Ultrasound and Needle Localization During Transoral Submandibular Sialolithotomy

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

Arjun S. Joshi, MD[1]; Shivangi Lohia BA[1]

The George Washington University – Division of Otolaryngology - Head and Neck Surgery

ABSTRACT

Background: Diagnosis and treatment of submandibular gland (SMG) sialolithiasis can be challenging. With the advent of sialoendoscopy the rates of successful treatment have increased significantly, but have not yet reached 100%. The most common cause of failure is lack of calculus localization prior to surgery.

Objectives: To present a novel technique of ultrasound (U/S) guided needle localization of calculi during intra-oral sialolithotomy and to discuss the advantages of U/S examination in patients with symptomatic submandibular sialolithiasis.

Methods: Thirty-three adult patients with symptomatic submandibular sialolithiasis who failed sialoendoscopic retrieval of stones underwent purely open sialolithotomy with pre-operative U/S guided needle localization of calculi. Outcomes of interest included: accurate detection of stones, successful completion of procedure, and time to completion of procedure.

Results: US guided needle localization detected 38 out of 40 submandibular stones (sensitivity= 0.95; 95% CI: 0.82 to 0.99) in 33 patients who underwent intra-oral sialolithotomy. The procedure was successfully completed in 30 (90.9%) patients. No procedures were terminated due to inability to locate stones intra-operatively. One patient (3.03%) required salvage sialadenectomy There were no instances of infection, ductal stenosis, loss of glandular function, or permanent nerve injury.

Conclusion: Ultrasound guided needle localization with methylene blue injection is a reliable method of calculus localization in patients with submandibular sialolithiasis.

CONTACT

Arjun S. Joshi, MD
The George Washington University – Division of Otolaryngology Head and Neck Surgery
Email: iamaya@mfa.gwu.edu
Phone: 202-741-3417

INTRODUCTION

Sialolithiasis is the most common cause of obstruction of the submandibular gland and accounts for approximately 80-90% of all cases of salivary gland calculi. Diagnosis of sialolithiasis can be challenging for a variety of reasons. Management options include sialendoscopic, sialendoscopic-assisted, or purely transoral sialolithotomy. Additionally, laser lithotripsy and extracorporeal shockwave lithotripsy are utilized, but have limited indications and frequently require repeated treatments. Submandibular sialadenectomy is typically reserved for salvage. Over the past several years, sialoendoscopy has garnered attention as a successful, minimally invasive technique for both diagnostic and therapeutic management of submandibular sialolithiasis and can be performed in the office-based or operative setting.[1]

The role of sialendoscopy for treatment of submandibular calculi, however, is limited to small stones < 4mm, mobile stones, and those in the distal ductal system.[2] Sialendoscopy is generally unable to visualize those sialoliths impacted in the secondary or tertiary ductal system.[2] The calculi that are visualized in the more proximal ductal system however, are usually not amenable to purely endoscopic removal due to technical limitations.

For those stones not amenable to purely endoscopic retrieval, there are few options for office-based localization and treatment of proximally based or large submandibular calculi. Transoral sialolithotomy can be safely performed under local anesthesia in the office-based setting, but its role is limited to calculi involving the distal 1/3 and middle 1/3 of Wharton's duct largely due to the inability to reliably localize sialoliths in the proximal ductal system.

Ultrasonography has been utilized by a myriad of other medical specialties to not only diagnose, but also localize and biopsy transcutaneously accessible masses.[3,4] It has demonstrated its utility as the initial imaging study of choice in the *evaluation* of salivary gland diseases, but has largely been ignored as an aid to the *treatment* of salivary gland calculi.[3]

In this study, we present a novel application of U/S guided needle localization in order to both reliably identify and treat proximally-based submandibular calculi in the office setting.

METHODS AND MATERIALS

From August 2009 to January 2012 a prospective database of patients with symptomatic SMG swelling was created and maintained. U/S examination was performed and patients with submandibular sialolithiasis were identified.

All U/S examinations were performed by the senior author using a Terason t3000 U/S machine, and a high-resolution 7.5–10-MHz real-time linear-array transducer. Images were interpreted and evaluated for the size, location, and number of stones.

Those patients with intraglandular calculi were excluded, and offered submandibular sialadenectomy. Those with calculi measuring less than 5mm underwent sialoendoscopy for the retrieval of sialoliths. Patients who failed endoscopic removal or had proximally-based and/or large calculi (>5mm) underwent U/S guided needle localization and transoral submandibular sialolithotomy.

All patients were offered initial treatment in the office setting. The operating room was reserved for those patients who requested general anesthesia or in the cases of unsuccessful sialolithotomy in the office. Post-procedure U/S examination was then performed to assess for residual stones or persistent obstruction. All patients who had findings of hyperechogenic foci or persistent calculi underwent mandatory re-exploration at the time of the procedure until no residual calculi were identified.

Primary outcomes were tabulated and included success of U/S guided needle localization and surgical time. Secondary outcomes included complications such as the presence of infection, ductal stenosis, lingual nerve injury, and need for salvage sialadenectomy.

Patients were then seen post-operatively at 2 weeks. Long-term follow-up was performed with a phone questionnaire at a minimum period of 3 months assessing for symptoms.

TECHNIQUE

The patient is comfortably seated in a chair with the head turned to the contralateral side. The oral cavity and surgical site are exposed using a self-retaining cheek retractor and tongue retractor. Ultrasound exam is performed in the paramandibular plane. Bimanual palpation is performed using the U/S transducer and a finger to visually and palpably confirm stone presence.

Following sono-palpation, a 25-gauge needle attached to a 3cc syringe containing local anesthetic (2 percent lidocaine hydrochloride and epinephrine 1:100,000) is used to infiltrate local anesthesia after needle localizing the calculus. Methylene blue (0.5cc) can also be infiltrated during this step, although not always necessary. The calculus is again palpated with the tip of the needle to confirm stone presence and the mucosa overlying the stone is gently scored with the bevel of the needle after withdrawal.

Next, a 1-1.5cm incision is made in the mid or posterior floor of mouth mucosa depending on the location of the stone. If the calculus is located in the mid-portion of the duct, the incision is made 1.5cm medial to the lingual surface of the mandible, and if located in the proximal duct, the incision is made closely following the lingual border of the mandible. The incision is deepened and blunt dissection is performed through a variable amount of sublingual gland. The lingual nerve is identified and preserved and dissected off the submandibular duct. Wharton's duct is then grasped distally with a smooth forceps, and the stone is identified in the duct more proximally. Methylene blue can help indicate the position of the stone. Wharton's duct is incised along the linear axis and the stone is delivered. The surgical site is rinsed with water or saline.

If necessary, a 14G angiocath stent is placed after removal of mid or distally located stones, and sutured in place using 4-0 or 5-0 nylon suture. U/S is then performed to confirm the absence of fragmented sialoliths.

RESULTS

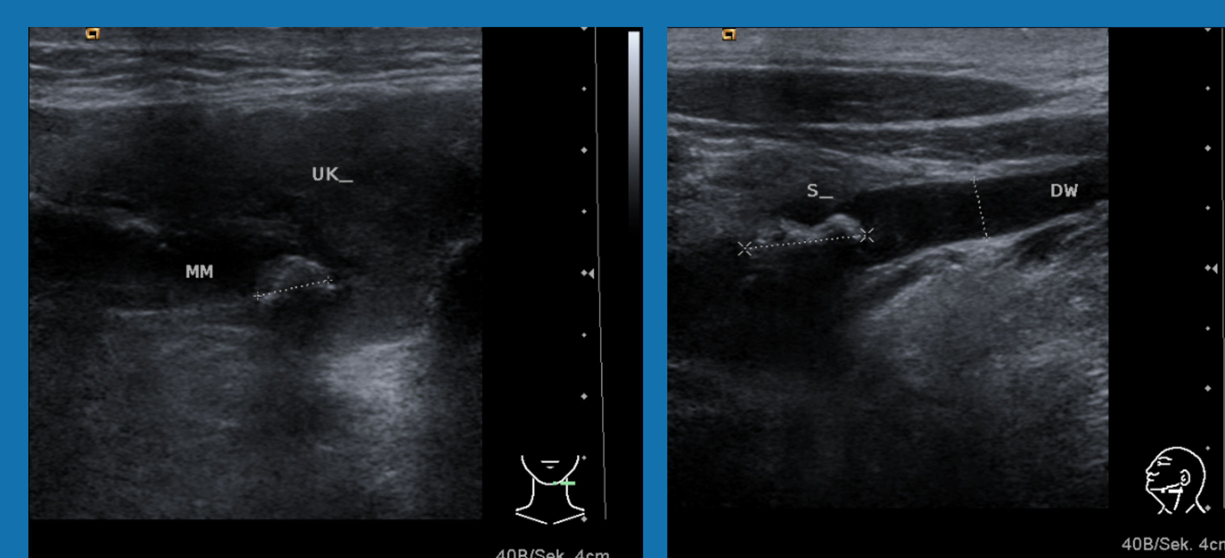
A total of 33 patients underwent intra-oral sialolithotomy for the management of SMG sialolithiasis. The subjects were males (n=16) and females (n=17) ranging in age from 13 to 84 years (mean 47.8). Twenty patients had sialoliths of the left SMG and 13 patients had sialoliths of the right SMG. A total of 4 procedures (12.1%) were performed in the operating room, and the remaining 29 procedures (87.9%) were performed in-office.

Pre-operative needle localization with US guidance detected the presence of 38 out of 40 stones (sensitivity =0.95; 95% CI: 0.82 to 0.99) in a total of 38 patients. In five out of seven patients, US guided needle localization identified the presence of 2 stones (sensitivity=0.71; 95% CI: 0.30 to 0.95).

Thirty out of 33 sialolithotomy procedures (90.9%) were completed successfully, and average time to completion (n=33) was 23.9 (SD=9.6) minutes. Of the three failed procedures, one was aborted due to bleeding from the lingual vein, and two procedures were terminated due to patient discomfort. None of the procedures were terminated because the stone could not be reliably located intra-operatively.

In two of the 33 procedures, the stone was accurately localized, but was not able to be delivered. In one patient the second proximal stone could not be delivered. One patient (3.03%) required salvage sialadenectomy for definitive management.

Two patients developed ductal stenosis, and were treated with simple dilation. There were no instances of infection, swelling, or tongue numbness in 29/33 patients with long-term follow-up (mean 8.1 months).



Figures 1 and 2. Proximal submandibular sialoliths

Figure 3. Transoral sialolithotomy

Patient Characteristics	
Age	47.8 (SD=17.3)
Gender	
M	16 (48.5%)
F	17 (51.5%)
Gland affected	
Left	20 (60.6%)
Right	13 (39.4%)
Symptoms	
Pain	14 (42.4%)
Swelling	32 (97.0%)
Discharge	3 (9.1%)
Peri-prandial	14 (42.4%)
Antibiotic use	17 (51.5%)
Smokers	12 (36.4%)

Table 1. Baseline patient characteristics

Procedure Results	
# of needle localized stones	38 (95.0%)
Sialolithotomy time (min.)	23.9 (SD=9.6)
Successfully completed	30 (90.9%)
Total failures	3 (9.1%)
Localization failure (intra-op)	0 (0.0%)
Complications	
Patients requiring salvage sialadenectomy	1 (3.03%)
Patients with FOM swelling	2 (6.1%)
Patients with ranula formation	1 (3.03%)
Patients stricture formation	2 (6.1%)
Patients with retained stones	3 (9.1%)

Table 2. Results of procedure

DISCUSSION

The treatment of submandibular sialolithiasis is largely dependent on the size and location of the pathology. U/S is effective for for the accurate diagnosis of submandibular sialolithiasis, but its role in treatment of this disease has largely been overlooked.[3] U/S can demonstrate and help to localize calculi located in the distal third, middle third, proximal third, or in the parenchyma of the submandibular ductal system.

In our case series, U/S guided needle localization was accurately able to identify a total of 40 stones in 33 patients. 22/33 (67%) of these patients had proximal sialoliths (average length, 7.49mm). 7/33 (21%) of these patients had mid-ductal stones. The remainder 4/33 (12%) had distally located stones. 7/33 (21.2%) had more two stones. These data underscore the effectiveness and demonstrate the applicability of the technique to a variety of different clinical scenarios.

Of the 33 patients, 29 (88%) had transoral sialolithotomy under local anesthesia in an office based setting. Only four patients (12%) were treated in the operating room (two patients requested general anesthesia). In only 3/33 (9.1%) patients were procedures terminated before retrieval of the stones. Complication rates were quite acceptable, and the majority of these were related to pain within the first few days after the procedure, which was adequately managed by oral pain medications. These findings underscore the safety of the technique under local anesthesia, and also suggests that the technique can be safely applied to patients with multiple stones.

Our technique has several advantages over previously described methods for treating large or proximately located sialoliths. First, based on the results of our limited data set, it appears as though sonopalpation and needle localization allow for visualization of all detectable calculi, which is not always achieved with diagnostic sialoendoscopy. Our technique is obviously limited to treatment of larger stones and more proximal/fixed stones; stones which are mobile and small (<2mm) can go undetected by U/S.

Second, our method allows for the treatment of calculi in various locations involving the submandibular ductal system without the use of extra instrumentation which can obscure the field of vision during the procedure. The surgical area of interest in transoral submandibular sialolithotomy is at most a 2x2cm region and minimizing instrumentation is a desirable goal. This in turn allows for better exposure, greater freedom of movement, and the patient and assistant to fully participate in the case.

Third, the procedure can be performed in-office under local anesthesia with minimal downtime. The operating room is usually reserved for failures of in-office sialolithotomy or for patient preference.

U/S needle localization does have certain difficulties however. It requires the surgeon to be highly trained in the use of U/S and U/S anatomy of the salivary glands. The technique also requires patience, as exposure and dissection can sometimes be difficult. We suggest beginning with directed training in the effective use of U/S for the salivary glands and then applying the technique to distal or mid ductal stones in the operating room setting. Once facile, the surgeon can treat more proximally based sialoliths, before venturing into an office-based setting.

CONCLUSIONS

U/S and needle localization is an effective technique for the localization and treatment of submandibular stones and has several advantages over previously described techniques. U/S technology is rapidly learned, widely applicable, and cost-effective and should be incorporated into the routine treatment algorithm of obstructive sialolithiasis.

REFERENCES

1. Nahlieli O, Baruchin AM. Endoscopic technique for the diagnosis and treatment of obstructive salivary gland diseases. *Journal of Oral and Maxillofacial Surgery.* 1999;57(12):1394–1401.
2. Walvekar RR, Razfar A, Carrau RL, Schaitkin B. Sialendoscopy and Associated Complications: A Preliminary Experience. *The Laryngoscope.* 2008;118(5):776–779.
3. Katz P. Ultrasound of salivary gland masses. Otolaryngol Clin North Am 2009; 42: 973-1000.
4. Ng SY, Songra AK, Bradley PF. A new approach using intraoperative ultrasound imaging for the localization and removal of multiple foreign bodies in the neck. *International Journal of Oral and Maxillofacial Surgery.* 2003;32(4):433–436.