



Advancements in thyroid surgery: enhancing safety and efficacy through technological and clinical innovations

The field of thyroid surgery has undergone significant advancements since Emil Theodor Kocher was awarded the Nobel Prize in Physiology and Medicine in 1909 for his contributions to the field. Over the years, numerous developments have been made to improve the safety and efficacy of thyroid surgery, particularly in the last decade. These advances have focused on lowering bleeding risks, protecting the recurrent laryngeal nerves (RLN), reducing postoperative hypoparathyroidism, minimizing scarring, and improving the detection of malignant diseases. One treatment modality that particularly stands out in lowering most of the medical risks and effectively treating various benign and malignant conditions is radiofrequency ablation (RFA).

To treat benign thyroid nodules that cause compressive symptoms or cosmetic disfigurement, ablative techniques have been employed, including chemical (ethanol or polidocanol) and thermal (laser, high-intensity focused ultrasound, microwave, and radiofrequency) therapies. Ethanol ablation has proven effective in cystic nodules over the past few decades. Since Food and Drug Administration (FDA) approval in 2018, RFA has gained popularity and shown a greater than 50 percent volume reduction rate for solitary nodules in many studies. The complication rate associated with RFA is lower than traditional thyroidectomy and can be done under local anesthesia in an office setting. Some patients are shown to have continued volume reduction beyond one year (1).

The increased use of imaging modalities in recent years has led to more frequent incidental detection of thyroid nodules. Consequently, the incidence of low-risk papillary thyroid cancer (PTC) has increased. Due to the indolent nature of these PTCs, the American Thyroid Association guidelines recommended active surveillance with regular imaging that could lead to additional invasive procedures such as biopsy and surgery. Many patients live with the anxiety of knowing that they still have cancer that could progress. Some retrospective studies from Korea and China have shown promising results of using RFA to treat PTC, with a meta-analysis showing no local tumor recurrence, lymph node metastasis, or distance metastasis in at least 5 years (2).

Thyroid resections are associated with some significant risks. Damage to the RLN remains one of the most devastating complications of thyroid surgery. Over the past decade, many people have tried various ways to lower the risk of RLN damage by using continuous intraoperative nerve monitoring (CIONM) of the vagus nerve and protecting the nerve by placing human amnion/chorion membrane allograft. Additionally, parathyroid glands are closely associated with the thyroid anatomically, and given their embryological origin, the exact location of the glands can be challenging to detect, especially during thyroid surgery for malignant diseases that involve possible metastatic lymph nodes. Recent technologies using near-infrared autofluorescence (NIRAF) and indocyanine green (ICG) have been utilized to detect the location and vascularization of the parathyroid gland effectively (3). However, using RFA with direct ultrasound visualization makes the risk of RLN damage very low. In a recent large North American study published in the *Surgery*, of the 620 nodules ablated, the overall complication rate was 3.2%, only 2.3% had temporary voice changes, none were permanent, and none had hypoparathyroidism (1).

In addition to the medical risks, scarring from thyroid surgery can significantly impact a patient's life. Minimally invasive video-assisted thyroidectomy (MIVAT) was first introduced in 1999 by Paolo Miccoli, using a 12-mm trocar 1 cm above the sternal notch. This technique has been replicated with various modifications, including accessing the thyroid by creating a subplatysmal flap from remote locations such as trans-axilla, axillo-mammary, trans-oral, retro-auricular, and submental, and with robotic assistance. MIVAT has been successfully used in many countries across Europe and Asia and has recently been adopted at select high-volume centers in the US. However, although these methods may reduce neck scarring, they are far from truly minimally invasive. Studies are underway comparing these procedures' operative time, complication rate, and cost-effectiveness. In contrast, RFA is often done in office settings under local anesthesia with a very low local infection rate and no scarring.

Although it has been less than 120 years since Dr. Kocher won the Nobel Prize for his contributions to thyroid surgery, the field has made tremendous strides toward improving patient outcomes and minimizing complications through new technological, clinical, and technical advances. The field still has much room for growth, and many exciting research innovations are on the horizon.

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Emad Kandil

Xinyi Luo, MD

(Email: xluo6@tulane.edu)

Emad Kandil, MD, FACS, FACE

(Email: ekandil@tulane.edu)

Department of Surgery, School of Medicine, Tulane University, New Orleans, LA, USA.

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