Sinus Tympani: A Practical Classification

Alaa A. Abou-Bieh, MD¹, Thomas J Haberkamp, MD²
¹Department of Otolaryngology, Faculty of Medicine, Mansoura University, Mansoura, Egypt
²Cleveland Clinic, Cleveland, OH, USA

Introduction

The sinus tympani (ST) is one of the recesses of the posterior tympanum (retro-tympanum) and it is one of the sinuses of the posterior tympanic wall which formed by the abutting of the primitive endochondral pouches of the eustachian tube origin as they develop the middle ear air system—namely the saccus posticus—against the solid upper portion of the Reichert’s cartilage of the second branchial arch which ossifies to develop the styloid complex of the Posterior tympanic wall. Therefore it lies between the labyrinthine capsule medially, posteriorly (posterior semicircular canal) and superiorly (lateral semicircular canal), the styloid complex [the pyramidal eminence (PE), the styloid eminence (SE) and the chordal eminence (CE)] laterally and the facial nerve (FN) (the nerve of the second arch) with its bony canal posteriorly, postero-laterally or laterally. Inferiorly, ST is limited by the bony ridge between the SE and bony labyrinth the subiculum (S) and to variable degree, by the jugular bulb. A bony or membranous ridge or bridge the ponticulus (P) sometimes present between pyramid and promontory. Anatomical studies noted the large anatomic variations of ST and tried to classify it according to variations to the size, extension and depth⁴,⁵,⁶ or shape⁶. The importance of ST comes from that it is often invaded by cholesteatoma and/or granulation tissue and also being well known for the high risk of residual and recurrent disease, because conventional surgical approaches always failed to provide adequate access to a deep sinus tympani to eradicate disease. Some authors suggested different surgical approaches to ST including the retrosigmoid⁹ and the combines approaches to be possible solutions of this problem. Although the endoscopic assisted surgery has improved visualization of this area in recent years, sometimes it does not solve the problem to fully access ST or to eradicate the disease completely.¹¹-¹ê The aim of this study is to describe a classification for ST different types based on their otosclerotic and surgical anatomy in relation to their development theories. By combining these three elements, we aim to find a simple, practical and clinically significant classification and at the same time to eliminate the discrepancy between the various methods used to describe it in literature. The main significance of this classification would be evaluating possible approaches to each of its types in a way that makes it possible to decide the surgical approach preoperatively in most of cases. In addition, to find a simple effective fixed way of to describe and report cases.

Methods and Materials

The gross anatomy and anatomical variations of posterior mesotympanum and retro-tympanic areas including the ST were studied in 55 Fresh frozen temporal bones (TBs). To the best of our knowledge, all bones came from adult cadavers. There were 31 right temporal bones and 24 left. All bones were dissected by the same approach and all were studied utilizing an operating microscope and otoscopes with 0°, 30° and 70° angles and 2.7 and 3.0 mm diameters. In addition, the ST anatomy and variations were studied in two hundred temporal bones CT scans (= 400 sides). These scans were randomly chosen regard less they were of normal individuals or showing any type of temporal bone pathology, but all were for adults.

Results

Four distinct types of ST could be observed: Type 1, it was pneumatized and consisted of an orifice (O) and cavity (C). O was bounded superiorly by P, inferiorly by S, posteriorly by the pyramidal crest (PC) and anteriorly by the promontory edge. C was bounded laterally by the FN canal, medially by the labyrinthine capsule, posteriorly by the posterior (vertical) semicircular canal (PSCC), superiorly by the posterior tympanic sinus (PTS) and Lateral (horizontal) semicircular canal (LSCC) and inferiorly by SE, S and the jugular bulb. C did not exceed the level of the mastoid segment of FN dorsally. This was the commonest type (48.7%) presented in 24 TBs (43.6%) and 202 ears in the CT scans (50.5%). In TBs, it was easily approached trans-canal microscopically and endoscopically assisted. Type 2, the well pneumatized type, it was formed from O and C or O, vestibule (V) and C. C was deep enough posteriorly to exceed the level of the mastoid segment of FN in any direction. It occurred in 9 TBs (16.3%) and 135 ears in the CT scans (33.8%) (t 31.6%). It necessitated to be approached via a trans-mastoid retro-facial approach or by a combined trans-canal (microscopically and endoscopically assisted) and trans-mastoid approach. It was usually associated with very well pneumatized mastoid. Type 3, the common posterior tympanic sinus in which ST communicated with the upper posterior tympanic sinus proper or with a retro-ponticulus up-ward extension. This category of ST should be subdivided into deep and very deep according to whether C would extend beyond the level of the mastoid segment of FN in any direction or not. It occurred in 20 TBs (36.3%). It was possible to expect it in CT scans only rarely and accidentally so it was not included in CT scans calculations. It necessitated to be approached via a trans-mastoid approach or by a combined trans-canal (microscopically and endoscopically assisted) and trans-mastoid approach depending on its depth. Type 4, the non- pneumatized type, was shallow with no true O or C. The presence of P, S and PC was variable and not consistent. It occurred in 2 TBs (3.6%) and 63 ears in the CT scans (15.8%) (t 14.3%). Most of the CT scans showed this type of unhealthy TBs. It was easily approached trans-canal. In 79 ears in CT scans there was a difference between ST type in one side than the other. Either one was shallow and the other was pneumatized or one was pneumatized and the other was well pneumatized. Endoscopic trans-canal approach alone was satisfactory in types 1and 4 but with less extent type 3.

Discussion

The evolution of the ST classification started in 1889 when Steinbrugge³ found this sinus could extend beneath the facial nerve. Following studies based the anatomic variations of ST and trials of classifications on single factor either the variations in the size, extension and depth⁴,⁵,⁶,7 or shape⁶. The present work based its proposed ST classification on its development theory mainly combined with its size, extension and depth. In addition, when this study correlated between ST types in CT scans and TBs and at the same time correlated between ST types and possible surgical approaches it provided a clinical significant for the classification and provided a preoperative way to plan ST approach.

Conclusions

ST shape and extension both depend mainly on the extent of its pneumatization, which in turn influences its relations to the surrounding structures in the retro-tympanic area. Extensively or unusually pneumatized types need special or combined approaches.

Contact
Alaa Ali Abou-Bieh
Mansoura Faculty of Medicine
Email: abenin@mans.edu.eg
Website: http://medfac.mans.edu.eg
Phone: +200112982895

References