Ultrasound-guided Fine Needle Aspiration of the Tongue Base: A Cadaver Feasibility Study

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ABSTRACT

Objective: We hypothesized that floor of mouth and tongue base anatomy could be visualized with ultrasound, and that ultrasound could be used to accurately guide needle placement and dye injection into the tongue base, serving as a surrogate for fine needle aspiration and biopsy.

Methods: Human cadaveric specimens were used to perform ultrasound to visualize the anatomy of the floor of mouth and base of tongue in a midline transcervical approach. Methylene blue dye was injected under ultrasound guidance into the base of tongue. Specimens were dissected and results were analyzed.

Results: 25 of 32 (78%) cadaver specimens were found to have correct placement of dye within the posterior genioglossus and intrinsic tongue musculature. 7 cadavers did not have correct placement of dye. Of these, 3 had dye staining the walls of the oropharynx and epiglottis. Two specimens had dye injected erroneously into the geniohyoid muscles. One patient was found to have had a partial glossectomy. Difference in neck circumference was not significant between those with correct (mean: 37.9 cm) and incorrect (mean: 37.4 cm) dye placement (p=0.75).

Conclusions: Anatomy of the floor of mouth and tongue base can be readily depicted with ultrasonography. After reasonable success of injecting dye into cadaver tongue bases, we conclude that there may be a future clinical role for ultrasound-guided fine needle aspiration of the tongue base (UGFNATB) for tongue base lesions.

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INTRODUCTION

The current accepted practice for obtaining tissue diagnosis of tongue base tumors is transoral biopsy performed under general anesthesia in the operating room. Despite being standard of care, operative transoral biopsy is not without its disadvantages, including subjecting the patient to the risks of general anesthesia, incurring additional cost, and delaying tissue diagnosis beyond the date of initial evaluation.

Ultrasound has been used with success to facilitate fine needle aspiration (FNA) of several head and neck pathologies.[1,2,3]

We desired to know if it would be possible to perform ultrasound-guided trans-cervical FNA of base of tongue tumors. This cadaver study was designed to describe floor of mouth and tongue base anatomy as seen on ultrasound, as well as assess the feasibility of using ultrasound to visualize needle placement and dye injection within the base of tongue, which could serve as a surrogate for FNA.

Figure 1: demonstration of midline transcervical technique

Figure 3: Arrow points to needle extending through geniohyoid muscle and into left lateral genioglossus muscle.

METHODS AND MATERIALS

After obtaining IRB exemption, we analyzed 37 cadaveric human specimens donated to the University of Tennessee Health Science Center. The gender and age (if known) of each cadaver specimen was recorded. Measurements of neck circumference of each specimen were taken from the base of the occiput to the hyoid bone.

Ultrasound was used to image each specimen in a transverse plane from the level of the hyoid bone to the mentum. Visualization of the mylohyoid, geniohyoid, genioglossus, and intrinsic muscles of the tongue base was confirmed. 0.1 cc of 0.25% methylene blue was placed in a syringe attached to a 1 ½ inch 23 gauge needle. The needle was placed in the midline neck, halfway between the hyoid bone and the mentum (Figure 1).

Ultrasound was used to guide needle placement and dye injection into either the right or left base of tongue, which was randomly pre-determined. Cadaver heads were bisected in the midline and inspected to determine the accuracy of dye injection. A positive result was considered to be dye that was within the genioglossus muscle or the intrinsic tongue muscles between the circumvallate papillae and the epiglottis on the correctly pre-determined right or left side.

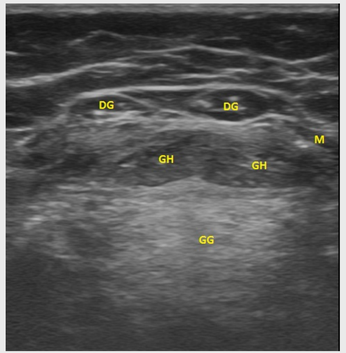

Figure 2: Ultrasound view of the floor of mouth and base of tongue from a transverse midline position, halfway between the mentum and the hyoid bone. DG= digastric, GH= geniohyoid, M= mylohyoid, GG= genioglossus.

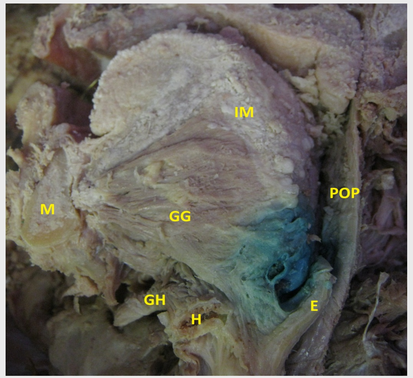

Figure 4: View of tongue and surrounding structures after midline sagittal bisection. M= mandible, IM= intrinsic muscles, GG= genioglossus, POP= posterior oropharyngeal wall, GH= geniohyoid, H= hyoid, E= epiglottis.

RESULTS

37 cadavers were available for study. 5 cadavers, one of which had a segmental mandibulectomy with a reconstruction bar in place, were felt to have distorted or degraded anatomy on ultrasound and were not injected nor analyzed.

The mean age at time of death was 74.5 years (range: 51-97 years). Neck circumference had a mean of 38.0 cm (range: 30-48 cm). Tongue and floor of mouth musculature was identified on ultrasound (Figure 2). Needle placement with notable bloom on injection was well visualized (Figure 3).

25 of 32 (78%) cadaver specimens were found to have correct placement of dye within the posterior genioglossus and intrinsic tongue musculature and on the appropriate right or left side (Figure 4). Seven cadavers did not have correct placement of dye. Of these, 3 had dye staining the walls of the oropharynx and epiglottis. Two specimens had dye injected erroneously into the geniohyoid muscles. One erroneously-injected patient was found to have had a partial glossectomy. Difference in neck circumference was not significant between those with correct (mean: 37.9 cm) and incorrect (mean: 37.4 cm) dye placement (t-test, p=0.75).

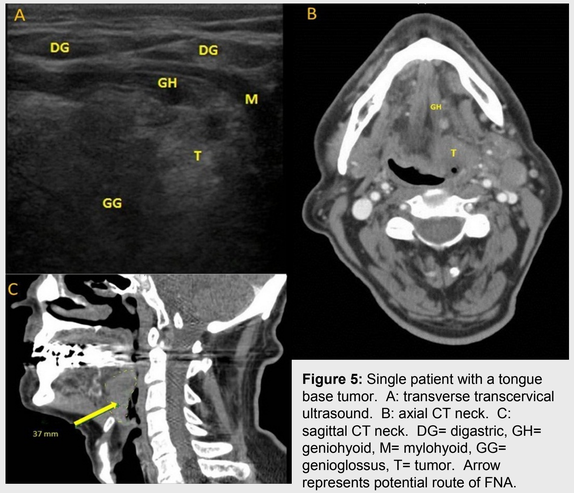

Figure 5: Single patient with a tongue base tumor. A: transverse transcervical ultrasound. B: axial CT neck. C: sagittal CT neck. DG= digastric, GH= geniohyoid, M= mylohyoid, GG= genioglossus, T= tumor. Arrow represents potential route of FNA.

DISCUSSION

Ultrasound is an imaging modality of increasing importance within otolaryngology.[1,2,3] Currently, UGFNATB is not an accepted practice to gain tissue diagnosis of the base of tongue, although tumors in this region are readily visualized with ultrasound (Figure 5). This cadaver study indicates that accurate transcervical placement of the needle within the posterior base of tongue is possible. Our success rate for dye localization in the base of tongue was 78%.

Use of UGFNATB in the clinic setting in place of transoral biopsy in the operating room may reduce the delay to pathological diagnosis and treatment. Yu et al. looked at one large retrospective study and one large prospective study of oral cavity tumors and noted that median time of symptom onset to evaluation by a medical professional was 4.5 weeks, median time from evaluation of a medical professional to time of tissue diagnosis was 11.8 weeks, and total time from symptom onset to tissue diagnosis had a median time of 22.5 weeks.[4] UGFNATB could conceivably shave 2-3 weeks off of the delay to diagnosis.

An additional potential advantage of UGFNATB is cost savings. Although we do not attempt here to perform a cost analysis between the two techniques, UGFNATB would undoubtedly trim costs. Furthermore, UGFNATB would avoid the risks of general anesthesia, which would be useful in the poor operative candidate.

Although our study is encouraging that UGFNATB may have a useful clinical application, to our knowledge there are no trials confirming its feasibility in the living patient. Additional study needs to be carried out to compare the diagnostic yield of UGFNATB with traditional transoral biopsy.

CONCLUSIONS

This cadaver study indicates that anatomy of the floor of mouth and tongue base can be readily depicted with ultrasonography. After reasonable success of injecting dye into the tongue base on our first attempt, we conclude that there may be a future clinical application of ultrasound-guided FNA of the tongue base for tongue base lesions.

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