Parapharyngeal Internal Carotid Artery: Comparative Analysis of Surgical Exposure and Vascular Control via Endoscopic Endonasal, Transoral, and Transcervical Approaches

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Abstract

Background: Comparative study of surgical exposure and vascular control of the parapharyngeal internal carotid artery (ppICA) via various approaches has not been described.

Methods: Ten cadaveric specimens were dissected exposing the ppICA via endoscopic and open approaches. Length of exposed vessel and potential vascular control were assessed.

Results: Endoscopic transoral and transcervical transmandibular approaches can expose a significant length of ppICA. Vascular control can be achieved via endoscopic and open techniques with differing time taken.

Conclusion: Exposure of the ppICA between endoscopic transoral and transcervical transmandibular approaches are comparable. However, time taken for vascular control in the latter is much shorter.

Introduction

Endoscopic approaches to the parapharyngeal space (PPS) have been previously reported. However, the potential vascular control of the internal carotid artery (ICA) through this approach has not been addressed. This study aims to compare surgical exposure and vascular control of the ppICA via open and endoscopic approaches.

Methods and Materials

Ten cadaveric specimens injected with colored latex were dissected bilaterally to expose the ppICA. Each specimen was sequentially dissected via various approaches including endoscopic endonasal (Figure 1A), traditional transoral, endoscopic transoral (Figure 1B and 1C), transcervical submandibular, transcervical transparotid and transcervical transmandibular approaches. Length of the exposed vessel and potential vascular control (time taken to complete the encircling suture) were assessed.

Conceptually, the PPS is usually divided in the axial plane by the fascial condensation generating pre- and post-styloid compartments. In this study, the PPS was also divided in the vertical plane into three levels defined by bony landmarks. This subdivision helped to illustrate the potential areas of exposure by the various approaches. The upper PPS was defined as that area extending from the skull base to the hard palate, the middle PPS as the area between the hard palate and the mandibular angle and the lower PPS as the area extending from the mandibular angle to the greater cornu of the hyoid bone (Figure 2).

Discussion

Various open surgical approaches have been described for the surgical treatment of PPS lesions, offering varying degrees of exposure and working space. All the techniques included in this study have intrinsic anatomical limitations that prevent the exposure of some part of the ppICA. The comparison of varying degrees of the exposure in the PPS between each approach are offered in Table 1. Lesions in the superior part of the PPS abutting or involving the skull base significantly require more advanced surgical techniques (i.e., mandibulotomy) to increase the exposure and avoid a blind dissection. This study showed the endoscopic-assisted transcervical technique and the transcervical-transmandibular technique can expose the superior aspect of the PPS and it can provide extensive exposure of the ICA. Circumferential dissection and passing of an encircling suture around the ICA can be achieved through both the endoscopic endonasal and endoscopic transoral corridors. The narrow and deep working space of the nasal corridor, makes instrumentations through the sinonasal tract more cumbersome and time consuming.

Results

The traditional transoral approach can expose only the middle level and the pre-styloid part of the PPS. Due to deep location and limited view, the exposed ICA could not be measured via this approach. The endoscopic transoral and the transcervical transmandibular approaches can expose a significant length of ppICA from the skull base to the greater cornu of the hyoid bone (mean lengths are 6.89 cm and 7.09 cm respectively; p(0.0027)). The length of ppICA exposed by endoscopic endonasal technique is limited inferiorly by the hard palate (mean length 2.715 cm); whereas, the direct exposure offered by the transcervical submandibular and the transcervical transparotid approaches only include the caudal of the ppICA (mean lengths are 3.69 cm and 4.395 cm respectively), as they are restricted superiorly by the mandible, the facial nerve and the styloid process (Figure 3). The mean length of ppICA exposed by the transcervical transmandibular approach was significantly higher compared to the endoscopic endonasal, transcervical submandibular and transcervical transparotid approaches (p = 0.0000). Vascular control can be achieved via endoscopic endonasal, endoscopic transoral and open transcervical techniques with differing time taken 121.6, 64.8 and 5.2 seconds respectively (Figure 4).

Conclusion

The surgical exposure of the ppICA offered by the endoscopic-transoral and transcervical-transmandibular approaches seems similar, and superior to that of other approaches. Endoscopic-assistance enhances the visualization; therefore, offering a more precise dissection. In addition, its use during minimal access approaches helps to avoid the morbidity associated with external incisions, mandibular osteotomies and facial nerve manipulation. Vascular control can be achieved via both endoscopic and open transcervical approaches; however the latter affords a quicker control and the ability to use vascular clamps. It is critical to recognize that this study only shows the potential of each approach. It does not accurately reflect clinical scenarios as the cadaveric model cannot mimic neither the distorted anatomy nor the significant bleeding associated with the rich vascular plexus encountered when managing lesions in this area.

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TABLE 1. Comparison of varying degrees of the PPS exposure

<table>
<thead>
<tr>
<th></th>
<th>Endoscopic endoral</th>
<th>Endoscopic transoral</th>
<th>Traditional</th>
<th>Transcervical submandibular</th>
<th>Transcervical transparotid</th>
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<td>Pre-styloid</td>
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<tr>
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<td>Lower PPS</td>
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<tr>
<td>+ Adequate exposure, - inadequate exposure</td>
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FIGURE 1. Cadaveric dissections using a 0° endoscope demonstrating the view of the left ppICA. A) endoscopic endonasal approach. B) and C) endoscopic transoral approach. IX, X, XI, XII cranial nerves; I, X; II; SP: styloid process; MP/PM, medial pterygoid muscle.

FIGURE 2. Subdivision of PPS in vertical plane

FIGURE 3. Exposed segment of the ppICA. (A) Endoscopic endonasal approach. (B) Endoscopic transoral approach. (C) Transcervical submandibular approach. (D) Transcervical transparotid approach. (E) Transcervical-transmandibular approach. BOT, base of tongue; FN, facial nerve; H, greater cornu of hyoid bone.

FIGURE 4. Demonstration of circumferential dissection and passing a suture around the ICA, which can be performed via both endoscopic (A and B) and open transcervical (C) approaches.