



Anatomic Study of Endolymphatic Sac On Posterior Fossa dura for Meniere's disease and for transpetrosal skull base approach

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ABSTRACT

Purpose: Compromising the endolymphatic sac in the skull base approaches impose a high risk of progressive hearing loss. The authors topographically measured the relationship between endolymphatic sac (ES) and the surrounding anatomic structures in an effort finding the safety distance while incising the presigmoidal dura.

Material and methods: Three imported formalin-fixed latex-injected cadaveric heads were exercised and four mastoidectomies were performed prior to the posterior retrolabyrinthine presigmoid transpetrosal approach. The endolymphatic sac was identified as a dura-splitting pouch medial to the posterior semicircular canal (PSC). The distance between the ES and jugular bulb, anterior margin of sigmoid sinus, and superior petrosal sinus (SPS) were measured.

Results: The distance between the ES and jugular bulb was expressed as ES-JB, in this study, 9.59 ± 2.70 mm (Mean \pm SD); ES-SPS, 9.00 ± 1.34 mm; and ES- Sig, 6.61 ± 1.25 mm. The minimum of ES-Sig. is 5.08 mm. All the upper margins of ES, in this study, are below the imaginary line of horizontal semicircular canal by 3.67-5.02 mm.

Conclusion: The exposure of PSC facilitates the visualization the contour of ES. In order not to injure the ES, the authors advise that the planning of incising the

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presigmoid dura be kept in the safety zone of 5 mm anterior to the sigmoid sinus.

Keyword: Meniere's disease, Skull base surgery

Introduction

Meniere's disease is an inner ear disorder characterized by vertigo, low-pitch tinnitus, and hearing loss. The medical treatment includes the low sodium intake, diuretics, and symptomatic treatment, such as the antihistamine and antiemetic. The surgical intervention is advised in patients who are refractory to medical treatment and in whom the progressive hearing loss was observed and possibly the deafness are inevitable. The endolymphatic sac (ES) decompression is an effective surgical intervention that removes the petrous bone overlying ES through the classic mastoidectomy^[1-3]. However, this procedure carries risk of facial nerve and vestibulocochlear nerve injuries and major sinus perforation^[4,5]. Another clinical issue is the transpetrosal presigmoid approaches for the petroclival tumors, and this approach requires the classic mastoidectomy also. In order to protect the ES during the mastoidectomy for Meniere's disease and transpetrosal presigmoid approaches, the authors conduct the measurement of ES in relation to the surrounding anatomic structures.

Materials and Methods

Three imported cadaver heads were dissected at the Tri-Service General Hospital skull base laboratory and total four mastoidectomies were performed for measurement the ES relation to surrounding structures (Figures 1-3). These three specimens were fixed with 5% formalin and the arteries were injected with red latex and veins were injected with blue latex. The specimen were secured in wooden head holders, and were dissected with a set of fine microneurosurgical instruments together with a high speed drill (microMax, Anspach Companies, Palm Beach Gardens, FL, USA) under a surgical microscope (Zeiss OPMI, Carl Zeiss Surgical, Inc., Thornwood, NY, USA).

Once the ES was identified on the posterior fossa dura, the following measurement was conducted. 1) the size of ES; 2) the distance of ES to superior petrosal sinus, ES-SPS; 3) the distance of ES to anterior margin of sigmoid sinus, ES-Sig.; 4) the distance of ES to Jugular bulb, ES-JuB; 5) the distance of ES to the imaginary line of lateral semicircular canal, ES-LSSC.



Figure 1. Photo depicting cadaver dissection of transpetrosal presigmoid approach showing the c shaped temporoparietooccipital craniotomy and pathway of transverse-sigmoid sinus.

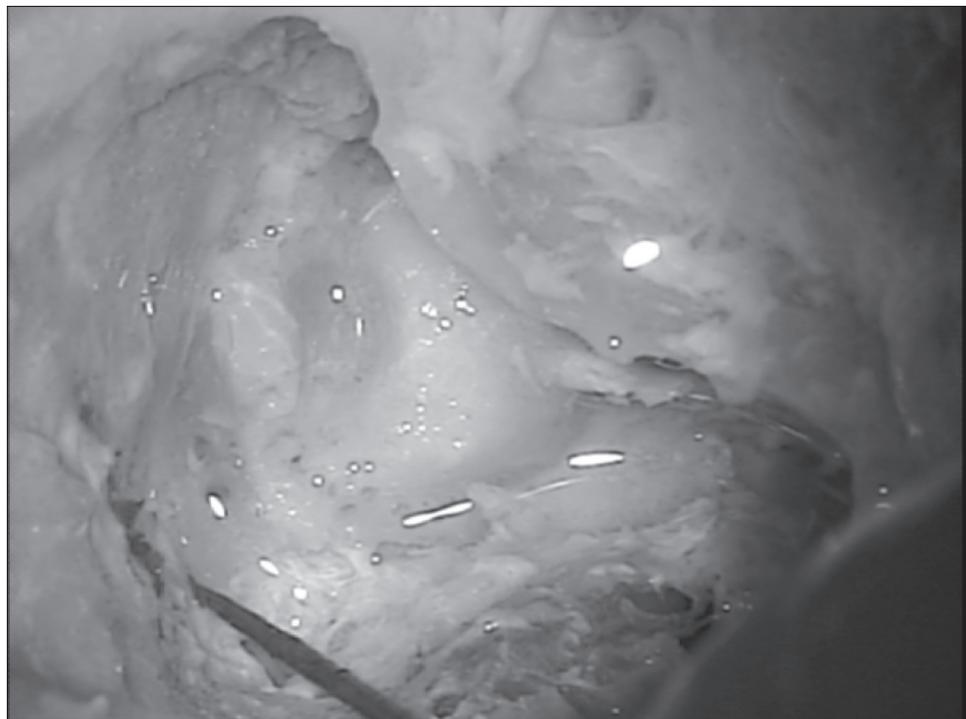


Figure 2. Photo showing the posterior dura after the classic mastoidectomy was completed. The tip of pointer depicting the presigmoid dura.

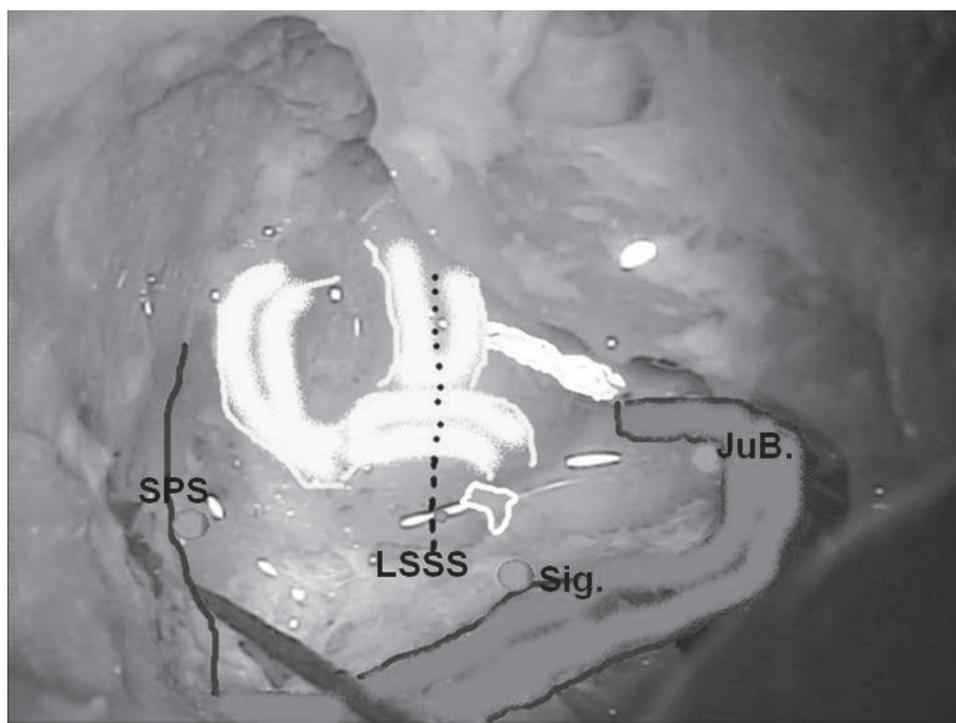


Figure 3. Photo reveals the measurement of endolymphatic sac to the surrounding microanatomy structure. White circle depicts endolymphatic sac. SPS: superior petrosal sinus, LSSC: lateral semicircular canal, Sig.: sigmoid sinus, JuB: jugular bulb.

Results

The results are expressed in Table 1. The distance between the ES and jugular bulb was expressed as ES-JB, in this study, 9.59 ± 2.70 mm (Mean \pm SD); ES-SPS, 9.00 ± 1.34 mm; and ES- Sig, 6.61 ± 1.25 mm. The minimum of ES-Sig. is 5.08 mm. All the upper margins of ES, in this study, are below the imaginary line of horizontal semicircular canal by 3.67-5.02 mm.

Discussion

Ammirati et al^[6] reported the relationship of ES to the surrounding structure intradurally, that is from the view through the traditional lateral suboccipital as the retromastoid approach. This study is very valuable while the surgeons are going to drill the internal auditory canal, the safe margin between the posterior margin of the internal auditory canal and the endolymphatic sac was advice. Bagger-Sjoberg et al^[3] reviewed



#	ES size (mmxmm)	ES-JB	ES_Sig	ES-SPS	ES-LSL
# 9, Rt	7.10x4.00	10.07	8.13	8.02	-3.67
# 9, Lt	5.96x4.63	7.16	6.54	7.73	-4.92
# 6, Rt	3.26x4.16	13.2	5.07	10.52	-5.02
# 4	5.50x3.60	7.94	6.7	9.73	-3.83
#0 Rt	4.87X5.76	10.49	5.35	13.17	-4.38
Mean	23.48	9.77	6.36	9.83	-4.36
SD	6.59	2.37	1.22	2.20	0.61

Figure 4. Distance between the endolymphatic sac to surrounding structures. ES size expressed in mm x mm, ES-JB: distance between the ES and Jugular bulb; ES-Sig: distance between the ES and sigmoid sinus; ES-SPS: distance between the ES and superior petrosal sinus; ES-LSS: distance between the ES and lateral semicircular canal.

the surgical anatomy and found the endolymphatic sac shunting is an ideal modality of treatment in that the surgical destruction will be minimal. Brinson et al^[4] published his works on endolymphatic shunt and yielded that the both the decompression and the shunting are effective. Durland et al^[5] reported the endolymphatic sac decompression significantly improved perception of physical health as well as the symptom-specific outcomes in patients who are intractable to medical treatment.

In our study, we found the distance between the ES to sigmoid sinus is 5.35-8.13 mm. and all the upper margins of ES are below the lateral semicircular canal. This study shows that the posterior margins of ES to sigmoid sinus is very close, so that, if the skeletonization of the posterior fossa endplate and the sigmoid sinus is not adequately performed, the ES might not been seen during the operation, which will compromise the safety of the procedure.

Af-Metfy et al^[7] reported their experience in treating thirteen patients harboring petroclival tumors with transpetrosal approach. Bambakidis et al^[8] reported the trend of transpetrosal approach to retromastoid approaches because the complication of traspetrosal approach is not without complication. Erkmen et al^[9] published the choice



of skull base approach in treating the petroclival tumors and summarize that for lesion behind the internal auditory canal, the lateral suboccipital approach is recommended; for lesions that are small and above the internal auditory canal, the subtemporal approach with anterior petrosectomy are recommended; for the lesions large and anterior to the internal auditory canal, the transpetrosal presigmoid approach is recommended. Behari et al^[10] report this approach to treat the extensive skull base tumors in the petroclival region.

The finding of the relationship of ES in posterior fossa can be helpful while the neurosurgeon performed the transpetrosal presigmoid approach for the petroclival tumors. Since the posterior fossa dura cut is the first step in opening the presigmoid dura. In this study, we found that the safe margin between the ES and sigmoid sinus is 5.35 mm. So we recommend that the presigmoid dura cut should be as close to sigmoid sinus as possible and should be within 5 mm to the anterior margin of sigmoid sinus.

Conclusion

For neurootologist who are going to perform the endolymphatic sac decompression for the Meniere's disease, we recommend end plate removal above the imaginary line lateral semicircular canal might not be necessary; as for neurosurgeons who are about the conduct the transpetrosal presigmoid approaches for the petroclival tumors, we suggested the presigmoid dura cutting should be within the safe margin of 5 mm to sigmoid sinus.

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