Benign Thyroid Nodule Interventions:
A Review and Imaging Considerations for the Interventional Radiologist

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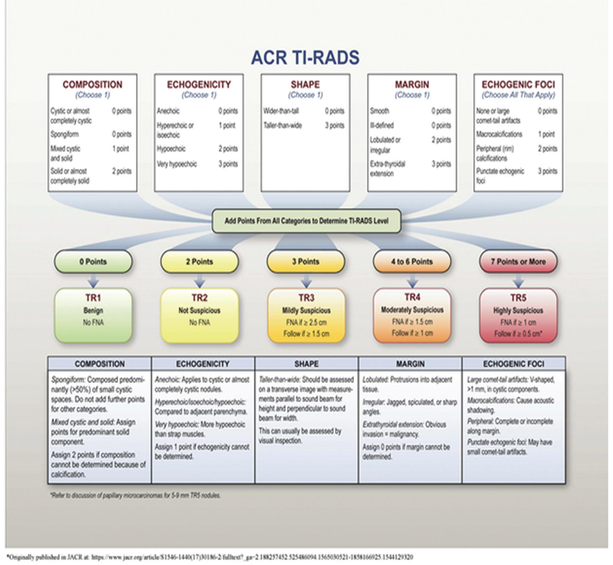
Background

- This educational exhibit reviews radiofrequency ablation (RFA) and embolization for benign thyroid nodules. This procedure is an alternative to traditional treatments like thyroidectomy and radioactive iodine.
- Thyroid nodules are predominantly benign but may cause compressive symptoms, or hyperthyroidism if they are functioning nodules.

Patient Workup

- Guidelines recommend at least two ultrasound guided fine-needle aspirations (FNAs) or core-needle biopsy (CNB) before RFA.
- Nodules should be characterized on US using The American College of Radiology's Thyroid Imaging, Reporting, and Data System (ACR TI-RADS), in conjunction with the Bethesda cytology classification system.



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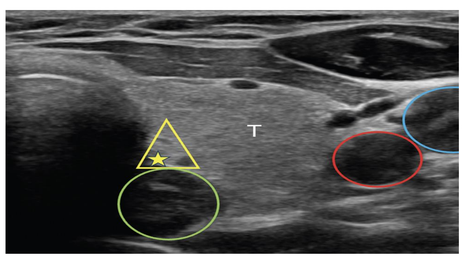
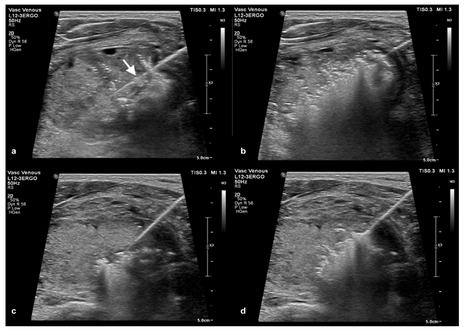
Clinical Findings/Procedural Details

- The thyroid RFA procedure involves percutaneous insertion of a needle electrode via a trans-isthmic approach. Lidocaine hydrodissection assists with the initial electrode insertion and avoidance of critical structures.



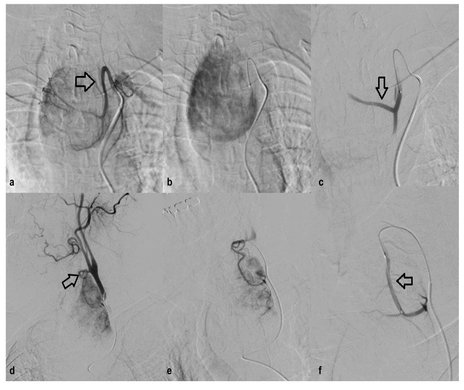
Ultrasound image depicting "danger zone" (yellow triangle) and approximate area of the recurrent laryngeal nerve (star). T=thyroid; green circle = esophagus; red circle = carotid artery, blue circle = internal jugular vein.

- The "moving shot" technique is recommended, where the electrode is incrementally moved within the nodule. By moving the ablation zone the operator can avoid heat injury to the vital structures.



Moving-shot technique. Needle indicated by arrow in a. Ablation proceeds from deep to superficial in various craniocaudal aspects of the nodule, as air bubbles will obscure the view of deeper portions of the nodule as ablation continues (b–d).

- Thyroid artery embolization (TAE) has recently emerged as an alternative to RFA for the interventionalist in scenarios where RFA or traditional open surgery is not feasible or difficult.

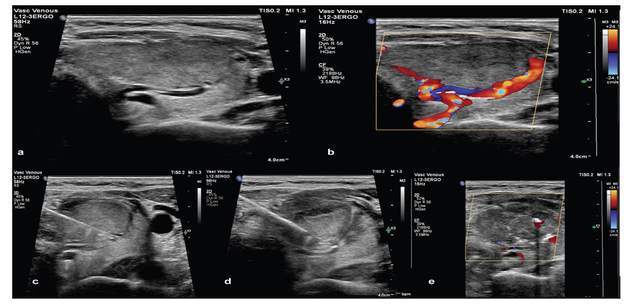


Left-sided superior and inferior thyroid artery embolization (STE/ITE) in a patient with a large nontoxic goiter and who was a poor candidate for surgery. The arrows in a and c represent the ITA (pre- and postembolization, respectively), whereas b shows parenchymal blush. Selective catheterization at the superior thyroid artery in e. The arrows in d and f represent the STE (pre- and postembolization, respectively), a branch of the external carotid.

Follow-Up

- In these patients, follow-up with clinic visits and ultrasound is performed at 1, 3, 6, and 12 months after ablation and every 6 to 12 months in the second year. Thereafter, patients are instructed to call back if they have a recurrence of compressive symptoms.
- For autonomous nodules, thyroid function tests should be checked at each follow-up visit to determine procedural success and if any medications need to be adjusted.
- The success of ablation for benign nonfunctioning thyroid nodules is determined by the volume reduction ratio (VRR) and the cosmetic and symptom score reduction. The following formula calculates VRR:

VRR = initial volume (mL)-final volume (mL) x 100/initial volume (mL).



Thyroid nodule in left lobe with visible thyroid artery (a). Color Doppler demonstrates flow within the thyroid artery (red signal, b). Arterial ablation in c and d with resultant loss of flow on color Doppler (e, circle).

Conclusions

- Thyroid RFA is a safe and minimally invasive treatment for benign thyroid nodules, and imaging plays a vital role in management.
- Proper workup includes ultrasound imaging classification to stratify the likelihood of malignancy and ultrasound-guided biopsy to confirm the diagnosis.
- The postprocedural ultrasound evaluation is the best objective measure of technical success and should be used along with clinical follow-up, such as symptom resolution, to evaluate procedural success
- TAE is another emerging procedure for thyroid goiter, specifically for patients with large surgically challenging goiters.