The authors performed a retrospective hospital institutional review board approved study to validate the feasibility and outcome of using a virtual needle tracking system (VirtuTRAX, CIVCO Medical Solutions, Kalona, IA) combined with real-time imaging to perform ultrasound (US)-guided percutaneous radiofrequency ablations (RFA) of benign thyroid nodules. Ultrasound imaging during pre-procedure planning and ablation helps to identify delicate anatomy such as the laryngeal nerve and other vital structures located near the thyroid. The virtual needle tracking system provides added RF electrode visualization during the ablation when changes in the tissues cause artifacts that obscure visualization.

Two subject groups were created based on expected complexity of a single nodule treatment. Group A patients underwent in-plane ultrasound-guided radiofrequency ablation of a thyroid nodule located less than 5cm from the skin surface and had anatomy demonstrating obvious trachea-esophageal groove margins under ultrasound imaging. Group B patients underwent out-of-plane approach to access the deepest margin of the nodule. The selected nodule was deeper than 5cm with a poorly detected trachea-esophageal groove margin.

Discussion and Results

All patients underwent a single radiofrequency puncture. The overall mean volume reduction of the nodule was greater than 70% with no difference in reduction seen between Group A and Group B. At 6-month follow-up, the treated nodules did not show signs of re-growth that would require additional treatment. Patient satisfaction with the outcome of the procedure was 93%. One patient in Group A experienced a first-grade skin burn.

Conclusions

Ultrasound-guided radiofrequency ablation of a benign thyroid nodule performed using VirtuTRAX:

- Provided active tip localization independent of ultrasound visualization
- Enabled in-plane and out-of-plane approach to safely access superficial and deep nodules of various difficulty
- “May improve accuracy and outcomes of radiofrequency ablation while reducing complication rate and shortening the learning curve.”

Author Commentary

“The VirtuTRAX (VT) system was used successfully in all procedures, providing guidance that allowed all procedures, even in challenging cases, to be performed with a single puncture.”

“In this setting, the use of virtual needle guidance could be helpful in reducing complications related to poor visualization of the RF electrode active tip, especially during ablation of nodules closer to sensitive structures (e.g. nerves, vessels, esophagus) or when nodules are closer to the danger triangle.”