Ultrasonic Bone Aspirator in Endoscopic Ear Surgery: Feasibility and Safety in a Cadaveric Temporal Bone

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Abstract

Objectives: 1. To describe the feasibility of using an ultrasonic bone aspirator in endoscopic ear surgery using cadaveric temporal bones. 2. To assess the safety of the ultrasonic bone aspirator in endoscopic ear surgery using cadaveric temporal bones.

Methods: Five temporal bones were dissected using exclusive endoscopic ear surgery and an ultrasonic bone aspirator, Sonopet® (Stryker®, Kalamazo, MI). Atticoantrostomy was undertaken. Another five bones were dissected using routine endoscopic equipment and standard bone curettes in the same manner. The feasibility and safety were assessed in terms of the following parameters by an otolaryngologist blinded to the mode of dissection: 1) Time for dissection 2) Adequacy of the atticoantrostomy 3) Damage to the tympanomeatal flap 4) Injury to the chorda tympani nerve 5) Ossicular chain disruption 6) Exposure of the facial nerve 7) Dural injury and 8) Damage to the endoscope.

Results: The time taken to perform atticoantrostomy was significantly less with the use of the ultrasonic bone aspirator as compared to conventional bone curettes.

Conclusion: The ultrasonic bone aspirator is a feasible option in endoscopic ear surgery and provides easy bone removal with no additional complications and greater efficacy than traditional bone curettes and should be a part of the armamentarium for transcanal endoscopic ear surgery.

Introduction

Transcanal Endoscopic Ear Surgery (TEES) has gained widespread acceptance as an alternative method to traditional microscopic ear surgery (MES). The otoendoscope provides a wider field of view, higher magnification and fewer anatomical limitations than the traditional microscope. As a result, otoendoscopy has been shown to decrease the rate of canal wall down mastoidectomy. Endoscopes have been used in the ear as an adjunct to microscopic dissection as well as for exclusive endoscopic middle ear surgery including tympanoplasty, atticotomy and ossiculoplasty, providing incisionless surgery. The wide view that TEES proves enables the surgeon to be able to access the attic, facial recess, hypotympanum and sinus tympani without the need for a post auricular incision. TEES can also decrease operating time due to the reduction in time that is needed to gain access to the middle ear. One of the limitations of transcanal endoscopic ear surgery is the inability of using standard drills due to the risk of damage to the endoscope as well as due to the limited workspace in the external auditory canal. [1] Most transcanal procedures have been performed with curettes, which may not provide precise control during bone removal and can be quite time consuming. The ultrasonic bone aspirator (Sonopet) is a novel device which allows for minimal removal of bone and maximal preservation of mucosa. However, data on the use and safety of the Sonopet in middle ear procedures is limited. [2]

The Sonopet’s mechanism of action is a torsional oscillation of a metal bone rasp at 25 kHz. The frequency is ideal in that it only cuts mineralized tissue. Irrigation emerges from a sheath near the tip of the hand piece and is adjustable with a rate of 3-40 mL/min. Aspiration occurs at the tip of the hand piece with a maximum aspiration pressure of 500 mm Hg. The purpose of this study is to determine the feasibility and safety of an ultrasonic bone aspirator, the Sonopet, as alternative to standard curettes in TEES. [3]

Methods

A total of 10 cadaveric temporal bones were dissected by an experienced otolaryngologist. An atticoantrostomy was performed using a Stryker endoscope tower with light source and camera. 5 of the bones were dissected using the Sonopet and 5 were dissected using traditional endoscopic ear equipment and standard bone curettes. A second otolaryngologist, who was blinded to the method of dissection, evaluated the bones based on the following parameters:

1) Time for dissection
2) Adequacy of the atticoantrostomy
3) Damage to the tympanomeatal flap
4) Injury to the chorda tympani nerve
5) Ossicular chain disruption
6) Exposure of the facial nerve
7) Dural injury
8) Damage to the endoscope

Results

9 cadaveric bones were included in the analysis. 1 was not included due to damage to the chorda tympani nerve during flap elevation. Mean dissection time in the curette group was 40.25 minutes and 28.80 minutes in the Sonopet group as depicted in Figure 1.

Table 1. Mean dissection time, standard error, standard deviation, minimum, and maximum between the two groups; p=0.02

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SE</th>
<th>StDev</th>
<th>Min</th>
<th>Median</th>
<th>Max</th>
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<tr>
<td>Curette</td>
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<td>40.25</td>
<td>1.65</td>
<td>3.30</td>
<td>38.00</td>
<td>39.00</td>
<td>45.00</td>
</tr>
<tr>
<td>Sonopet</td>
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<td>28.80</td>
<td>1.77</td>
<td>3.96</td>
<td>25.50</td>
<td>28.00</td>
<td>35.00</td>
</tr>
</tbody>
</table>

Figure 1. Sonopet hand piece and claw

Discussion

The use of an ultrasonic bone aspirator may expand the indications for TEES. The ultrasonic bone aspirator has been used in several other types of surgery including neurosurgery, sinus surgery and spinal surgery with good results. [4-6] It has been shown to permit safer and faster procedures for the surgeons as opposed to a drill in other anatomical areas. [4] Data on the safety and use in middle ear surgery is very limited. This particular study showed that the mean dissection time was significantly less using the Sonopet as compared to standard curettes. Time decreased with each dissection as we became more accustomed to its use. One of the most important benefits of using the Sonopet is the time that it may save in the dissection, which could result in overall cost savings. This study showed no injury to vital structures using the Sonopet. In fact, there was a significantly higher percentage of ossicular chain disruption in the standard curette group. This may in part be explained to less precision and control in using the standard curettes. The main drawback of the study is the limited number of temporal bones dissected. Also, it is a cadaveric temporal bone study and clinical correlation is required. However, the study suggests several potential advantages using the Sonopet including less operative time and more control in bone removal in endoscopic ear surgery while having a decreased rate of complications. Clinical experience is necessary to determine the clinical value of the device demonstrated in this anatomic study.

Conclusions

The ultrasonic bone aspirator is a feasible option in endoscopic ear surgery and may provide easier bone removal with no additional complications and greater efficacy than traditional bone curettes and can be a part of the armamentarium for transcanal endoscopic ear surgery. Clinical evaluation of the device is warranted.

References