

Normal and Abnormal Sonographic Findings at the Thyroidectomy Sites in Postoperative Patients With Thyroid Malignancy

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OBJECTIVE. We describe typical sonography characteristics of locally recurrent tumors after thyroidectomy for thyroid cancer and the benign conditions mimicking tumor recurrence, with an emphasis on the differential diagnosis.

CONCLUSION. Ultrasound is an effective imaging technique not only for the detection of locally recurrent tumors but also for the differential diagnosis of locally recurrent tumors and other abnormalities mimicking tumor recurrence.

The traditional monitoring tool for the surveillance of neck tumor recurrence after thyroidectomy followed by radioactive iodine ablation is serial measurement of serum thyroglobulin levels when the patient is off thyroxine therapy. A baseline or thyroid-stimulating hormone (TSH)-stimulated serum thyroglobulin level (either recombinant human TSH or thyroid hormone withdrawal) of more than 2 ng/mL is predictive of persistent tumor or metastasis, whereas a level of less than 1.0 ng/mL indicates the absence of residual tumor in 98% of patients [1, 2]. Although the serum thyroglobulin level is a highly sensitive and specific indicator of local recurrence or distant metastasis, the identification and precise localization of disease ultimately have a notable impact on management strategies including surgical planning [3].

In recent years, high-resolution neck sonography has emerged as the dominant imaging technique to evaluate for locoregional recurrence because of its superior sensitivity compared with whole-body ¹³¹I scanning (94.1% vs 56.8%, respectively) [3, 4]. High-resolution neck sonography also has the advantage of being independent of the degree of tumor differentiation (i.e., serum thyroglobulin level) unlike FDG PET or ¹³¹I whole-body scanning. Therefore, sonography is currently recommended as a tool for routine surveillance in the follow-up of postoperative patients with thyroid cancer [3, 5].

In this article, we illustrate the sonography characteristics of the normal thyroid bed after thyroidectomy, locally recurrent tumor,

and benign conditions mimicking local tumor recurrence including remnant thyroid tissue, reactive lymph node, fibrous scar, and suture granuloma, with an emphasis on the differential diagnosis.

Normal Postoperative Changes After Thyroidectomy

The normal thyroid gland is located in the anterior lower neck between the thyroid cartilage and the thoracic inlet. After thyroidectomy, the local inflammatory response results in proliferation of fibrofatty connective tissue, which fills the dead space made by surgery [6]. There is also displacement of the strap muscles, the carotid sheath structures, and the cervical esophagus on the left side toward the thyroid bed. Therefore, on sonography examination, the fibrofatty connective tissue appears as an inverted triangular or flattened uniform hyperechoic area indented laterally by the carotid space, anteriorly by the strap muscles, and medially by the laryngotracheal structures (Fig. 1).

Local Tumor Recurrence

Up to 20% of patients with differentiated thyroid carcinoma develop locoregional recurrences, and 8% of these patients will eventually die of thyroid cancer [7]. Because a disease-free postoperative thyroid bed should have uniform hyperechogenicity of fibrofatty connective tissue, any hypoechoic nodule in the thyroid bed is suspicious for recurrence [8, 9]. From our studies in which we analyzed 38 postoperative thyroid carcinoma patients, the rate of malignancy was

Keywords: local tumor recurrence, sonography, thyroid cancer, thyroidectomy, thyroid malignancy

DOI:10.2214/AJR.09.2513

Received February 3, 2009; accepted after revision December 10, 2009.

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AJR2010; 194:1596–1609

0361–803X/10/1946–1596

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significantly higher in nodules with marginal spiculation, microcalcification, and a taller-than-wide shape—that is, nodules with an anteroposterior diameter that is longer than the transverse diameter on a transverse or longitudinal plane [10–12]. Shin et al. [13] reported that all 20 recurrent tumors at the thyroid bed in their study had well-defined margins. However, Lee et al. [11] revealed that marginal irregularity was the sonography finding most frequently seen in their study of 19 recurrent tumors, with 78.9% showing marginal irregularity. Considering that spiculated margin is a well-known sonography finding of malignant thyroid nodules, the locally recurrent tumors might also have a spiculated margin [10]. This theory should be confirmed with further study.

Metastatic lymph nodes also frequently occur within the thyroid bed [3]. Sonography features suggesting metastatic lymph nodes include round shape, absence of an echogenic hilum, microcalcifications, hyperechogenicity, and cystic change [14]. The color Doppler sonography feature of a malignant lymph node is peripheral flow [3].

Despite several useful sonography findings suggesting locally recurrent thyroid tumors, it is still difficult to differentiate recurrent tumors from nonrecurrent lesions on sonography alone. Therefore, sonographically guided fine-needle aspiration cytology should be considered for nodules newly detected in the thyroid bed; with such sonography findings, local tumor recurrence can be diagnosed early [7, 11, 13] (Figs. 2–6).

Benign Conditions Mimicking Local Tumor Recurrence

Postoperative Scar

In some patients, posttreatment soft-tissue changes may persist indefinitely, and without the ability to compare surveillance scans with prior imaging studies, it can be difficult to interpret the surveillance scans. The persistence of areas of thickening may be related to the development of dense fibrous scar similar to cellular tumor on cross-sectional images. On serial scans, dense fibrous scars tend either to remain stable in size and configuration or to decrease in size [15] (Figs. 7 and 8).

Suture Granuloma

A suture granuloma is a benign granulomatous inflammatory lesion that may occur after a surgical intervention in which nonabsorbable suture materials were used [16]. Histologically, such a lesion is charac-

terized by a histiocytic reaction with foreign-body giant cells surrounding the suture materials [16] (Figs. 9–11).

Reactive Lymphoid Hyperplasia

Reactive lymphoid hyperplasia can also occur in the postoperative thyroid bed even after central neck dissection. If the lymph node is too small to be found during either the preoperative or the intraoperative time period, the remaining lymph node can be grown as a hypoechoic nodule by successive antigenic stimuli. In many cases, reactive lymphoid hyperplasia has the well-known sonographic characteristics of a well-defined, coffee bean-shaped, homogeneous nodule with preserved echogenic fatty hilum [14] (Fig. 12).

Remaining Thyroid Tissue

The remaining thyroid tissue rarely causes a diagnostic problem if we have information regarding the type of surgery performed on a patient. Remaining thyroid tissue appears as the normal thyroid parenchyma did before any additional treatment or if there was no underlying parenchymal disease such as thyroiditis [13]. With radioactive ablation therapy, remnant thyroid tissue undergoes progressive fibrosis, which appears as a heterogeneous hypoechoic mass [17] and shows no vascularity [18] (Figs. 13–15).

Miscellaneous

Occasionally, esophageal or tracheal diverticulum can cause diagnostic difficulties by mimicking local tumor recurrence in postoperative patients (Fig. 16).

Conclusion

Sonography is the most sensitive imaging technique for detecting locally recurrent tumor or regional lymph node metastasis [14]. The sonography findings typical of a recurrent tumor at the thyroidectomy site can be summarized as a hypoechoic nodule with irregular or spiculated margins, microcalcifications, and a taller-than-wide shape. Although benign conditions mimicking local tumor recurrences can also occur at the thyroidectomy site, understanding the characteristic sonography findings of some of the conditions allows us to avoid performing an unnecessary invasive procedure, such as sonographically guided fine-needle aspiration cytology or even surgery.

Acknowledgment

We thank Bonnie Hami, Department of Radiology, University Hospitals Health Sys-

tem, Cleveland, OH, for her editorial assistance in preparing the manuscript.

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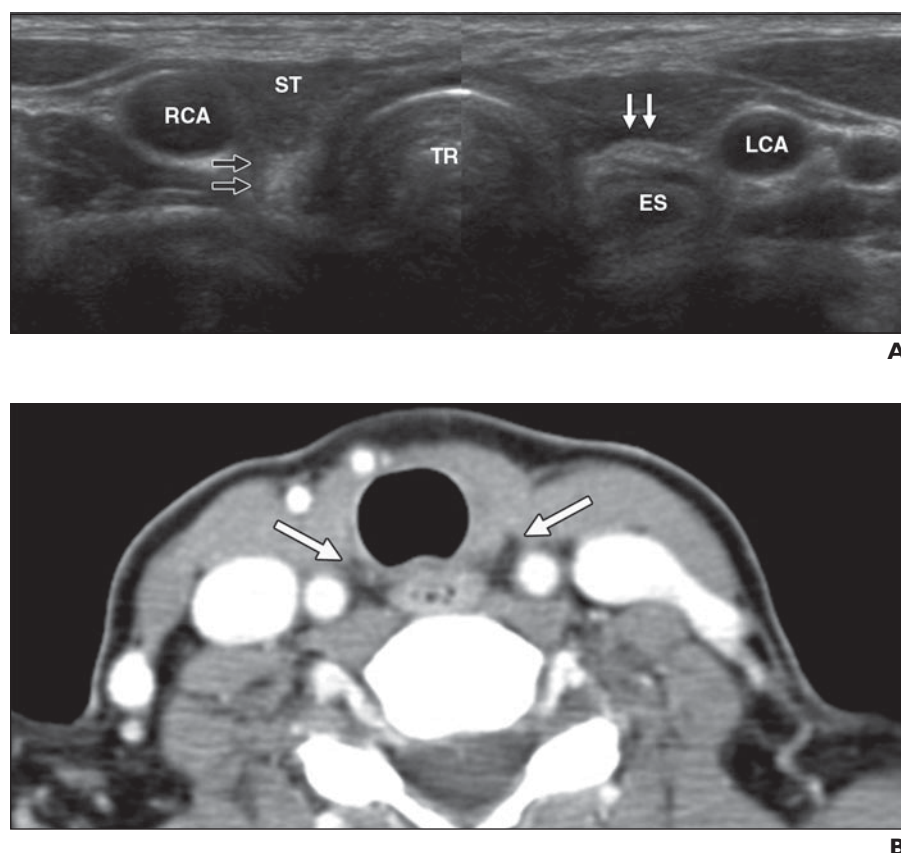


Fig. 1—Normal thyroid bed after total thyroidectomy in 43-year-old woman with thyroid cancer. **A**, On transverse sonogram, inverted triangular hyperechoic fibrofatty tissue (*black arrows*) is well depicted between carotid artery and proximal trachea in right thyroid bed. In left thyroid bed, hyperechoic fibrofatty tissue (*white arrows*) is flattened by posteriorly located cervical esophagus. When performing sonography, entire thyroid bed—that is, from lower half of thyroid cartilage to thoracic inlet—should be examined on transverse and longitudinal scans. A simple maneuver to turn the patient's neck the contralateral side is extremely useful for depicting the thyroid bed more clearly because collapsed thyroid bed is stretched away and adjacent normal structures are separated from one another. RCA = right carotid artery, ST = strap muscle, TR = trachea, ES = esophagus, LCA = left carotid artery. **B**, Axial contrast-enhanced CT scan shows complete obliteration of thyroid bed by small amount of fibrofatty tissue (*arrows*).

Sonography of Thyroidectomy Sites

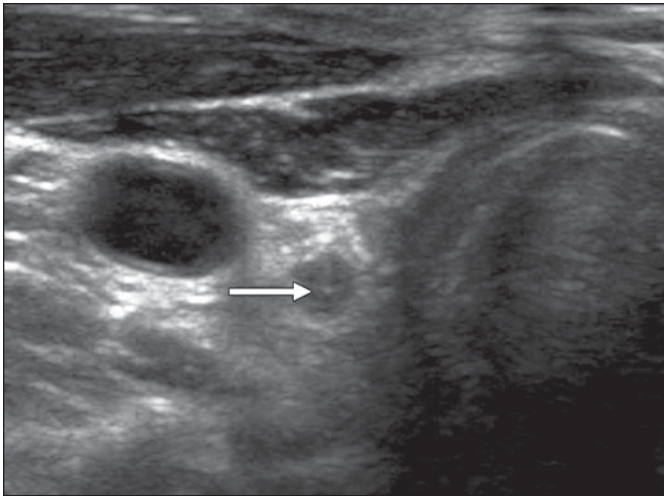


Fig. 2—38-year-old man who underwent total thyroidectomy for papillary thyroid carcinoma 18 months earlier. During follow-up, serum thyroglobulin level was elevated. Transverse sonogram shows 0.5-cm-long hypoechoic nodule with internal echogenic spot (*arrow*) suggestive of microcalcification on right thyroid bed. Subsequent surgery confirmed presence of recurrent papillary thyroid carcinoma.

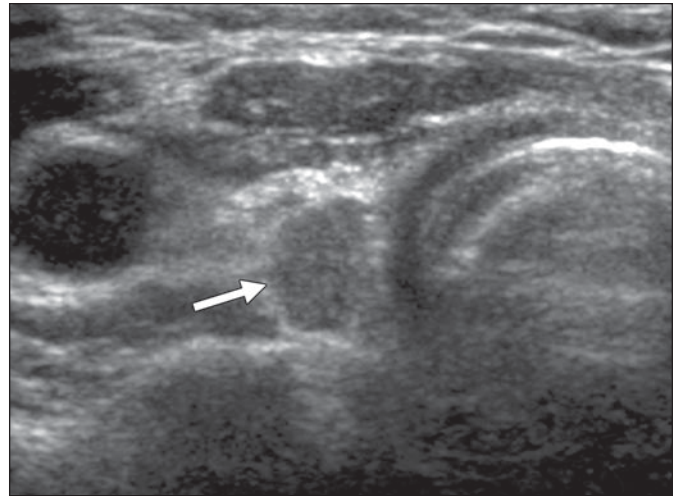
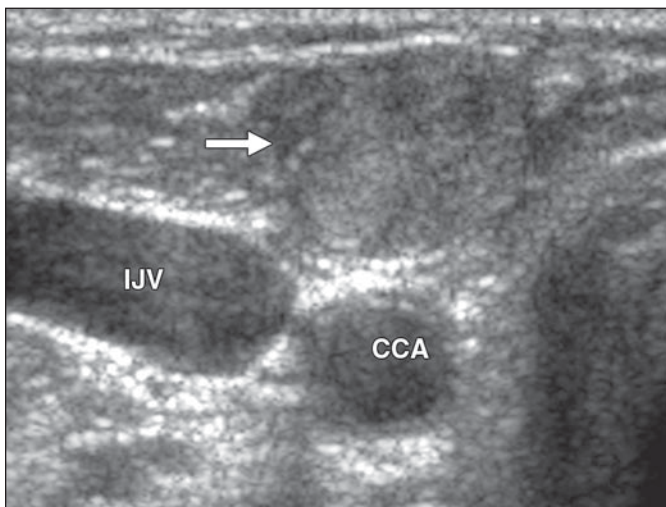
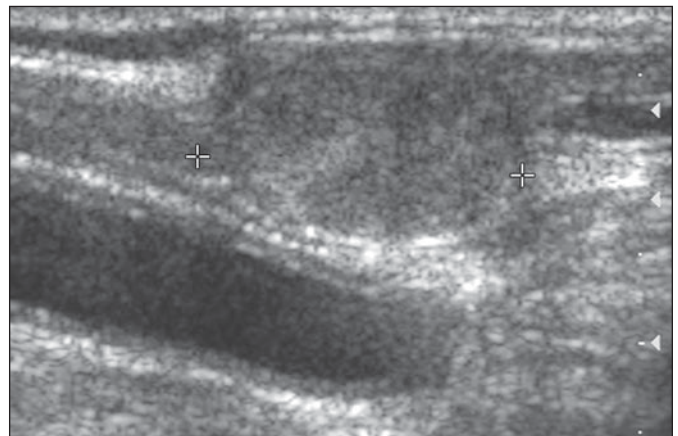


Fig. 3—47-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 12 months earlier. Transverse sonogram of right thyroid bed shows 0.7-cm-long hypoechoic nodule with spiculated margin (*arrow*) and taller-than-wide shape. This appearance is typical of locally recurrent tumor and was confirmed as recurrent papillary carcinoma by subsequent sonographically guided fine-needle aspiration cytology and excision.



A



B

Fig. 4—76-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 18 years earlier. Serum thyroglobulin level was elevated during routine follow-up.

A and B, Transverse (**A**) and longitudinal (**B**) sonograms show 2.2-cm-long, ill-defined, heterogeneous isoechoic nodule (*arrow*, **A**; *cursors*, **B**) located within strap muscles in right thyroid bed. It was confirmed as locally recurrent papillary carcinoma by sonographically guided fine-needle aspiration cytology and excision. IJV = internal jugular vein, CCA = common carotid artery.

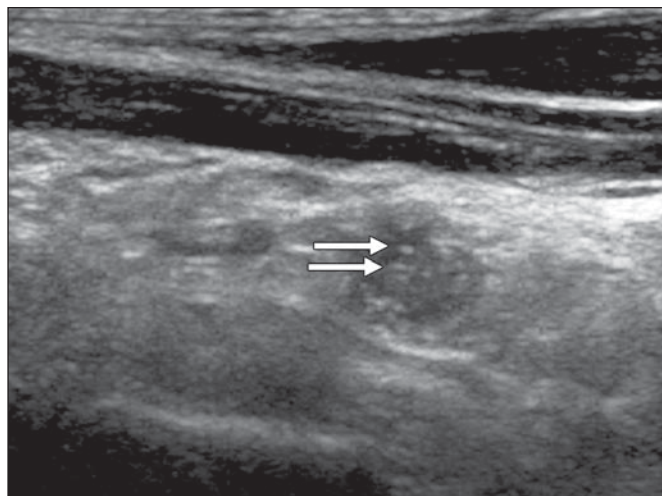
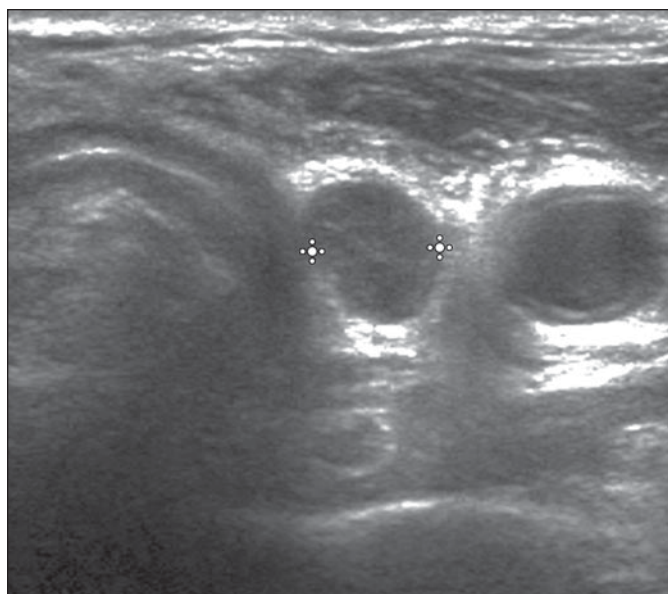
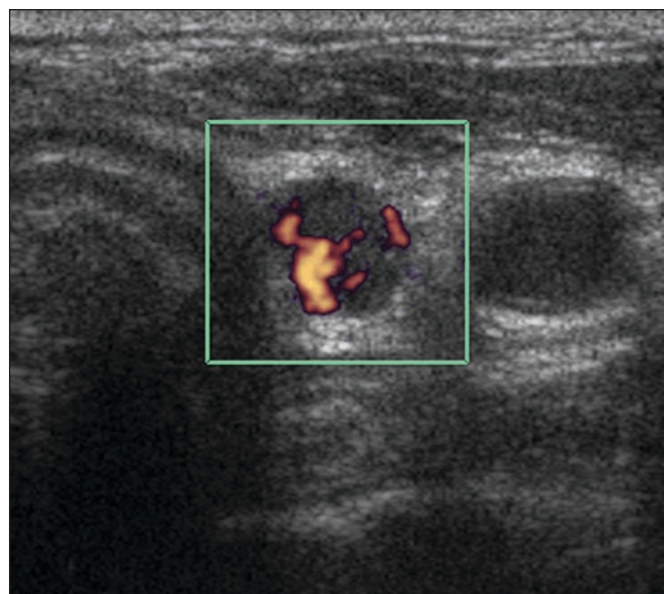


Fig. 5—41-year-old man who underwent total thyroidectomy for papillary thyroid carcinoma 31 months earlier. Follow-up longitudinal sonogram shows 0.7-cm-long hypoechoic nodule with multiple internal hyperechoic dots (*arrows*) suggesting microcalcification on right lower level 6. Pathologic examination based on surgery confirmed presence of recurrent papillary thyroid carcinoma.



A



B

Fig. 6—51-year-old man who underwent total thyroidectomy for papillary thyroid carcinoma 7 years earlier.

A, Follow-up transverse sonogram shows 0.9-cm-long, taller-than-wide hypoechoic nodule (*cursors*) on left thyroid bed.

B, Power Doppler sonogram reveals peripheral and intranodular vascularity. Subsequent cytologic examination based on sonographically guided fine-needle aspiration cytology confirmed recurrent papillary thyroid carcinoma.

Sonography of Thyroidectomy Sites

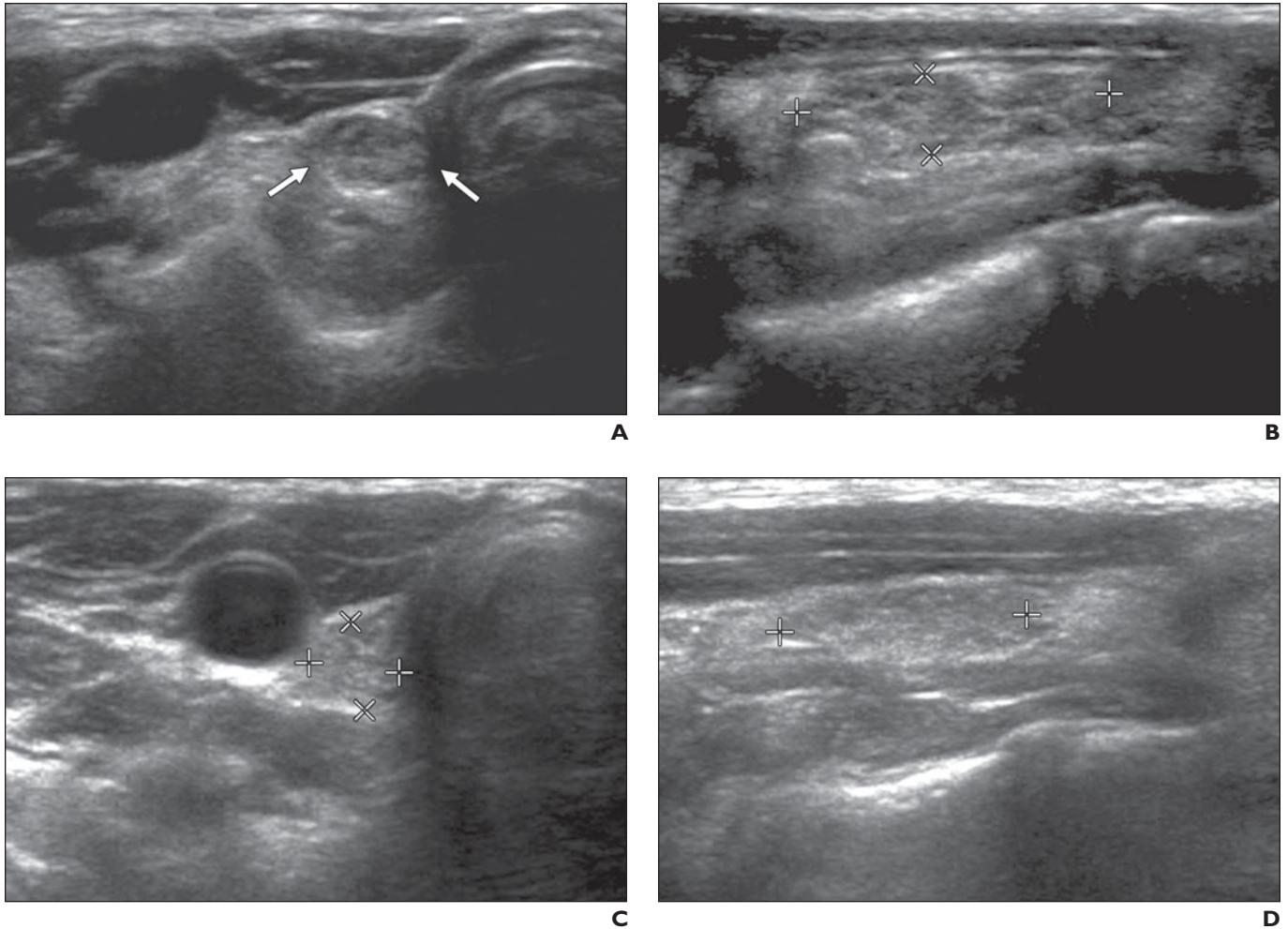


Fig. 7—15-year-old boy who underwent total thyroidectomy for papillary thyroid carcinoma 4 years earlier. **A** and **B**, Transverse (**A**) and longitudinal (**B**) sonograms show $0.5 \times 0.6 \times 1.6$ cm long, ill-defined, elongated, amorphous, heterogeneous echoic lesion (arrows, **A**; cursors, **B**) on right thyroid bed. Multiple linear internal echoes are seen parallel to tissue plane. Result of initial sonographically guided fine-needle aspiration cytology was nondiagnostic. **C** and **D**, Follow-up transverse (**C**) and longitudinal (**D**) sonograms obtained 11 months after **A** and **B** show that lesion (cursors) has decreased to $0.4 \times 0.4 \times 1.5$ cm long. Because it was negative on ^{131}I scanning, it was assumed to be postoperative scar.

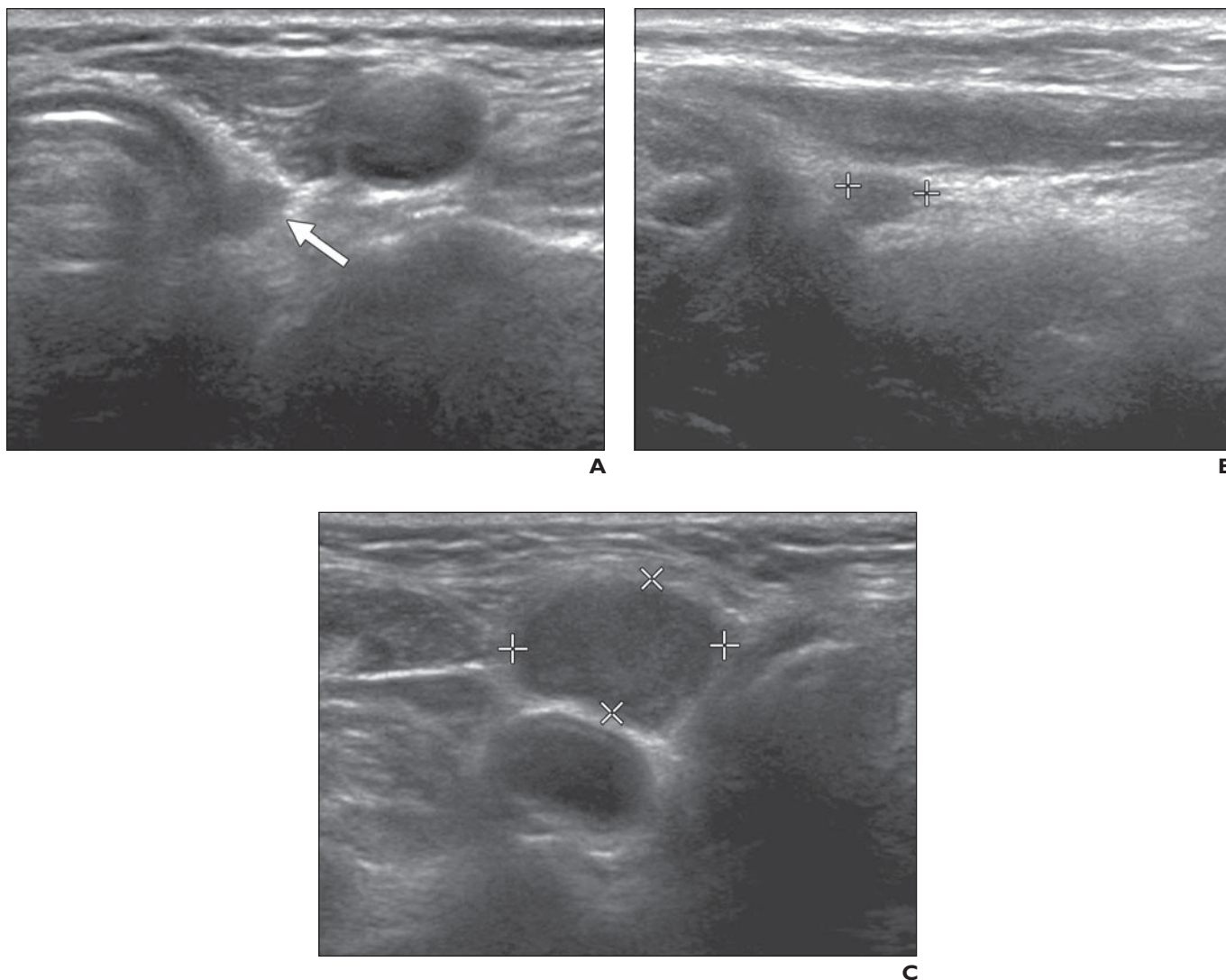


Fig. 8—68-year-old woman who underwent total thyroidectomy for right papillary thyroid carcinoma 13 years earlier. Because serum thyroglobulin level was elevated, sonography was performed.

A and B, Transverse (**A**) and longitudinal (**B**) sonograms show 0.5-cm-long, ill-defined, homogeneous hypoechoic nodule (*arrow, A; cursors, B*) located in left thyroid bed.

C, Sonogram obtained at same time as **A** and **B** shows metastatic lymph nodes (*cursors*) in right lateral neck.

Sonography of Thyroidectomy Sites

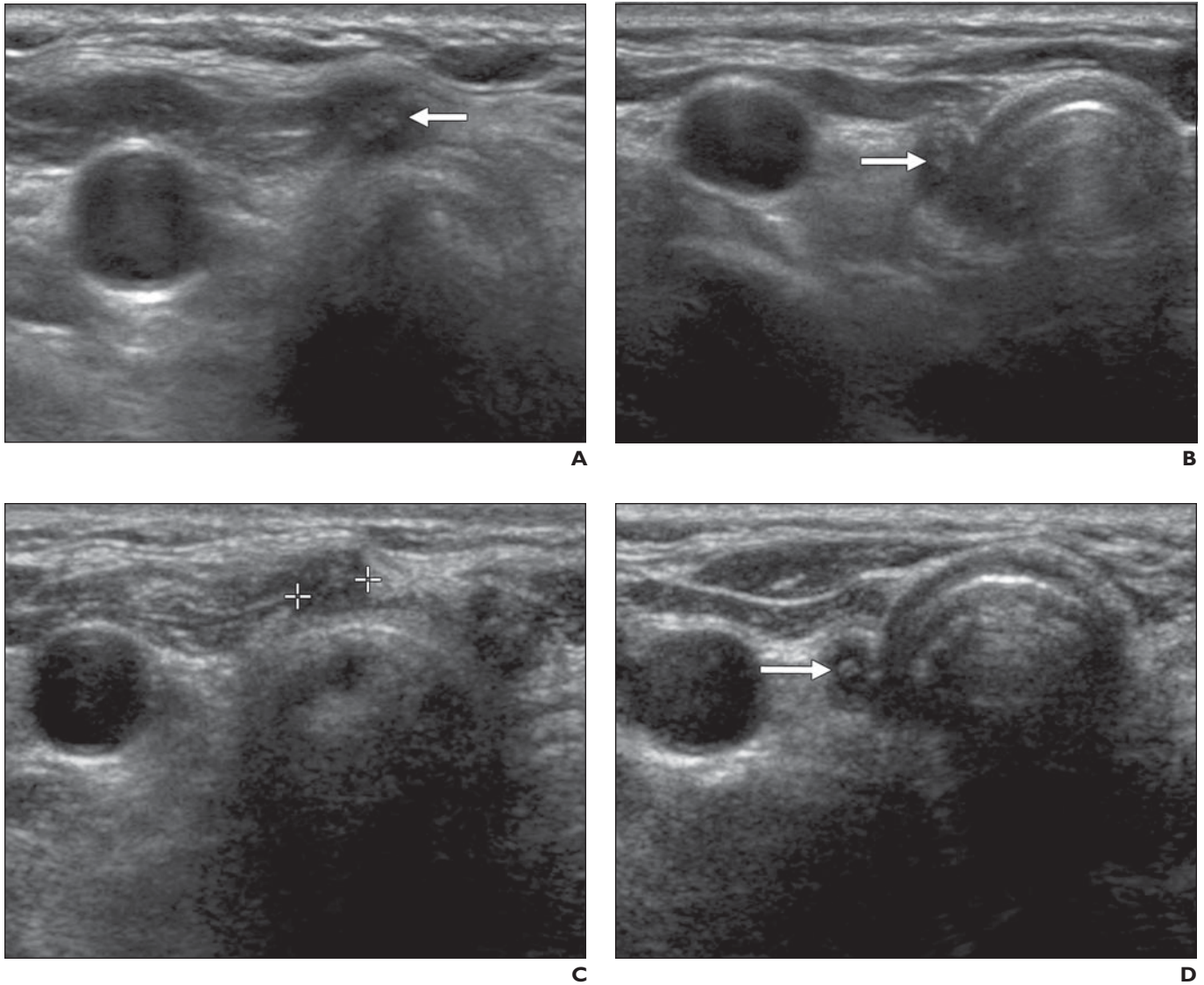


Fig. 9—27-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 10 years earlier.

A and B, On routine follow-up transverse sonograms, 0.5-cm-long (**A**) and 0.6-cm-long (**B**), ill-defined, round hypoechoic nodules with centrally or paracentrally located echogenic dots (*arrow*) are detected in thyroid bed. Subsequent sonographically guided fine-needle aspiration cytology revealed foreign-body granulomas.

C and D, Follow-up transverse sonograms obtained 6 months after **A** and **B** show that lesions had decreased to 0.4 cm (**C**) and 0.5 cm (**D**), respectively, and that margins of lesions (*cursors*, **C**) are clearer. Note paired appearance of centrally located echogenic dots (*arrow*, **D**), which was regarded as knot made by nonabsorbable suture.

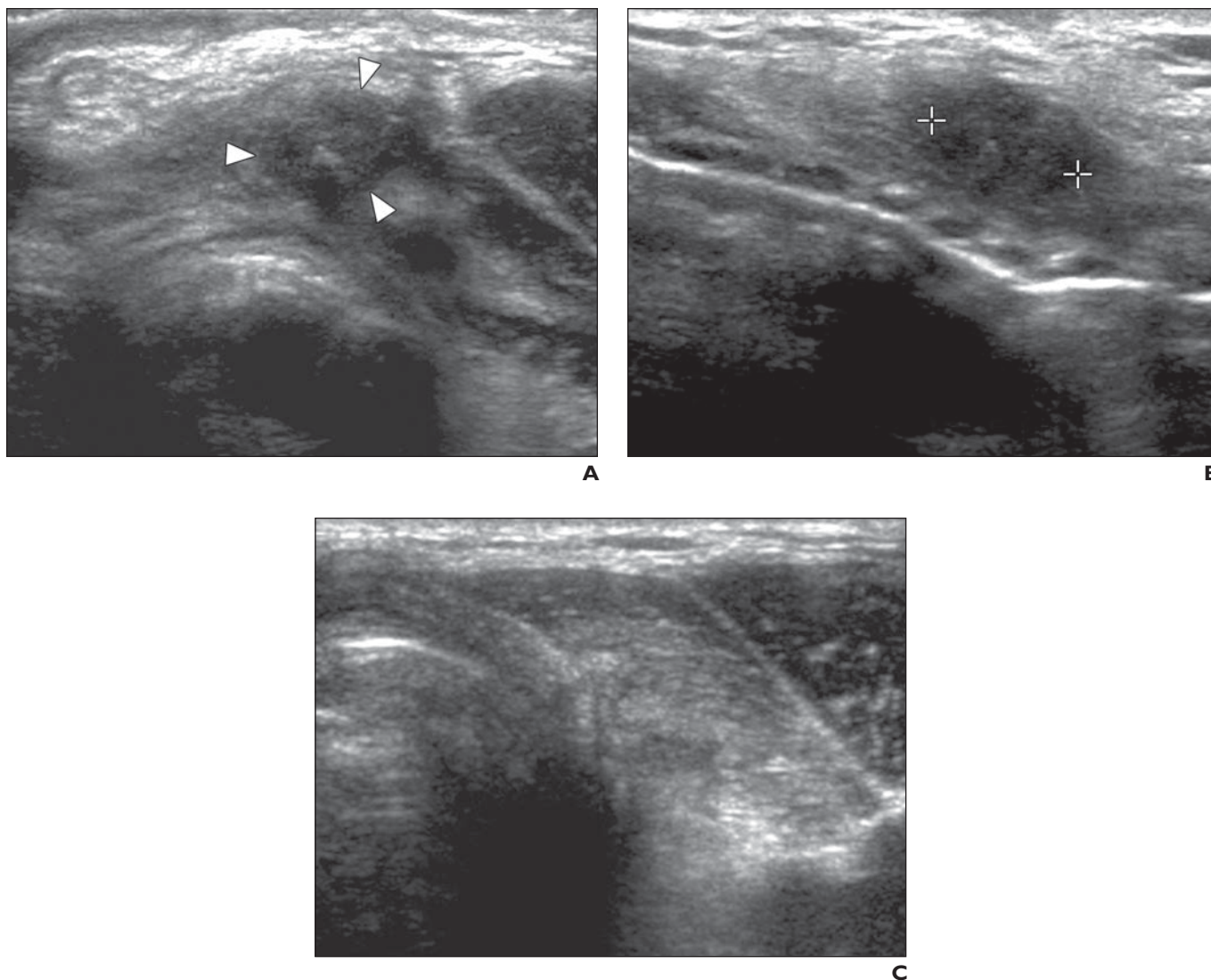


Fig. 10—42-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 3 years earlier.

A and B, On routine follow-up transverse (**A**) and longitudinal (**B**) sonograms, 1-cm-long, ovoid hypoechoic nodule (*arrowheads, A; cursors, B*) is detected anterior to cervical trachea. It has ill-defined margin and central echogenic focus with paired appearance. Foreign-body granuloma was suspected on sonography examination, and subsequent sonographically guided fine-needle aspiration cytology confirmed diagnosis of suppurative foreign-body granuloma.

C, Follow-up transverse sonogram obtained 2 years after **A** and **B** shows complete resolution of lesion.

Sonography of Thyroidectomy Sites

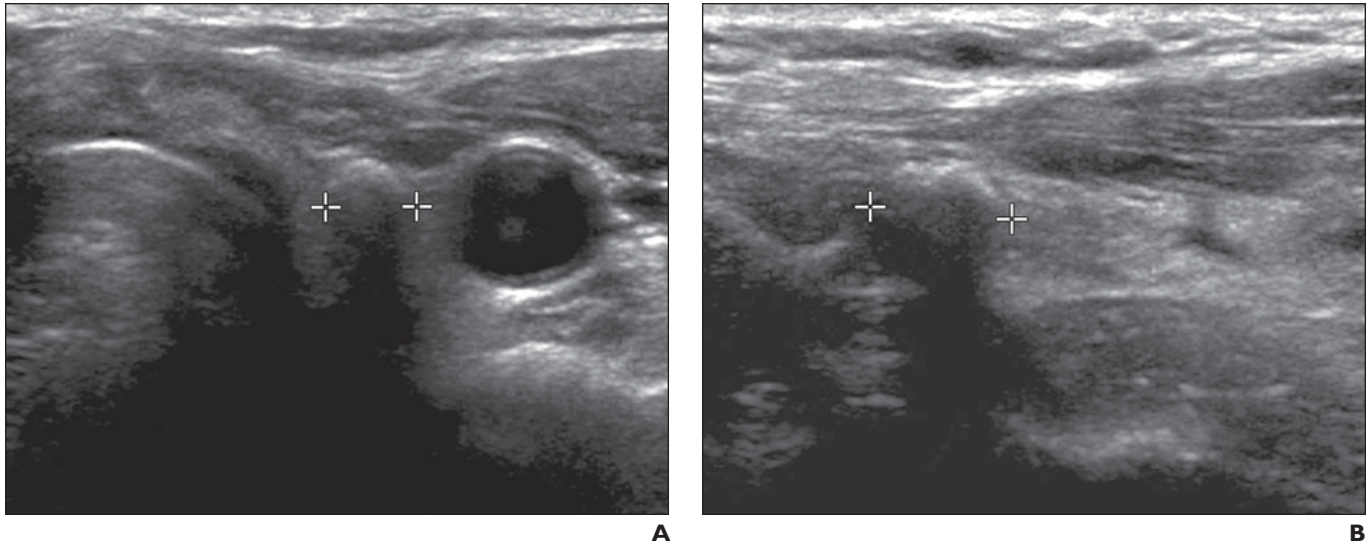


Fig. 11—49-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 14 years earlier.

A and B, On routine follow-up transverse (**A**) and longitudinal (**B**) sonograms, 0.5-cm-long, densely calcified nodule (*cursors*) with posterior acoustic shadowing is noted in left thyroid bed. Although calcification is frequently seen in recurrent tumors, result of sonographically guided fine-needle aspiration cytology was granuloma, which is consistent with negative results obtained on serum thyroglobulin level. Follow-up sonography images obtained 2 years later (not shown) showed no change in size or shape of granuloma.

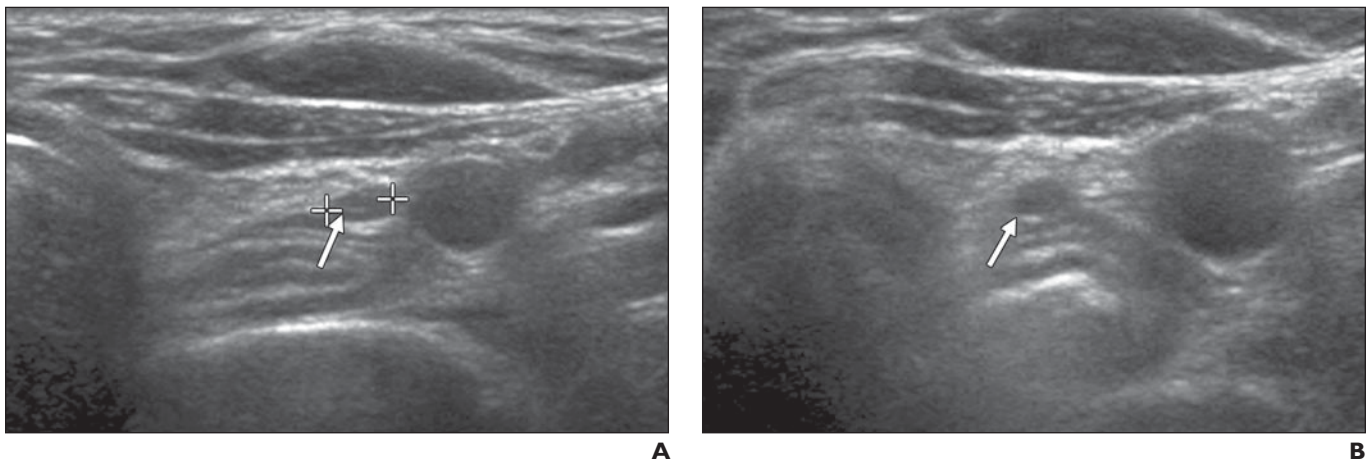
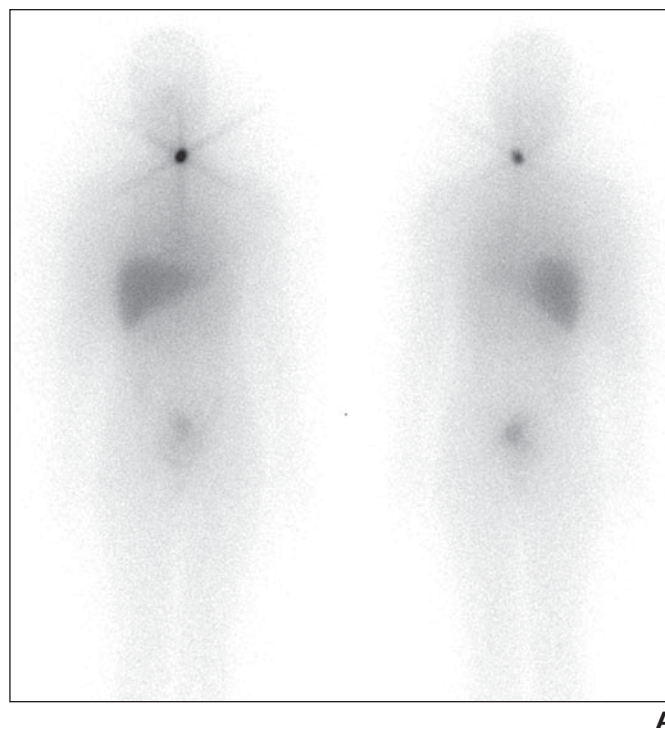


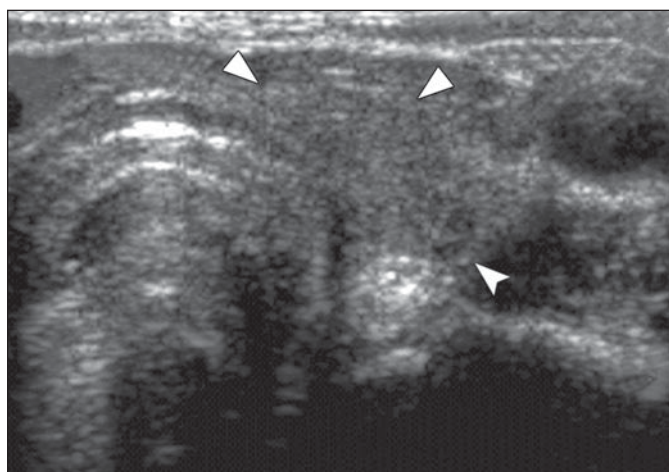
Fig. 12—29-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 4 years earlier.

A, Routine follow-up transverse sonogram shows 0.38-cm-long, well-defined, ovoid and elongated homogeneous hypoechoic nodule (*arrow* and *cursors*) in left thyroid bed. Nodule shows even cortical thickness and homogeneous hypoechoic homogeneity with posterior enhancement; these findings are typical of reactive lymphoid hyperplasia. Diagnosis of reactive hyperplasia was confirmed by sonographically guided fine-needle aspiration cytology.

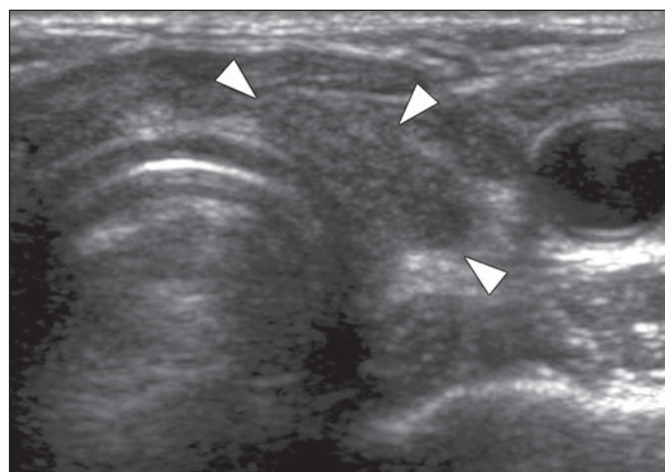
B, Follow-up sonography image obtained 30 months after **A** shows that lesion (*arrow*) has decreased in length to 0.26 cm.



A



B



C

Fig. 13—22-year-old woman was treated with 150 mCi (5,550 MBq) of ^{131}I 2 months after total thyroidectomy for papillary thyroid carcinoma 2 years earlier.

A, On ^{131}I whole-body scan, area of focal hot uptake is seen in left thyroid bed.

B, Transverse sonogram obtained 3 months after **A** shows 1.4 × 0.7 cm long, ill-defined, homogeneous hypoechoic nodule (*arrowheads*) in left thyroid bed. Although result of sonographically guided fine-needle aspiration biopsy was nondiagnostic, exploration of left thyroid bed was performed for suspicion of recurrent tumor due to elevation of serum thyroglobulin level, which failed to find recurrent tumor.

C, On follow-up transverse sonogram obtained 3 years after **B** shows mass (*arrowheads*) has decreased to 1.2 × 0.4 cm long; in addition, serum thyroglobulin level had decreased from 4.8 to 0.94 ng/mL. Remnant thyroid tissue was diagnosed considering all results—whole-body scan, change of serum thyroglobulin level, and follow-up sonography findings.

Sonography of Thyroidectomy Sites

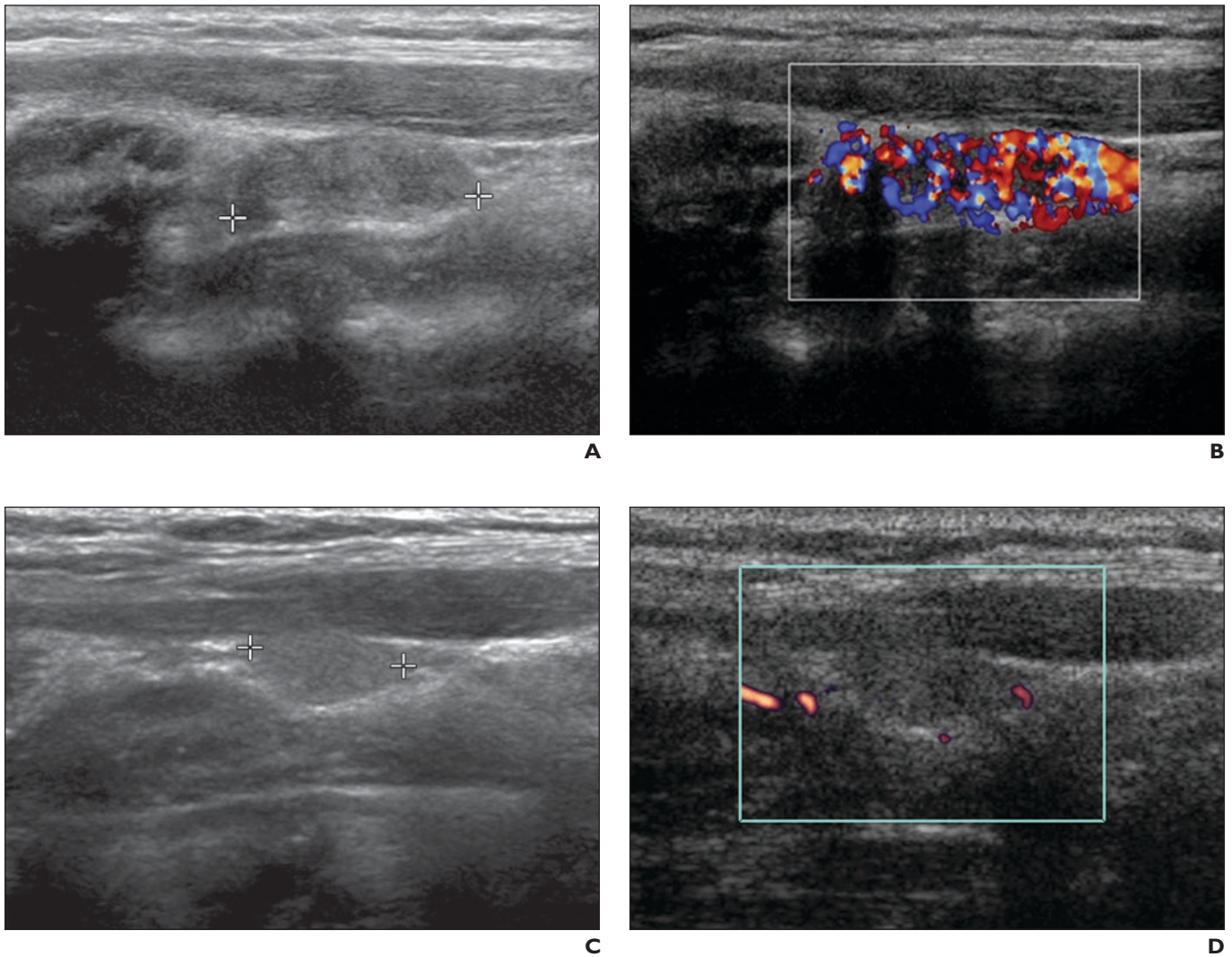


Fig. 14—42-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 18 months earlier.
A, Routine follow-up longitudinal sonogram shows 1.8-cm-long, hypoechoic solid nodule (*cursors*) on left thyroid bed.
B, Longitudinal color Doppler sonogram shows homogeneous intranodular and perinodular hypervascularity. Sonographically guided fine-needle aspiration biopsy confirmed lesion to be remnant thyroid tissue.
C and **D**, Follow-up longitudinal sonograms obtained 1 year after **A** and **B** show subsequent decrease of size (**C**) of nodule (*cursors*, **C**) and decrease of intranodular vascularity (**D**).

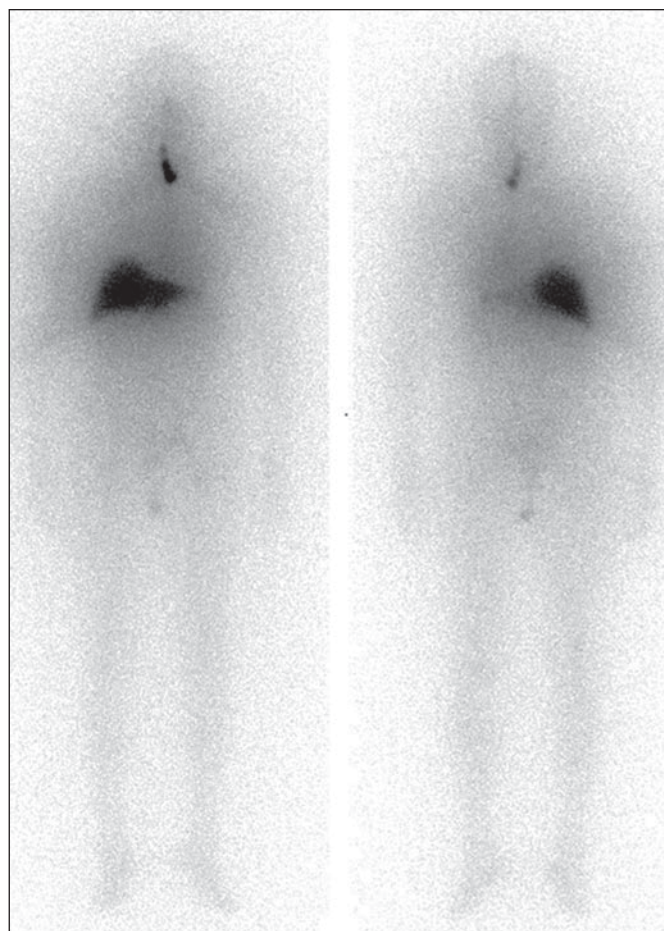
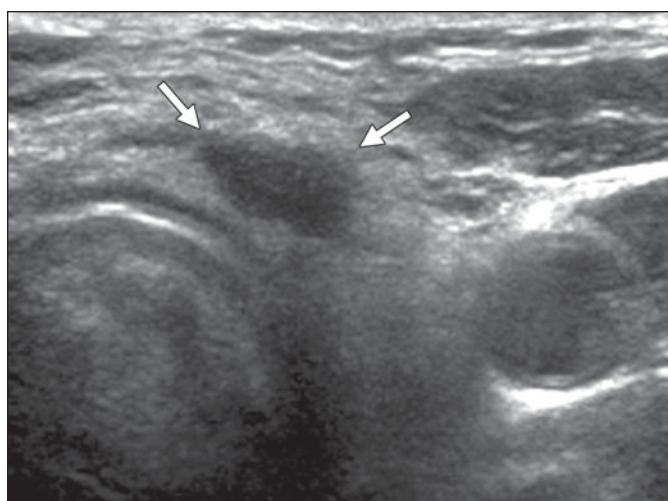
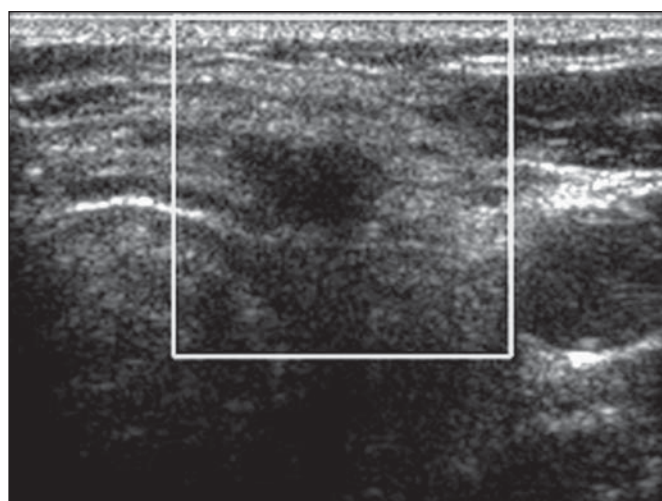
**A****B****C**

Fig. 15—76-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 2 years earlier.

A, On low-dose diagnostic ^{131}I whole-body scan obtained before therapy, area of focal hot uptake is seen in left thyroid bed.

B, Transverse longitudinal sonogram obtained 6 months after **A** shows 1-cm-long, ill-defined homogeneous hypoechoic nodule (arrows).

C, Transverse color Doppler sonogram shows no vascularity. Follow-up longitudinal sonogram obtained 6 months (not shown) revealed that lesion had decreased to 0.9 cm long. It was believed to be remnant ablated thyroid tissue considering results of whole-body scan and follow-up sonography.

Sonography of Thyroidectomy Sites

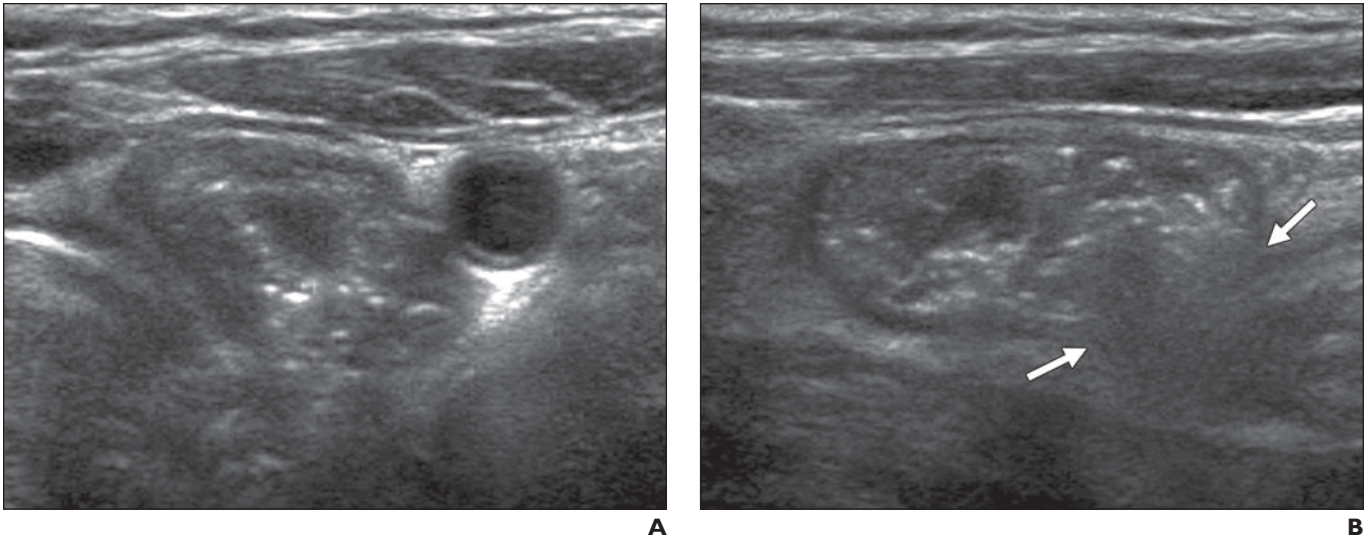


Fig. 16—58-year-old woman who underwent total thyroidectomy for papillary thyroid carcinoma 7 years earlier.

A and B. Routine follow-up transverse (**A**) and longitudinal (**B**) sonograms show 2.6×1.7 cm long, well-defined, heterogeneous low-echoic mass with even, hypoechoic rim in left thyroid bed. Lesion has multiple scattered echogenic spots mimicking calcifications. However, real-time sonography examination (not shown) revealed movement of echogenic spots and change in configuration of mass according to patient's swallowing. Longitudinal sonogram shows continuity of hypoechoic rim of mass (*arrows, B*) with outer muscle layer of cervical esophagus, suggesting Killian-Jamieson diverticulum (lateral esophageal diverticulum).