Endoscopic Transantral Transalisphenoid Approach to the Meckel’s Cave – An Anatomical Study

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Introduction

Multiple approaches have been designed to access Meckel’s cave and to accommodate to different morphology and extensions of its lesions. We conducted anatomical study to investigate the feasibility and anatomical landmarks of a true anterior approach through maxillary sinus and through greater wing of the sphenoid, for which we suggest the term transalisphenoid, to the Meckel’s cave. Surgical advantages and limitations are discussed.

Methods and Materials

Five cadaveric neurovascular-injected heads were used for endoscopic dissection. Neuronavigation was used to confirm surgical trajectory and evaluate the use of anatomical landmarks.

Results

The endoscopic transantral transalisphenoid (ETT) approach was divided into 4 following stages:
1. Entry into maxillary sinus: Caldwell-Luc procedure with sublabial mucosa incision was used to access maxillary sinus.
2. Exposure if greater wing of sphenoid: Posterior and lateral wall of maxillary sinus was removed, and infraorbital nerve was mobilized out of its bony groove. Contents of pterygopalatine and infratemporal fossa were then dissected and mobilized/removed. Temporalis muscle and upper head of lateral pterygoid muscle were elevated supraorbitally.
3. Exposure of medial of middle fossa: Transalisphenoid procedure - drilling of great wing’s bone - was performed based on 4 landmarks: inferior orbital fissure, foramen rotundum, foramen ovale, infratemoral crest. As a result, V2, V3, and temporal dura were exposed.
4. Exposure of Meckel’s cave and lateral wall of cavernous sinus: Intradural dissection was easily performed between V2 dural sheath and temporal dura. Meckel’s cave can be exposed and accessed up to trigeminal porus. Lateral wall of cavernous sinus can be exposed up to trochlear and oculomotor nerves. Surgical access and maneuverability was excellent in the Meckel’s cave and laterally. However, we found limited maneuverability in the upper and anterior cavernous sinus. The access was blocked partially by the maxillary strut.

Discussion

The ETT approach creates an anterior corridor to Meckel’s cave and medial middle fossa. This offers a direct access to Meckel’s cave lesions, and capability of intradural dissection, which is critical for complication avoidance. In contrast to current transpterygoid approach, which provides access to area medial and inferior to the trigeminal ganglion, ETT approach offers excellent surgical access to anterior, posterior, and lateral aspects of the ganglion. Importantly, the ETT approach offers multi-compartment access to middle fossa, infratemporal and pterygopalatine fossa. Therefore, it can provide adequate surgical access to tumors that span those three compartments, such as dumb-bell extension of trigeminal schwannomas or perineural spread of malignancy involving trigeminal nerves, especially V2 and V3 branches, Meckel’s cave, and cavernous sinus such as schwannomas, meningiomas, and sinonasal tumors.

Conclusions

The ETT approach is technically feasible and offers excellent surgical access to the anterior and lateral portions of the Meckel’s cave, with potential expansion toward the infratemporal fossa and lateral middle fossa. It could be ideally suited for lesions that extend from the maxillary sinus, infratemporal fossa, or pterygopalatine fossa into the middle cranial fossa, Meckel’s cave, and cavernous sinus such as schwannomas, meningiomas, and sinonasal tumors.

References

4. Figure 2. (A) Yellow line delineates area of greater wing of sphenoid (GWS) to be drilled in transalisphenoid procedure, using landmarks: inferior orbital fissure (IOF), foramen rotundum (FR) plane down to pterygoid process (PP), foramen ovale (AOV) plane and infratemporal crest (ITC). (B) Dura opening with mandibular branch (V3) visible. (C) Temporal dura (TAD) and lateral dural sheath (LDS) are exposed. (D) Intradural dissection is easily performed between V2 dural sheath and temporal dura. Meckel’s cave can be exposed and accessed up to trigeminal porus. Lateral wall of cavernous sinus can be exposed up to trochlear and oculomotor nerves. Surgical access and maneuverability was excellent in the Meckel’s cave and laterally. However, we found limited maneuverability in the upper and anterior cavernous sinus. The access was blocked partially by the maxillary strut.

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Figure 1. (A) Sublabial mucosa incision, and subperiorbital elevation to expose anterior antral wall (AANW) and inferior orbital nerve (ION). (B) AAW was opened with chisel, rongeur, and high-speed drill to enter maxillary sinus and access posterior antral wall (PAW). (C) PAW was removed and ION was mobilized out of its bony groove. Branches of inferior orbital artery (IOA) must be sacrificed to mobilize the nerve. ION is a landmark for finding maxillary branch (V2) of trigeminal nerve. Branches of internal maxillary artery (IMA) can be found during the dissection, sphenopalatine artery (SPA) runs medially toward sphenopalatine foramen, descending palatine artery (DPA) runs along greater palatine nerve (GPN), and posterior superior alveolar artery (PSAA) runs inferiortoward the upper teeth. (D) After mobilization of pterygopalatine fossa contents, infratemporal fossa can be entered through transmaxillary approach (TMA) can be identified with longitudinal fibers, and lateral pterygoid muscle can recognized with fiber in posterolateral direction. Subperiorbital elevation of the two muscles would expose the greater wing of sphenoid (Fig. 1A).