D).

The mean serum Tg level of four patients who had undergone a total or completion thyroidectomy was 0.30 ng (range, 0.01-1.02 ng). Additionally, the mean serum Tg antibody level of those four patients was 0.10 ng (range, 0.01-0.37 ng). Clinical and other imaging findings are summarized in Table 2.
Fig. 1: A 38-year-old woman with biopsy-proven foreign body granuloma. A. A total of 311 days after thyroidectomy, US shows curved hyperechoic line with posterior acoustic shadowing (arrowheads) in the superficial layer of the left anterior chest wall, adjacent to the pectoralis major muscle. The lesion resembles a calcification on US but CT scan and pathologic examination show no calcification. B. Follow-up US after 476 days shows an oval, well-defined soft tissue echogenic lesion (arrowheads), isoechoic relative to the adjacent muscle. Color Doppler shows no vascularity. C, D. PET-CT scan, 442 days after thyroidectomy shows a well-defined nodule (arrowheads in C), slightly hyperdense compared to the muscle with increased FDG uptake (peak SUV = 2.3) (arrowheads in D). E. Microscopic findings show empty spaces with remnant amorphous material and adjacent fibrosis and foreign body giant cells (hematoxylin and eosin stain, × 40).

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Fig. 2: A 29-year-old man with foreign body granuloma. A. A total of 352 days after thyroidectomy, US shows straight hyperechoic line with posterior acoustic shadowing at the inner aspect of the left sternocleidomastoid muscle. B. Follow-up US, after 494 days, shows an oval isoechoic mass without posterior acoustic shadowing. Color Doppler US shows no vascularity. C. Enhanced CT scan, 413 days after thyroidectomy shows an oval well-defined enhancing nodule (arrow), slightly hyperdense compared to the muscle.

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Fig. 3: A 55-year-old woman with biopsy-proven foreign body granuloma. A. A total of 762 days after thyroidectomy, US shows an oval, well-defined solid echogenic lesion (arrowheads), isoechoic relative to the muscle in the left chest wall. B. Color Doppler shows no vascularity (arrowheads). On follow-up US, the lesion disappeared (not shown). C. Enhanced CT scan, 711 days after thyroidectomy shows well-defined enhancing nodule (arrowheads), slightly hyperdense compared to the muscle. D. PET-CT scan, 711 days after thyroidectomy shows increased FDG uptake (p-SUV = 6.0) (arrow). E. Sections show deposition of amorphous eosinophilic material, infiltration of chronic inflammatory cells, and foreign body-type giant cells. Right side reveals dense fibrosis and rare empty spaces with amorphous material (hematoxylin and eosin stain, ×40).

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### Table 1: US findings of foreign body granulomas

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*: pathology confirmed by gun biopsy; **: pathology confirmed by fine needle aspiration; Tg, thyroglobulin; antiTg Ab, antithyroglobulin antibody; NT, not taken.

### Table 2: Clinical and other imaging findings of foreign body granulomas

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Conclusion

In summary, foreign body granulomas after endoscopic thyroidectomy show hyperechoic linear lesions with posterior acoustic shadowing in the early phase and oval, iso- to slightly hypoechoic solid lesions in the later phase. These lesions show evolutionary change over time from a decrease in size and echogenicity, becoming a well-defined margin and finally disappearing. Although suspicious lesions in the thyroidectomy bed should be biopsied percutaneously for pathologic confirmation, if the lesions show characteristic US findings of foreign body granulomas, performance of invasive procedures is not necessary. Follow-up US may be helpful for the diagnosis.
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