#### **Educational Forum**

# Ultrasound Examinations of the Head and Neck – From the Beginning to Now



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## The Developmental History of Head-and-Neck Ultrasonography

In the past, head-and-neck ultrasound examinations were mostly performed by radiologists, whereas ultrasound examinations of the thyroid gland were mostly carried out by endocrinologists and endocrine surgeons.<sup>[1]</sup> In recent years, otolaryngologists are familiar with the anatomy of head and neck except the skull bone that is not conducive for ultrasound examinations, ultrasound examinations can be carried out for most soft tissues in the head and neck.<sup>[2]</sup> Previously, very few otolaryngologists were familiar with or trained to perform ultrasound examination in Taiwan and overseas countries, and ultrasound examinations were at most used for research or differential diagnosis of otolaryngologic diseases. However, in recent years, promotion by various medical centers has resulted in more and more otolaryngologists joining the ranks of head-and-neck ultrasound examinations, resulting in ultrasound examinations becoming a routine examination item in otolaryngology.<sup>[1]</sup>

Since 2010, due to promotion by Professor Pa-Chun Wang, medical staffs from Cathay General Hospital were successively sent to National Taiwan University Hospital to learn from the pioneer of head-and-neck ultrasound in Taiwan: Professor Cheng-Ping Wang on the operation techniques and diagnostic methods for head-and-neck ultrasound. Until now, there are 5–6 attending staffs performing head-and-neck ultrasound at our department in Cathay General Hospital. Every month, >100 patients underwent head-and-neck ultrasound examinations. Under the support of the current department chair, Dr. Su-Yi Hsu and various branch chiefs, ultrasound examination is available in Taipei Headquarters, Sijhih Branch, and Hsinchu Branch.

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### CURRENT CLINICAL APPLICATIONS OF HEAD-AND-NECK ULTRASOUND

Ultrasonography is mainly used for head-and-neck mass evaluation and cancer survey. As most parts of the head and neck are soft tissues and relatively superficial, ultrasonography is extremely suitable for preliminary assessment and diagnosis.<sup>[2]</sup> In current clinical practice, ultrasonography can be used for assessment of thyroid disorders, lymph node lesions, and other masses in the head and neck.<sup>[3]</sup> With regard to thyroid disorders, a sono-guided fine-needle biopsy can be used to determine the nature of tumors preoperatively and postoperative follow-up for tumor recurrence.

As head-and-neck cancers have a high probability of cervical lymph node metastasis, ultrasonography can be used as a reference basis for tumor staging during initial diagnosis<sup>[4]</sup> and for follow-up evaluation after treatment. With regard to evaluation of other masses in the head and neck, initial diagnosis can be obtained based on the anatomical site and ultrasonographic characteristics.<sup>[2]</sup>

Fine-needle aspiration or core-needle biopsy can be used for the diagnosis of thyroid masses, salivary gland tumors, or lymph node lesions under ultrasound guidance. Ultrasound-guided aspiration can be used to obtain sufficient tissues for disease diagnosis<sup>[3]</sup> and avoid injury major blood vessels and nerves in the neck. For elderly patients or patients with multiple comorbidities who are not suitable for general anesthesia and pathological specimens cannot be obtained by operation, ultrasonography can be used to diagnose certain diseases in these patients. In addition to the use of ultrasonic guidance for

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diagnosis, clinicians in our hospital are currently employing ultrasonography for treatment, for example, intralesional drug injection, such as ethanol injection of thyroid cysts or radiofrequency ablation of benign thyroid nodules.<sup>[1]</sup>

In addition, ultrasonography can be used for evaluation of intraoral and oropharyngeal structures, for example, measuring thickness of the tongue base, to predict the severity degree of sleep apnea in patients. Sometimes, it can be used to evaluate tongue and tongue base tumors as well. In addition, ultrasonography can be used to assess vocal cord activity, swallowing dynamics, and size of laryngeal tumors (intralaryngeal ultrasound). In addition, ultrasound examinations of peritonsillar abscesses can be carried out or even guide for abscess drainage. For treatment, some sleep surgeons used ultrasound to determine and avoid injury lingual artery during the tongue base reduction surgery for sleep apnea.<sup>[1]</sup>

## PROSPECTS AND FUTURE OF HEAD-AND-NECK Ultrasonography

Currently, for deep-seated head-and-neck tumors, ultrasound can be used to guide fine-needle aspiration to aid in diagnosis.<sup>[3]</sup> However, in some cases, such as lymph node lesions, the amount of tissue obtained from fine-needle aspiration is not sufficient for diagnosis, and surgery must be arranged for tissue proof. Some simple lesions can be obtained under local anesthesia. However, it is sometimes needed for surgical resection under general anesthesia. In such situations, ultrasound-guided core biopsy (USCB) is another option for tissue sampling if these are high risks of complication with general anesthesia. In addition, USCB is less invasive, results in smaller wounds that heal faster, and can reduce medical costs.

Similar to other forms of diagnostic imaging, as technology progresses, ultrasonography evolved from traditional two-dimensional to three-dimensional ultrasonic imaging. Therefore, more accurate volume measurements can be obtained. If Doppler effect is employed, blood vessel morphology can be determined and used in the diagnosis of thyroid disease and nature of lymphadenopathy.<sup>[4]</sup> In addition, if time axis is added to three-dimensional ultrasonic waves to become four-dimensional ultrasonic waves, this can be used to evaluate moving organs.<sup>[1]</sup>

Ultrasound elastography has rapidly developed in recent years and is mainly used to evaluate tissue consistency to determine whether masses are benign or malignant.<sup>[1]</sup> Initially, ultrasound elastography was mainly used in breast cancer. In recent years, research on its application in thyroid nodules, cervical lymph nodes, salivary gland lesions, and other neck masses has started.<sup>[5]</sup> However, some of these areas are still at the research phase.

Contrast-enhanced ultrasound (CEUS) shows satisfactory results for evaluating damaged tissues and is mostly used for liver tumors. In the head-and-neck field, CEUS can be used for locating salivary stones. It can also be used for tracking lymph node metastasis in head-and-neck cancer as its accuracy is comparative with nuclear medicine imaging.<sup>[6]</sup>

### CONCLUSION

Before the 21<sup>st</sup> century, there were few otolaryngologists or head-and-neck surgeons regularly doing sonography for their patients, but now sonography is a promising imaging tool in clinical practice of otolaryngology and head-and-neck surgery, and can be ready for use in clinic or with clinicians everywhere.<sup>[7]</sup> Head-and-neck ultrasonography has advantages of being convenient, rapid, safe, and low invasiveness in otolaryngology and is widely used in the diagnosis and treatment of diseases of the ear, nose, throat, and especially the head and neck.<sup>[2]</sup> We believe that it will inevitably become a useful tool to safeguard public health in the future.

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#### **Conflicts of interest**

There are no conflicts of interest.

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