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Original Article

Surgical anatomy of petrous part of the internal carotid artery

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ABSTRACT

The purpose of this study was to reveal the anatomical relationships of petrous part of the internal carotid artery. Sixteen human cadavers were investigated via preauricular surgical approach (bilateral exposure on each cadaver). A 6 cm long incision was made in front of the auricle, along the posterior border of the ramus of mandible, as higher as the level of the temporomandibular joint. After luxation of temporo-mandibular articulation and milling of tympanic bone, vertical and horizontal segments of petrous part of the internal carotid artery were exposed.

The vertical segment's mean length was 12 mm (ranged 10 mm to 15 mm). The relationships of the vertical segment were the jugular fossa posteriorly, tympanic bone laterally, and Eustachian tube anteriorly. Horizontal segment's mean length was 20 mm (ranged 18 mm to 22 mm). Angle between vertical and horizontal segments of the petrous part of the internal carotid artery was measured 105° (ranged 95 to 110°).

V, VII, IX, X, XII cranial nerves, internal jugular vein, and Eustachian tube are important structures, which must be protected during high carotid surgery. © **Neuroanatomy. 2009; 8: 46–48.**

Key words [carotid canal] [petrous part] [internal carotid artery]

Introduction

Exposition of the petrous part of the internal carotid artery (pICA) necessitates close control during surgery for proximal internal carotid artery aneurysms. The most difficult manipulation is the exposure of the internal carotid artery on the level of the carotid canal, and in most cases it is accompanied by local neurological complications in postoperative period that are results of the trauma to the nerves during the dissection stage of the corresponding region. The purpose of our study was to investigate the anatomical relationships of the internal carotid artery in petrous part of the temporal bone in two segments: a vertical and a horizontal segment.

Materials and Methods

Eight formalin-fixed human cadavers were investigated. Sixteen pre-auricular surgical approaches were performed (bilateral exposure on each cadaver). A 6 cm long preauricular incision was made along the posterior border of the ramus of mandible. The skin incision started from the level of the temporomandibular joint (Figure 1). After dissection of the subcutaneous tissues and parotid capsule, the posterior pole of the parotid gland was detached from styloid and mastoid processes. In the stylo-mastoid angle the facial, vagus, hypoglossal nerve and glossopharyngeal nerves were identified (Figure 2).

Detachment of the digastric and styloid muscles, resection of the styloid process and subluxation of the mandibular joint was performed to reveal the internal carotid artery, which enters in carotid canal medial to the tympanic bone (Figure 2).

Milling of the carotid canal exposed pICA's vertical segment, which directed superiorly before turning at the genu to form the horizontal segment (Figure 3). The horizontal segment was beginning at the genu, passing anteriorly and medially to the cochlea (Figure 4). Trigeminal ganglion was lying over the medial portion of the pICA.

Results

In 16 surgical approaches in all cases, the dissection techniques were identical. In all cases the anatomy of the retro-parotid space was stable, particularly, cervical segments of the cranial nerves VII, IX, X, XII started from the stylo-mastoid angle.

The mean length of the vertical segment of the pICA was 12 mm (ranged 10 to 15 mm) (Table 1). The relationship of the vertical segment was the jugular fossa posteriorly, tympanic bone laterally, and Eustachian tube anteriorly.

Horizontal segment's mean length was 20 mm (ranged 18 to 22 mm) (Table 2). In all cases it passed anteriorly and medially to the cochlea. In all cases, the cochlea was vulnerable to be damaged during the exposure of the horizontal segment of the pICA.

During milling the horizontal segment of the carotid canal, the mean exposed length of the trigeminal nerve was 10 mm (range 8 to 12 mm). The trigeminal nerve's dissection was not complete.

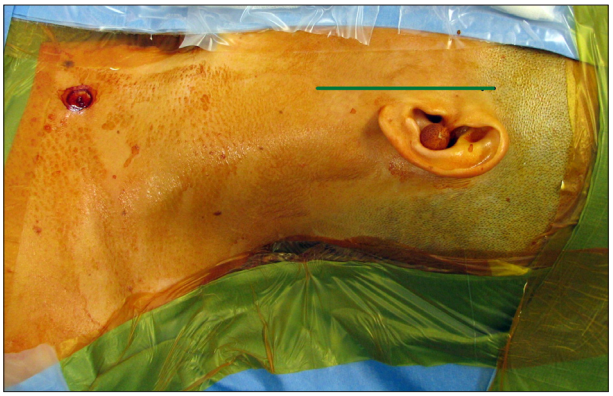

Figure 1. The skin incision starting from the level of the temporomandibular joint, with a preauricular course along the posterior border of the ramus of mandible.

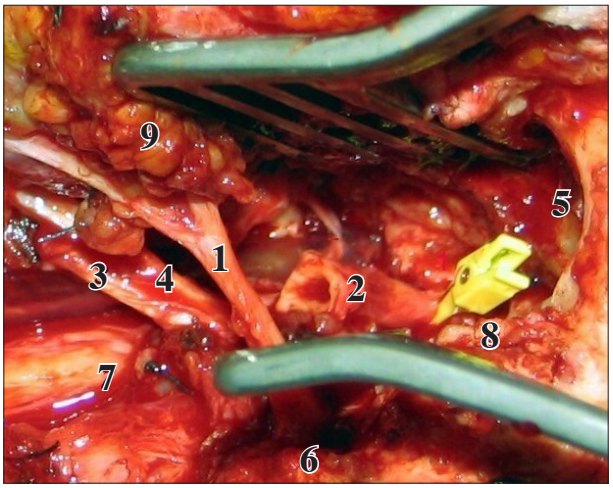

Figure 2. Left temporo-mandibular region. *(**1:** facial nerve; **2:** internal carotid artery; **3:** hypoglossal nerve; **4:** glossopharyngeal nerve; **5:** area for temporomandibular joint; **6:** styloid-mastoid angle; **7:** vagus nerve; **8:** carotid canal; **9:** parotid gland)*

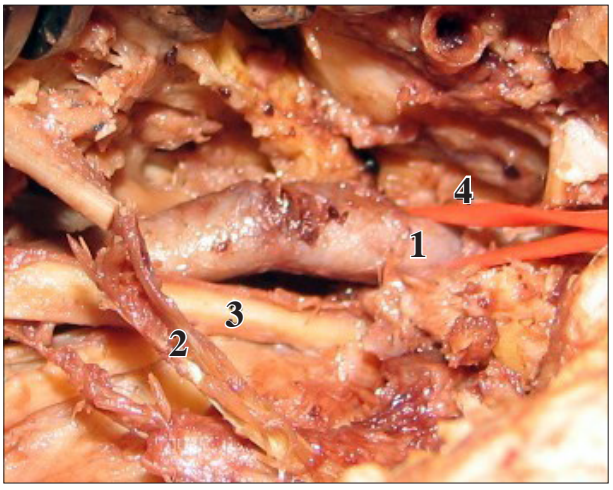

Figure 3. Left temporo-mandibular region. *(**1:** vertical segment of the petrous part of the internal carotid artery; **2:** facial nerve; **3:** glossopharyngeal nerve; **4:** Eustachian tube)*

Figure 4. Right temporo-mandibular region. *(**1:** vertical segment of the petrous part of the internal carotid artery; **2:** horizontal segment of the petrous part of the internal carotid artery; **3:** genu of the petrous part of the internal carotid artery; **4:** cochlea is damaged during milling)*

Table 1. The length of the vertical segment of pICA.

Lenght (mm)	Number of cases (n)	%
10	4	25
12	6	37.5
13	4	25
15	2	12.5

Table 2. The length of the horizontal segment of pICA.

Lenght (mm)	Number of cases (n)	%
18	6	37.5
20	8	50
22	2	12.5

Table 3. The angle between two segments of pICA.

Angle (degree)	Number of cases (n)	%
95	4	25
105	10	62.5
110	2	12.5

Angle between vertical and horizontal segments of the pICA was 105° (ranged 95 to 110°) (Table 3).

In all cases, the internal carotid artery was adhered to the carotid canal via connective tissue.

Discussion

The classification of the segments of the internal carotid artery is object of debate. Fischer described five segments of internal carotid artery, however, the various segments were named opposite the direction of blood flow [1]. Gibo et al. identified four segments, however, they did not describe the particular anatomic features [2]. Bouthillier et al. recognized five segments as the cervical, petrous, cavernous, clinoid and supraclinoid segments [3]. Ziyal et al. described five segments: the cervical, the petrous, the cavernous, the clinoid and the cisternal segment [4].

Exposition of the pICA deserves proximal control during surgery for proximal internal carotid artery aneurysms. On the level of the carotid canal, the exposure of the internal carotid artery is the most difficult manipulation. Knowledge of microsurgical anatomy of petrous segment may decrease neurological complications during surgical approaches [5,6].

Paullus et al. reported the mean length of the vertical segment as 10.5 mm and horizontal segment as 20.1 mm [7].

Ferreira et al. reported that the exposure of the trigeminal nerve by the mandibular branch approach increased the length of the exposed trigeminal nerve to 20.1 mm [8].

Ferreira et al. described two branches of pICA: the caroticotympanic branch originated in the vertical segment and pterygoid branch in the horizontal segment. The frequency of the caroticotympanic branch is so low that its presence is sometimes considered as anomalous [8].

Paullus et al. [7] and Katsuta et al. [9] described the anatomical relationships of the pICA as the facial canal, internal acoustic meatus, cochlea, geniculate ganglion, facial nerve, trigeminal nerve, Eustachian tube, middle meningeal artery, and jugular foramen with internal jugular vein. The lack of knowledge of the anatomical relationships may result in damage to these anatomical structures during surgical exposure of the pICA.

Conclusion

Facial, vagus, hypoglossal, glossopharyngeal and trigeminal nerves, internal jugular vein, and Eustachian tube are important anatomical structures, which must be protected during the exposure of the pICA. In all cases, the cochlea is damaged during exposure of the pICA's horizontal segment.

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