

Ultrasound Assessment After Transoral Submandibular Sialolithotomy

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ABSTRACT

Background: Ultrasound examination is a highly sensitive imaging modality for various pathological processes of the salivary glands. It can accurately localize and diagnose different causes of obstruction and is a reliable tool in the assessment of the submandibular gland after sialolithotomy.

Objective: To demonstrate the utility of ultrasound in the immediate post-procedural setting after transoral sialolithotomy.

Methods: Thirty-three adult patients with symptomatic submandibular sialolithiasis underwent transoral sialolithotomy with pre- and immediately post-operative ultrasound examination of the affected gland. Outcomes of interest included presence of residual stones or stone fragments, and proximal ductal dilation.

Results: Following sialolithotomy, U/S examination demonstrated residual stones in 7 out of 33 patients (6 true positives, 1 false positive). The appearance of hyperechogenic foci with posterior shadowing was a strong indicator of retained stones ($p < 0.0001$), while the appearance of hyperechogenic foci without posterior shadowing did not indicate the presence of residual calculi ($p = 1.00$). Presence of persistent proximal ductal dilatation on U/S after sialolithotomy also did not predict retained calculi ($p = 0.295$).

Conclusion: Ultrasound examination is a reliable tool for the assessment of retained stones both before and after submandibular sialolithotomy. The appearance of hyperechogenic foci with posterior shadowing can be reliably used to guide further surgical management of patients in the immediate post-operative period.

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INTRODUCTION

Ultrasound (U/S) examination has become increasingly employed in the treatment of salivary gland calculi and is used as the initial imaging study of choice internationally given its non-invasive nature and ease of operation.¹ It is now gaining popularity in the U.S. It offers the benefit of dynamic imaging and allows for the assessment of changes in head and neck anatomy as they occur.

The role of U/S in the treatment of submandibular calculi has been largely limited to pre-operative assessment in order to locate stones and plan the operative management.¹ Operative management consists of either sialendoscopic or transoral sialolithotomy versus submandibular sialadenectomy. There is very little present in the literature however, regarding the use of U/S in the immediate or delayed post-procedural setting in order to assess patients for the presence of persistent calculi and predict success of transoral sialolithotomy.

Despite the high success rates of both sialendoscopic and open sialolithotomy there is still a risk of recurrence, especially in patients with retained calculi.² U/S performed immediately after sialolithotomy, could potentially guide the need for immediate re-exploration and allow the clinician to determine the chance of success.

Given the previous reports of the successful application of ultrasound in the pre-operative management of sialolithiasis, we undertook the current investigation to evaluate the utility of ultrasound to accurately identify patients at risk of symptomatic sialolithiasis secondary to residual stones immediately following sialolithotomy and to identify some of the key indicators that predict success of sialolithotomy.

METHODS AND MATERIALS

Thirty-three adult patients with symptomatic submandibular sialolithiasis underwent purely open sialolithotomy at the George Washington University Hospital from August 2009 to January 2012. All patients had a history of recurrent and painful swelling of one or both submandibular glands, a known submandibular sialoliths diagnosed by CT or ultrasound, and had failed treatment with sialoendoscopic retrieval of stones.

All patients underwent a pre-operative high-resolution ultrasound examination of the affected submandibular gland for the identification and localization of calculi. Immediately following sialolithotomy, each patient underwent a second ultrasound examination to identify retained stones or evidence of persistent obstruction and underwent further exploration if possible. All subjects returned for follow up ultrasound examination 2 weeks post-operatively.

All ultrasound examinations were performed using an ultrasound scanner and a high-resolution 7.5–10-MHz real-time linear-array transducer, and were conducted by the lead investigator. Initial images were obtained in the paramandibular plane via a submaxillary approach with the head turned to the contralateral side. Immediately following the procedure, images were again obtained in the paramandibular plane via a submaxillary approach. Additional scanning was also performed in the transverse and oblique planes to identify any retained stones. All ultrasound images were interpreted by the lead investigator and were evaluated for the following: residual stones and/or stone fragments causing persistent obstruction, and persistent proximal ductal dilatation.

RESULTS

A total of 33 patients underwent open sialolithotomy for the management of submandibular gland sialolithiasis. The subjects were males ($n=16$) and females ($n=17$) ranging in age from 13 to 84 years (mean age 47.8 years). Twenty patients had sialoliths of the left submandibular gland and 13 patients had sialoliths of the right submandibular gland.

Immediate post-procedure ultrasound demonstrated retained stones (hyperechogenic foci with posterior shadowing) in 7 out of 33 patients (21.2%). In 2 of these 7 patients the procedure was terminated prior to stone retrieval due to discomfort, and in 1 patient it was terminated prior to stone removal due to bleeding. U/S exam after procedure termination demonstrated hyperechogenic foci with posterior shadowing in all 3 patients with known residual calculi. Another 3 of the 7 patients underwent staged surgical procedures (sialolithotomy followed by sialodochoplasty and/or sialoendoscopy) and demonstrated residual stones during the follow up procedure. The last patient underwent re-exploration and was not found to have a retained stone. The appearance of hyperechogenic foci with posterior shadowing accurately predicted stone presence in 6/6 patients and was falsely positive in 1 patient ($p < 0.0001$).

Another fifteen patients were found to have hyperechogenic foci without posterior shadowing and no evidence of stones on further exploration. Seven of the thirty-three patients (21.2%) were also noted to have persistent proximal ductal dilatation on ultrasound exam without obvious calculi. Further exploration in these seven patients failed to locate any residual stones. Neither the presence of hyperechogenic foci without posterior shadowing nor the presence of proximal ductal dilatation was an indicator of retained calculi ($p=1.00$ and $p=0.295$ respectively).

Two weeks post-operatively, complete symptom resolution was achieved in thirty-one out of thirty-three patients (94%). There were no instances of infection, ductal stenosis, loss of glandular function, or permanent lingual nerve paralysis with follow-up ranging from 6 months to 1 year.

Table 1. 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 2. Pre-operative US findings	
Presence of stone	32 (97.0%)
Proximal ductal dilation	9 (27.3%)
Proximal ductal sialiectasia	1 (3.03%)
Intraglandular dilation	23 (69.7%)

Table 3. Post-operative US findings	
Presence of stone	7 (21.2%)
Proximal ductal dilation	7 (21.2%)
Proximal ductal sialiectasia	2 (6.1%)
Intraglandular dilation	18 (54.5%)



Figure 1. Right submandibular sialolith

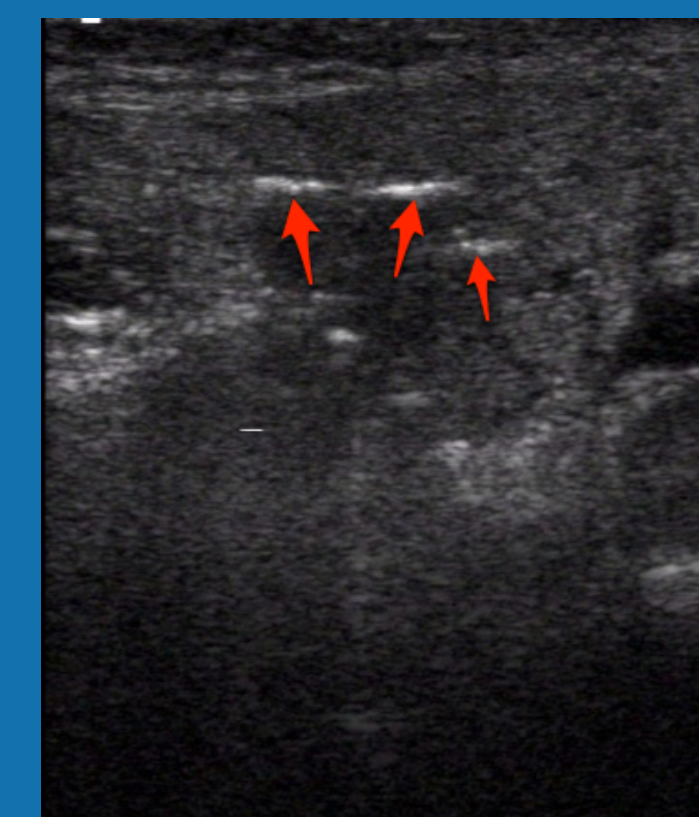


Figure 2. Hyperechogenic foci, air bubbles

DISCUSSION

Recent studies have reported high success rates with the use of sialolithotomy in the management of submandibular gland calculi. However, despite these encouraging results there still remains a chance of symptomatic recurrence in a minority of patients. The pattern of failure in these patients is usually due to ineffective pre-operative localization of stones leading to retained calculi in the post-operative period.

The results of our study indicate that ultrasound is reliably able to predict which patients are at risk of having recurrent symptomatic sialolithiasis secondary to residual stones immediately following sialolithotomy. In our series of 33 patients, ultrasound accurately identified those patients with residual stones and/or stone fragments and differentiated them from patients with persistent proximal ductal dilation without actual obstruction. Specifically, we found that the presence of hyperechogenic foci with posterior (or acoustic) shadowing is the best indicator of the presence of residual stones and the best predictor of success after sialolithotomy. This has been previously reported in the literature by a number of authors who have all described a typical hyperechoic focus with posterior shadowing to indicate the presence of a stone.⁵

Additionally, the appearance of hyperechoic foci *without* posterior shadowing is not indicative of the presence of sialoliths and likely represents air bubbles or blood in the ductal system following trauma from surgical dissection. Lastly, the presence of proximal ductal dilatation immediately following sialolithotomy is also not an accurate indicator of persistent obstruction, and instead is likely related to chronicity of obstruction. 4/7 patients (57%) with proximal ductal dilation on US immediately following sialolithotomy had complete resolution of this finding two weeks post-operatively, and therefore are unlikely to have had residual calculi. The remainder (43%) continued to have ductal dilation but with no other findings of sialolithiasis.

Our results are in accordance with previous reports of the reliability of ultrasound to detect residual sialoliths in the minor salivary glands of the lip and to intra-operatively localize foreign bodies in the neck following trauma.^{3,4} These findings hold important clinical implications for the surgeon. First, they indicate that ultrasound is an invaluable tool in the post-operative period and should be used in the assessment of patients undergoing sialolithotomy. Second, they demonstrate that ultrasound is effectively able to guide the need for immediate re-exploration and predict chances of surgical success in patients at risk of recurrence.

CONCLUSIONS

There is no widely used method to assess for residual stones following endoscopic-assisted or open submandibular sialolithotomy. Our findings demonstrate that ultrasound accurately identifies the presence of residual calculi in the immediate post-operative period and the presence of hyperechogenic foci with posterior shadowing on US can reliably be used to guide the need for further surgical exploration in patients undergoing sialolithotomy of the submandibular gland.

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