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REVIEW

A short review of basic head and neck interventional procedures in a general radiology department

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Abstract

Image-guided interventional procedures provide a safe way to diagnose and treat a variety of head and neck abnormalities. The procedure time is usually short, and most procedures can be performed on an outpatient basis. Knowledge about strengths and weaknesses, efficacy, potential complications, and pitfalls of these procedures allows the best treatment to be chosen for a particular lesion type. This review discusses some of the commonly performed interventional radiology procedures in a general radiology department in the management of patients with neoplastic diseases in the head and neck region.

Keywords: *Head and neck; cancer; interventional procedure; biopsy; ethanol ablation; vocal cord injection; radiofrequency ablation.*

Introduction

As in most areas of medicine, radiology plays a pivotal role in head and neck surgery and oncology. This review discusses some of the commonly performed interventional radiology procedures in a general radiology department in the management of patients with neoplastic diseases in the head and neck region.

Ultrasound-guided biopsy

The initial step in the work-up of any neoplastic disease is to establish the diagnosis. While mucosal lesions in the upper aerodigestive tract can be accessed and biopsied by endoscopy, many malignant tumors present as mass lesions in the neck, which may or may not be palpable.

Modern high-resolution ultrasound is ideal in the initial assessment of most neck lesions, and can determine their nature and delineate their location and extent, with the exception of deep-seated lesions[1]. Although ultrasound is sensitive in identifying the abnormality, it may lack specificity. This shortcoming can be overcome by combining ultrasound with fine-needle aspiration cytology (FNAC). FNAC performed under ultrasound guidance therefore complements diagnostic ultrasound in the evaluation of head and neck lesions. It is a readily available, inexpensive, relatively noninvasive, well tolerated, and rapid outpatient procedure with reported diagnostic accuracy in malignant lymphadenopathy exceeding 90%[2]. However, often there are still nondiagnostic FNAC samples (due to suboptimal smear preparation, scanty aspirate, or heavy blood contamination) and incomplete classification, especially in cases of lymphoma. The nondiagnostic rate for FNAC in head and neck lesions ranges from 10% to 30%[3–6], and in part depends on the cytologist's expertise. Repeating the FNAC may not always provide definitive diagnosis, while increasing patients' anxiety and frustration. As such, core-needle biopsy under ultrasound guidance is a valuable alternative. In fact, some institutes prefer core-needle biopsy as the first approach to tissue sampling.

Core biopsy needles fall into 2 major categories: side-cutting and end-cutting needles. Side-cutting needles consist of the outer cutting shaft and the inner stylet with a specimen notch (Fig. 1). With the needle tip positioned at the target tissue edge, the inner stylet is advanced into the target tissue, which will partly prolapse into the specimen notch. The specimen is obtained by advancing the outer cutting shaft to resheath the inner stylet and cut out the specimen core. The major drawback of side-cutting

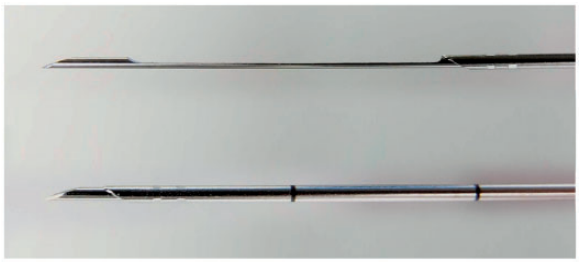

Figure 1 **Side-cutting needle consists of the outer cutting shaft and the inner stylet with a specimen notch. With the needle tip positioned at the target tissue edge, the inner stylet is advanced into the target tissue, which will partly prolapse into the specimen notch. The specimen is obtained by advancing the outer cutting shaft to resheath the inner stylet and cut out the specimen core.**

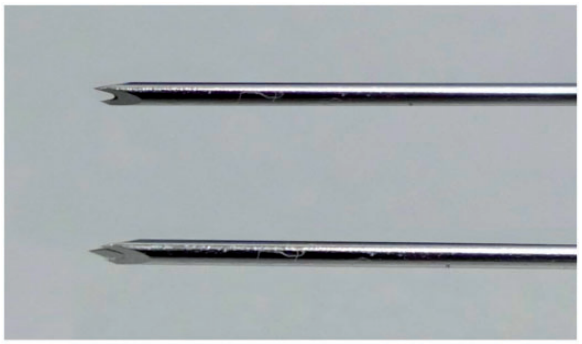

Figure 2 **End-cutting needles comprise an inner stylet and an outer trocar. The technique of using the end-cutting needle is similar to that for the use of fine needles for aspiration cytology. There are different designs of the configuration of the tip of the end-cutting needles, and this example shows the serrated cutting end of the Franseen needle.**

needles is that part of the outer shaft and the stylet distal to the specimen notch may have to extend beyond the target to place the notch at the optimal position, such that there is increased risk of injury to adjacent structures. This is a particular concern for biopsy of neck lesions, which are frequently in close proximity to major vessels. Moreover, the amount of sample retrieved in each pass is determined by the size of the specimen notch, and often multiple passes may be required to obtain adequate tissue samples, especially when microbiology or biochemical tests are needed in addition to histopathology.

End-cutting needles comprise an inner stylet and an outer trocar (Fig. 2). The needle tip is positioned at the target area within the sampling tissue, and a syringe is attached via a connection tube to the trocar after removal of the inner stylet. With suction applied by the syringe, the trocar is moved to-and-fro and rotated to retrieve the sample specimen. Specimen disposal from the needle is achieved by reintroduction of the trocar or saline flush into a specimen bottle. The technique of using the end-cutting needle is similar to that for the use of fine needles for aspiration cytology. It can be safely used for biopsy of even small lesions close to vital structures, provided that the needle tract is clearly delineated and the needle tip is confined within the target tissue under ultrasound guidance. Furthermore, end-cutting needles frequently obtain adequate tissue samples in one pass because long cores of tissue are retrieved by the cutting suction mechanism, with no limitation by the specimen notch as in side-cutting needles. There are different designs of configuration of the tip of the end-cutting needles. Larger-bore needles with cutting tips such as the Franseen trephine type (Angiotech, Vancouver, BC, Canada), the slotted type, and a more acute bevel angle supposedly yield better specimens[7].

Core biopsy yields large tissue samples with preserved architecture which, together with immunohistochemical stains, provide precise histopathologic diagnosis. Published results show excellent performance of side-cutting needles for head and neck lesions, widely perceived as a safe and effective technique for biopsy of head and neck lesions[8–12] including lymph nodes[13,14], salivary glands[15], and thyroid[16–19]. Sensitivity, specificity, and accuracy of 97.9%, 99.1%, and 97.9%, respectively, were reported by Kim et al.[13] for ultrasound-guided core-needle biopsy of cervical lymphadenopathy in patients with no known malignancy, with no procedure-related complications. Screaton et al.[14] also reported sensitivity, specificity, and accuracy of 98.1%, 100%, and 98.7%, respectively, for ultrasound-guided core biopsies of cervicofacial lymphadenopathy in the differentiation of benign from malignant lymphadenopathy. For lymphoma, sensitivity of 98.5%, specificity of 100%, and accuracy of 98.7% in the differentiation of lymphoma from reactive lymphadenopathy[14], and 80% sufficiency in histological subclassification to guide management without the need for surgical biopsy have been reported[14]. Buckland et al.[15] reported a short series of ultrasound-guided cutting-needle biopsy of parotid lesions in 16 patients. The biopsy yielded diagnostic specimens in all patients and was diagnostic in 13 patients whose FNAC were inconclusive. Accuracy of 100% was observed in 7 patients who were subsequently operated on, and 9 patients avoided unnecessary surgery. A modified coaxial technique for simultaneous FNAC and biopsy of thyroid nodules was proposed by Strauss et al.[18] in cases when FNAC alone was insufficient. Ultrasound-guided core-needle biopsy was advocated by Kwak et al.[19] as a safe and accurate method for the diagnosis of thyroid lymphoma, and may suitably replace diagnostic thyroid surgery.

To our knowledge, there are no published results on the performance of end-cutting needles for head and neck

lesions, and thus direct comparison between the 2 needle types is not feasible. However, our own experience[20] in using the Franseen trephine type needle with the serrated stylet tip showed it to be safe and of high yield in terms of adequacy and accuracy. The risk of injury to normal structures occult on ultrasound, such as the facial nerve within the parotid gland during needle advancement with the trocar in situ, is minimal and no greater than that of FNAC. No complication of tumor seeding along the biopsy tract, significant hemorrhage, or scar induction were encountered, presumably because of the small caliber of the needles used and the minimal (only one in most of the cases) number of needle passes required. At our institute, the use of the Franseen needle biopsy extends to biopsy of deep-seated lesions via the intraoral approach under ultrasound guidance[21]. The use of the Franseen needle, with its lower risk of injury to adjacent vasculature and high yield in a single pass, is ideal for this purpose. 18-Gauge or 20-gauge Franseen needles usually suffice for biopsy of lymphadenopathy and salivary glands. 22-Gauge Franseen needles are optimal for biopsy of thyroid lesions, small lesions, and deep-seated lesions via the intraoral approach.

Percutaneous ethanol injection ablation of neck nodal metastases from papillary thyroid carcinoma

Interventional radiology also contributes to the treatment of malignant disease in the neck. One of the common applications is to perform ultrasound-guided percutaneous ethanol ablation of neck nodal metastases from papillary thyroid carcinoma.

Total thyroidectomy with excision of affected regional nodes is the most common primary treatment for papillary thyroid carcinoma. It is often complemented by ablation of remnants with radioactive iodine-131. However, on follow-up new or previously undiagnosed lymph node metastases may be identified in many patients with papillary thyroid carcinoma.

For recurrent papillary thyroid carcinoma, radioiodine therapy is often of limited value. In view of the indolent course of the disease and the difficulty of subsequent surgery, there is a need for a less invasive approach than repeated surgical exploration for treating patients with limited nodal metastases.

Percutaneous ethanol injection is a well-established treatment modality in other body parts, including hepatocellular carcinoma (HCC)[22], benign parathyroid adenomas, hyperfunctioning thyroid nodules[23], and cystic thyroid nodules[24]. Percutaneous ethanol injection treatment of limited cervical lymph node metastases from papillary thyroid carcinoma was first reported by Lewis et al.[25]. Five or fewer involved lymph nodes that are amenable to percutaneous ethanol injection was proposed as the selection criteria, and patients were either poor surgical candidates expressing preference for no further surgery or were unresponsive to previous radioiodine therapy.

The technique is relatively straightforward. Under ultrasound guidance, each node is punctured and injected at multiple sites for complete treatment. Alcohol 99.5% is used, and the volume injected depends on the lesion size. Injection is stopped when the lesion is completely filled or when the injected ethanol starts to diffuse along the needle track toward the surrounding soft tissues. The deepest portion of node is treated first; the needle is then repositioned and injection is repeated until the entire node is adequately treated (Fig. 3). Care must be taken to avoid diffusion of ethanol along the needle track into surrounding cervical soft tissues. At least 2 treatment sessions are required for each patient, because the lesion is usually mostly solid before the first injection and the injected ethanol tends to diffuse back along the needle track before the lesion is completely treated. The lesion then becomes more necrotic a few weeks later, and a second injection usually can completely fill up the lesion.

Routine clinical and sonographic follow-up every 6–8 weeks is then arranged for each patient. The end point is achieved when the node on follow-up has disappeared or decreased in size, and there is no residual evidence of perfusion on power Doppler. A small percentage of patients may experience transient hoarseness or minor and transient pain, but major complication such as nerve damage is rare.

Advantages of percutaneous ethanol injection (PEI) include that it is far less invasive than neck exploration, can be repeated multiple times without increased technical difficulty, is of low cost with little or no morbidity, and can be performed as an outpatient procedure. It is therefore an inexpensive, effective, essentially risk-free alternative for patients who might otherwise be considered for watchful waiting.

Repeated exploration and radioiodine therapy are reserved as appropriate treatments for patients with widely metastatic disease and for those with a more aggressive form of papillary thyroid carcinoma.

Ultrasound-guided vocal cord injection for unilateral vocal cord paralysis

Ultrasound is also useful in guiding procedures aiming to treat complications of malignant disease. One recently introduced application is ultrasound-guided vocal cord injection for unilateral vocal cord paralysis[26].

Vocal cord paralysis caused by tumor infiltration of the recurrent laryngeal nerve is a common complication in patients suffering from neck and mediastinal malignancies. The approach to treatment of symptomatic unilateral vocal cord palsy is to attain medialization of the paralyzed vocal cord. The glottic competence on phonation and swallowing can be restored by bringing the paralyzed cord to midline or near-midline position, with only one functional contralateral vocal cord.

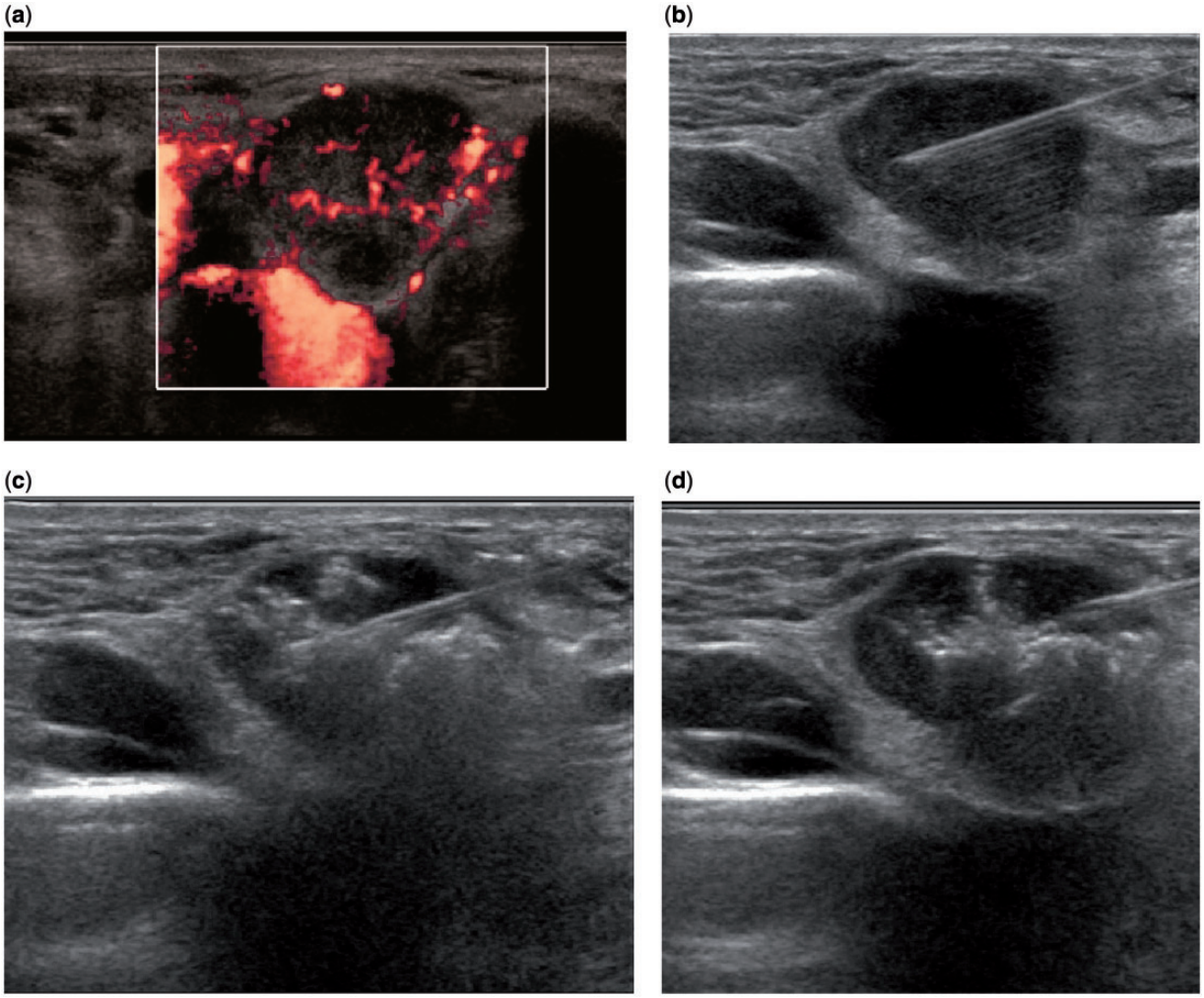

Figure 3 **(A) Power Doppler ultrasound shows a metastatic node from papillary thyroid carcinoma with prominent vascularity. (B) The needle is first positioned at the deepest part of the metastatic node. (C) Ethanol injected into the metastatic node appears echogenic. (D) The needle tip is repositioned at another site for further injection until the entire node is adequately treated.**

Traditional surgical treatment includes vocal cord injection and laryngeal framework surgery. Transcutaneous vocal cord injection is usually the preferred treatment because of its relative simplicity. The needle can be inserted through the cricothyroid membrane toward the undersurface of the vocal cord[27], or through the thyrohyoid notch to access the endolaryngeal and then the vocal cord under endoscopic guidance[28]. This action allows direct visualization to guide needle placement for injection. However, at times the alterations/variations in anatomy may not allow needle entry.

Alternatively the needle can be inserted directly through the thyroid cartilage to enter the vocal fold. This transcartilaginous approach avoids any anatomic constraint to access the vocal cord except for heavily calcified/ossified thyroid cartilage. However, it is a submucosal approach and is mostly a blind procedure, which at times can be difficult for accurate needle positioning, and is particularly problematic in patients with thick neck soft tissues in whom external judgment of the level of the vocal cords is a daunting task.

Ultrasound guidance is a useful adjunct to this procedure[26]. The false vocal cords and the vocal ligament (free edge of the true cord) appear hyperechoic because of their high fibrous content, while the true vocal cords appear hypoechoic because of their high muscle content[29–31]. The level of vocal cords is approximately at the midpoint between the thyroid notch and the lower border of thyroid cartilage at the midline. The sonographic identification of the vocal fold can be further facilitated by reference to the phasic vocal cord movement (of the normal side) during respiration. As such, ultrasound can be used for real-time guidance of needle entry and direction of insertion to attain the optimal position for vocal cord injection (Fig. 4). The needle entry site is paramedian, with angulation targeting the

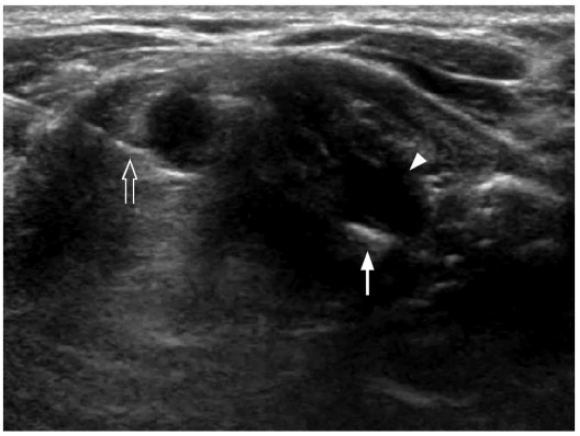

Figure 4 **Ultrasonogram shows normal appearance of the left larynx: vocal fold (arrowhead), arytenoid (arrow); the injecting needle (open arrow) is inserted into the right vocal fold via the transcutaneous transcartilage approach.**

center of the vocalis muscle. A number of biocompatible materials can be used for injection. We have used Radiesse or Restylane. Radiesse is an injectable implant that contains synthetic calcium hydroxyapatite microspheres (25–45 μm) suspended in an aqueous gel carrier. Restylane (small particle-size hyaluronic acid) contains animal- or bacterial-derived variations of the naturally occurring extracellular glycosaminoglycan present in various human tissues such as the vocal cord lamina propria. The location and adequacy of vocal cord medialization may also be assessed during injection by ultrasound[26].

Ultrasound-guided vocal fold injection for unilateral vocal cord paralysis helps patients with cancer to regain the glottic competence on phonation and swallowing, thereby mitigating the problems of hoarseness and aspiration.

Radiofrequency ablation

In 1975, Onofrio[32] reported on fluoroscopic-guided radiofrequency ablation (RFA) rhizotomy for the treatment of trigeminal neuralgia in 140 patients, the first report on percutaneous RFA for head and neck disease. At present, percutaneous RFA is an established treatment option for various head and neck diseases. This section focuses on the RFA procedures predominantly performed in radiology departments, particularly using ultrasound guidance.

In the late 1990s, Solbiati et al.[33] and Dupuy et al.[34] reported on percutaneous RFA for local-regional control of recurrent well-differentiated thyroid carcinoma (DTC). Between 2001 and 2011, multiple studies reported successful disease control for local-regional recurrent DTC[35–38] and benign thyroid nodules[39–49] by ultrasound-guided percutaneous RFA.

Computed tomography (CT)-guided percutaneous RFA for head and neck diseases has also been used for local control of recurrent adenocystic carcinoma by Bui et al.[50] in 2002, and in a series of patients with advanced head and neck cancer by Brook et al.[51] in 2008 and Owen et al.[52] in 2011. However, its reported use and application are less than ultrasound-guided guided RFA procedures.

Principles of RFA

RFA works by sending an oscillating current to a target lesion via an active tip. The current returns by a large-area dispersive electrode that adheres to another part of the body. A high field density is created around the needle tip because of its relatively small area, and micromovements of tissue ions are induced by the oscillating current, which in turn creates frictional heat. When the frictional heat reaches a cytotoxic threshold (threshold temperature usually >60°C), thermal ablation is achieved. The thermal energy is dissipated by conduction to areas adjacent to the active tip, inducing further coagulation necrosis or reversible hyperthermia in farther tissues, depending on the temperatures attained[53] (Fig. 5).

The time required to induce irreversible cellular damage is shorter at a higher temperature. At tissue temperature of 50–52°C, cell death occurs in 4–6 minutes, whereas at 60–100°C, cellular damage occurs almost instantly. Further increase in tissue temperature to 100–110°C results in tissue vaporization[54].

Preablation assessment

Imaging

CT or ultrasound guidance should be performed before treatment for documentation of lesion size, volume, and characteristics. Fibrosis and calcification are an intrinsic hindrance to thermal ablation[53] while for predominantly cystic lesions, ethanol ablation is a good alternative[55].

FNAC

FNAC should be done under image guidance to ensure that the sample is taken from a representative area. For malignant lesions, a positive FNAC result is generally considered adequate, whereas 2 FNACs obtained on 2 separate occasions are required before treating benign thyroid nodules.

Symptoms and cosmetic concerns

These aspects could be documented by the help of a visual analog scale or scoring system for ease of comparison during follow-up[54].

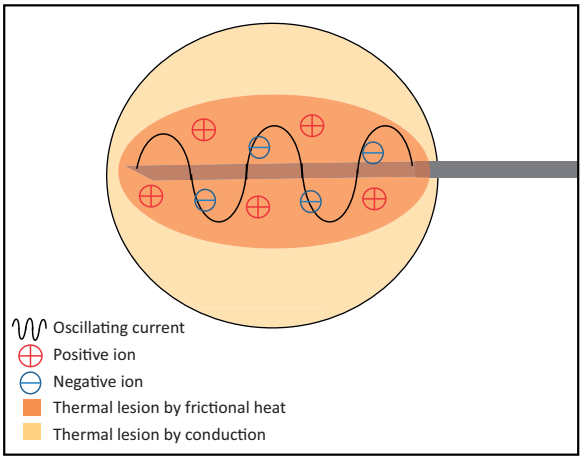

Figure 5 **Thermal lesion formed around active tip of RF electrode.**

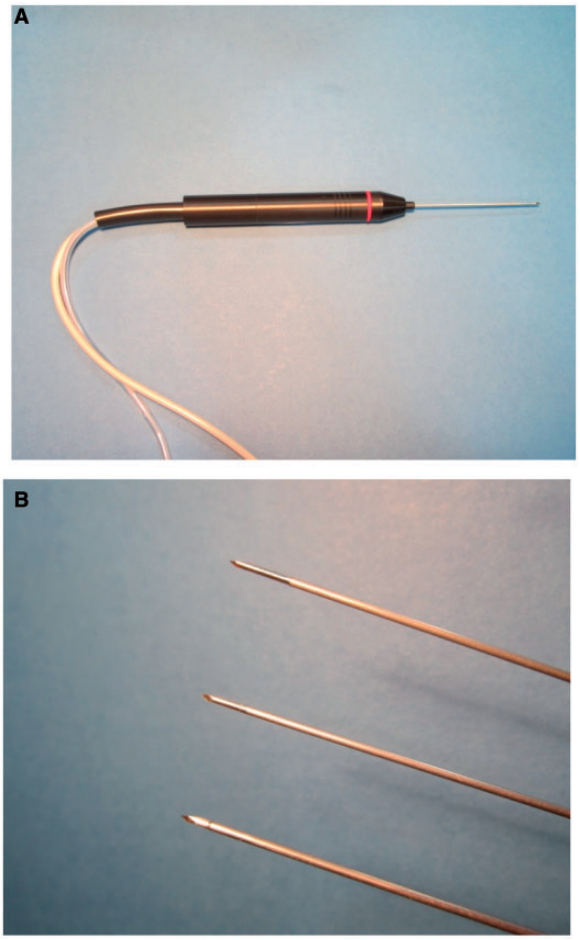

Figure 6 **(A) Internally cooled RF electrode for thyroid lesion: 7 cm long, 18-gauge (Apro Korea, CoATherm Ice). (B) Close-up view of active tips: 5 mm, 7 mm, and 10 mm.**

Laboratory test

In general, a complete blood count and coagulation profile are obtained. For the treatment of thyroid-related lesions, thyroid function, serum thyroglobulin, and antithyroglobulin antibody are measured[37].

Devices

Current output from a radiofrequency (RF) generator is delivered to the lesion via an RF electrode. Two types of RF electrodes have been used. A multipronged expandable electrode (14-gauge, 10 cm long with 4–9 prongs expandable to 3.5–4.0 cm) was used by Deandrea et al. and Spiezia et al.[40,43] for their treatment of benign thyroid nodules, whereas a single, straight RF electrode (17–18-gauge, active tip 0.5–2 cm) (Fig. 6) was used in most other studies treating benign thyroid nodules or malignant head and neck cancer[35–39,41,42,44–49]. A straight electrode is more popular probably because of its smaller needle bore and easier manipulation for complete lesion ablation[54]. An internal cooling system, to prevent tissue charring and improve RF energy dissipation, is incorporated in most of the current straight electrodes. The radius of thermocoagulation is reported to be increased from 8 mm to 10–12 mm when an internal cooling system is incorporated[35,36].

Procedure

For ultrasound-guided RFA, it is advisable to have venous access before the start of the procedure to prepare for any complication that may require resuscitation, although such a condition has never been reported. Local anesthesia is adequate for pain control. Premedication is avoided in most reported studies, as continuous verbal communication with patient serves as an important guide to identify any injury to the recurrent laryngeal nerve[37,41,42]. Local anesthesia is used for infiltration of the skin puncture site and around the target lesion. A small (3–4 mm) skin incision was made by Deandrea et al.[40], catering for the use of a larger-bore multipronged electrode, whereas studies that used straight electrodes did not require a skin incision[35–39,41,42,44–49].

Electrodes are introduced in a plane such that the whole needle tract and the needle tip are visualized on ultrasound. The active tip is placed to avoid injury of structures in the danger triangle deep to the medial aspect of the thyroid gland, where the recurrent laryngeal nerve and/or esophagus are expected (Fig. 7). The transisthmic approach is therefore advocated for the treatment of thyroid lesions[54] (Fig. 7).

Transient echogenic change during treatment is thought to represent coagulative necrosis and tissue vaporization, and serves as an indicator of successful thermocoagulation. The echogenic area generated immediately obscures posterior structures (Fig. 8) and, for larger lesions, the electrode tip has to be repositioned a few times for complete treatment[35–37,39,41,42]. It is therefore recommended to ablate lesions from deep to

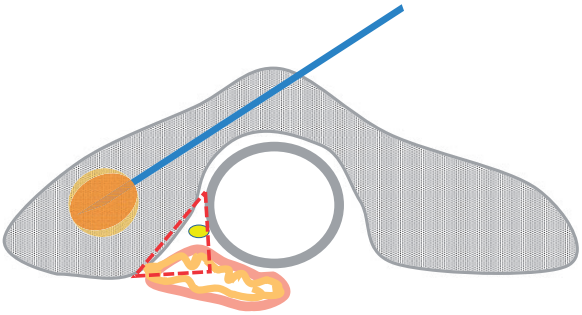

Figure 7 **Trans-isthmic approach. Blue line represents RFA electrode. Orange and yellow spheres represent thermal lesion. Danger triangle is enclosed by red dotted line. Yellow dot represents recurrent laryngeal nerve. The esophagus is shown in pink.**

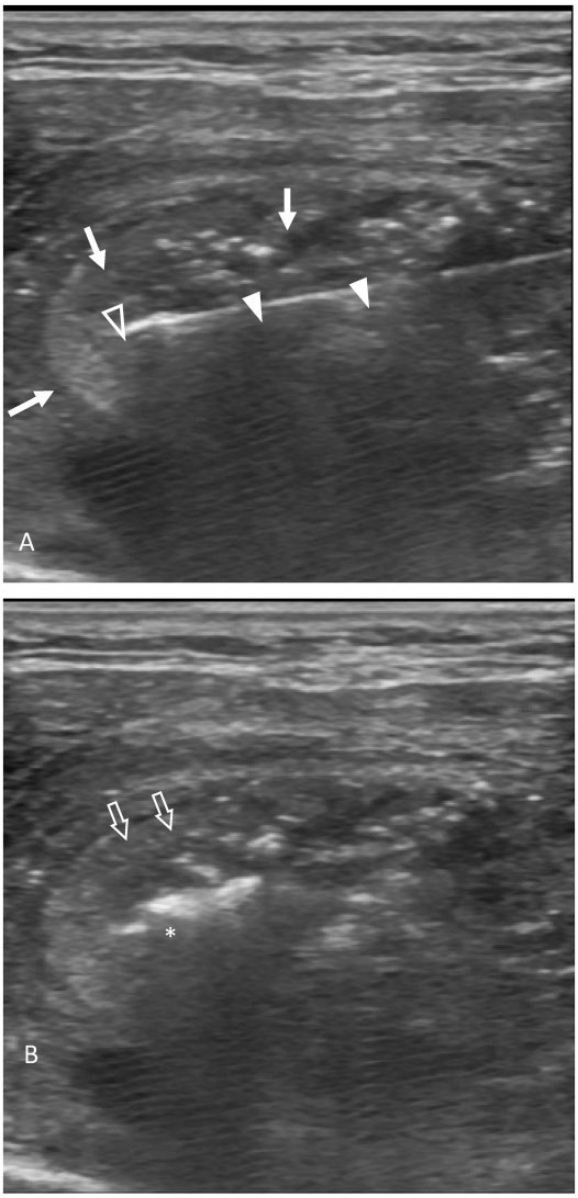

Figure 8 **Sequential transverse ultrasound-guided image of the right lobe of thyroid during RFA via trans-isthmic approach. (A) RFA needle (white arrowheads) in situ. Active tip (open arrowhead) and thyroid nodule (arrows). (B) Echogenic change (open arrows) around the active tip represents thermocoagulation. Note the echogenic change that obscures posterior visualization (asterisk).**

superficial and from remote to close. Based on the above concept, Baek et al. proposed a moving shot technique for the treatment of larger thyroid lesions[37,41,42,44,45,49].

Ablation begins at a lower current, such as 30 W for 1-cm active tip or 50 W for a 1.5-cm active tip. If a transient hyperechoic zone does not form within 5–10 s, stepwise increment of power by 5–10 W is adopted up to a maximum of 100–110 W. Complete ablation is indicated by complete echogenic change of lesions after RFA.

CT-guided RFA is done under general anesthesia and, less often, conscious sedation[50,52]. It requires close monitoring by telemetry and continuous pulse oximetry. Vital signs should be closely recorded.

Monitoring and follow-up

Patients should be monitored for an hour after the procedure with light compression applied to the site of treatment. Severe neck pain or discomfort is managed with oral or intravenous analgesics[54].

Clinical symptoms, cosmetic concern, serum thyroglobulin level, thyroid function, and imaging appearances are monitored on follow-up. On ultrasound, treatment response is seen as reduction in size, and reduction/absence of intranodular vascularity if previously present. Progressive involution should be expected in the first few months to up to a year. Enlargement of the nodule after initial shrinkage should raise suspicion for recurrence, and an image-guided FNAC should be performed[35,37].

Efficacy

Ultrasound-guided RFA is predominantly used for local control of recurrent DTC (Table 1)[35–38]. Surgery remains the gold standard for the treatment of thyroid carcinoma and nodal metastasis.

RFA has been shown to be a safe and effective alternative for the treatment of cervical recurrence that is not suitable for surgery. RFA results in significant reduction in size and symptomatic improvement, with a low local recurrence rate if the lesions are completely ablated. The serum thyroglobulin level is generally reduced[37] but is more variable, as there may be other confounding factors such as distant metastasis.

Baek et al.[37] and Lewis et al.[25] suggested that RFA is superior to ethanol ablation for DTC recurrence, since it provides better disease control with fewer treatment sessions. Monchik et al.[36] advocate RFA for lesions

larger than 1 cm, and ethanol injection for lesions smaller than 10 mm or in close proximity to nerves.

CT-guided RFA in patients with incurable head and neck cancer, who have failed standard curative treatment, has been shown to be an effective treatment alternative that addresses the challenges of local control and quality of life (Table 2)[50–52].

Complications

Ultrasound-guided RFA

For ultrasound-guided RFA the complication rate is low, with hoarseness of voice being the most significant sequela. Most patients experience transient pain and heat sensation during RFA. This is usually well tolerated, and is reduced by lowering or turning off the power for a few seconds. Lower neck swelling and local discomfort are common[35,38,45] but usually self-limiting, and resolve within 1–2 weeks.

Hematoma and skin burn may occur along the treatment tract. Hematoma is usually a result of mechanical injury rather than thermal injury. If a hematoma is large, RFA should be deferred. Skin burn was reported in 2 patients treated for recurrent DTC[35,38] and in a few patients treated for benign thyroid nodules[39]. All occurred at the puncture site, resulting from a protruding active tip from a superficially located lesion, and all resolved within 2 weeks using topical ointments.

Important structures close to the thyroid gland include the recurrent laryngeal nerve, the esophagus, and the trachea. Recurrent laryngeal nerve palsy is usually detected during or immediately after the procedure as hoarseness of voice. Recovery usually occurs within 3 months, but residual dysphonia tends to be permanent[35,37–39,42,45]. If the target lesion is close to the recurrent laryngeal nerve, injection of 5% dextrose in water solution[36] or normal saline[54] between them may help in preventing nerve injury. If voice change occurs during the procedure, the ablation should be stopped immediately[45,54]. Heat irritation of the trachea results in coughing, and RFA should be stopped. To date, no permanent injury to the trachea or esophagus has been reported. Carotid blowout, procedure-related death, abscess, or infection has not been reported, but such possibilities should be kept in mind.

CT-guided RFA

Major complication rates of 11% and 14% were reported by Brook et al.[51] and Owen et al.[52], respectively. In both series, complications consisted of carotid blowout and stroke, with one patient dying as a result of carotid blowout. Retrospective analysis of intraprocedural CT scans by Brook et al.[51] revealed that the retractable electrodes were within 1 cm of the carotid artery during ablation in these cases.

The Task Force Committee of the Korean Society of Thyroid Radiology has published recommendations for the optimal use of RFA for benign thyroid nodules and recurrent thyroid cancers, based on literature review, multicenter studies, and expert consensus[56]. Indications for RFA of benign thyroid nodules include symptomatic

Table 1 **Results of ultrasound-guided RFA in locoregional recurrence from differentiated thyroid cancer**

	Dupuy et al., 2001[35]	Monchik et al., 2006[36]	Baek et al., 2011[37]	Park et al., 2011[38]
No. of patients	8	16	10	11
No. of lesions	11	23	12	16
Follow-up months, range (mean)	6–26 (10.3)	10–68 (40.7)	16–31 (23 ± 5.5)	1–14 (6)
Local recurrence	1	2	1	2
New recurrence in the neck	2	3	2	Not available
Size reduction (mm)	24–18 mm	–	13.8 ± 7 to 3.3 ± 9.9 mm	–
Volume reduction	–	95% for lymph nodes	41–400%	9.4–96.8%

Table 2 **Results of CT-guided percutaneous RFA in advanced hand and neck cancer**

	Bui and Dupuy, 2002[50]	Brook et al., 2008[51]	Owen et al., 2011[52]
No. of patients	1	14	21
No. of lesions	1	27	21
Lesion response	70% necrosis	Yes (by RECIST criteria)	Yes (by RECIST criteria)
Quality of life	Ear pain and facial paralysis resolved before mortality from pulmonary metastasis	Improved in 67% (4/6 patients) by University of Washington quality of life scores	Improved (by University of Washington quality of life scores)
Complications	0	3 (11%)	3 (14%)
Carotid blowout	0	1 (with death)	1
Stroke	0	2	2

RECIST, Response Evaluation Criteria in Solid Tumors.

nodules, nodules causing cosmetic problems, and autonomously functioning thyroid nodules (AFTN) causing thyrotoxicosis. RFA may be used in patients with recurrent thyroid cancers in the surgical bed or lymph nodes, those who are at high surgical risk, or those who decline further surgery.

Conclusion

Image-guided interventional procedures provide a safe way to diagnose and treat a variety of head and neck abnormalities. The procedure time is usually short, and most procedures can be performed on an outpatient basis. Knowledge about strengths and weaknesses, efficacy, potential complications, and pitfalls of these procedures allows the best treatment to be chosen for a particular lesion type. With close collaboration with clinical colleagues, innovative treatment for a variety of lesions can be developed by head and neck interventional radiologists.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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