

Editorial Review

Posterior fossa endoscopy

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Introduction

The use of endoscopes in all disciplines of surgery has undergone massive expansion in recent years. Otolaryngology has, too, seen the use of endoscopes in diagnosis and management multiply. This has been particularly noticeable in the fields of laryngology and rhinology. The otologist and neurotologist have maintained their strong attachment to the operating microscope, but are beginning to explore the utility of endoscopes in the cerebellopontine angle (CPA).

Endoscopy of the posterior fossa

The endoscopic anatomy of the CPA has been described by O'Donoghue and O'Flynn, 1992 as consisting of four levels, starting superiorly and proceeding inferiorly. The levels are:

Level 1. The trigeminal and abducens nerves with related vascular structures, usually the superior cerebellar artery and vein. Also in the first level are the entrance to Meckel's cave and the petroclinoid ligament.

Level 2. The acousticofacial bundle entering the porus some 13 mm from the pontomedullary junction. The bundle enters the porus 55 mm deep to the surface of the squamous temporal bone when approached via the retrosigmoid route. The anterior inferior cerebellar artery is seen at this level.

Level 3. The cranial nerves IX, X and XI can be seen passing laterally towards the jugular foramen closely related to the posterior inferior cerebellar artery.

Level 4. At the level of the foramen magnum, the cranial and spinal accessory nerves, and the hypoglossal nerve, plus the vertebral and basilar arteries occur in close proximity.

The endoscope used for visualizing the CPA is the 4 mm O-Hopkins rod lens type. The field angle most commonly used is the 0 degree, but also occasionally used are the 30, 70 and 110 degree endoscopes. The access for the endoscope is typically a 2 cm retrosigmoid craniotomy, a curvilinear dural incision followed by immediate drainage of cerebrospinal fluid from the pontine cisterns. This allows the cerebellum to fall gently away without the need for retraction. Endoscope insertion is then controlled by video-camera and monitor. The 70 and 110 degree

endoscopes are placed under microscope control. In order to maintain a strictly sterile field direct vision can not be used with the endoscope. Monitoring of the facial nerve is always employed during CPA endoscopy.

Acoustic neuroma surgery

The most frequent use of CPA endoscopy reported in the literature and in our unit is in the excision of small acoustic neuromas. The endoscope is introduced as described above. The role of endoscopy in acoustic neuroma surgery is firstly to visually map the anatomical landmarks with less disturbance than would be necessary if the operating microscope was used alone; and secondly to complement the microscope during excision of the tumour including the final check for completeness of resection at the end of the operation.

The initial mapping of the CPA anatomy using the endoscope reveals structures that would be hidden if the operator depended solely on the direct vision obtained by the microscope. The important structures to be localized by the endoscopist are the acousticofacial bundle and the cerebellar vessels in particular with respect to their relationship to, and distortion by the tumour. Once a mental image is formed the endoscope is replaced by the operating microscope and the dissection proceeds.

The endoscope is used during the microdissection to provide an overall panorama of the CPA, and examine areas hidden from the direct view of the microscope. This is of particular significance when exposing the lateral extent of the tumour. This lies lateral to the porus acusticus in the internal auditory canal. Access to this requires removing the bone of the posterior wall of the internal auditory canal. The potential hazard with this procedure is the posterior semicircular canal which is situated 5–10 mm (mean = 7 mm) from the posterior margin of the porus. The surgeon needs to judge the minimum amount of posterior canal wall to remove to get adequate exposure of the tumour for resection, for which purpose the endoscope is of great value (O'Donoghue *et al.*, 1994; Rosenberg *et al.*, 1994). Removing too much bone may lead to failure to preserve hearing function, which is important in small acoustic tumours. The possible

benefit of endoscopy in the preservation of hearing was illustrated by Magnan (O'Donoghue *et al.*, 1994) in a series that compared use and non-use of the endoscope and hearing outcome. Six of 21 patients in the non-endoscope group retained hearing compared to 13 of 21 in the endoscope group.

Trigeminal nerve decompression

It is generally accepted that trigeminal neuralgia is caused by a combination of compression of the sensory root of the trigeminal nerve at the root entry zone, and intrinsic demyelination of the nerve (Dandy, 1934; Janetta, 1967). Decompression involves locating the compressing vessel, microvascular dissection of the compressing vessel off the nerve which is made difficult by layers of thickened arachnoid adherent to both nerve and vessel, and interposition of material, usually Teflon sponge (Magnan, 1997). This is most commonly performed with the use of the operating microscope.

The function of the endoscope is in the mapping of the anatomy of the trigeminal nerve in the CPA. The 4 mm rod lens affords an excellent panoramic view of the trigeminal nerve from the brain stem to Meckel's cave (Prott, 1974; O'Donoghue and O'Flynn, 1992), allowing the site of the compressing vessels to be accurately located. The advantage of the endoscope is that, provided sufficient cerebrospinal fluid is released from the basal cisterns, minimal retraction is required in order that the compressing vessel or vessels be located. Once found the endoscope is substituted for the operating microscope and the decompression performed. The endoscope can then be used to check the adequacy of the decompression before wound closure.

Facial nerve decompression

Hemifacial spasm is caused by compression of the facial nerve at the root entry zone (Fukushima, 1995). Microvascular decompression of the facial nerve is analogous to that of the trigeminal nerve. The endoscope again has a role in mapping the CPA anatomy and locating the compressing vessel or vessels. The acousticofacial bundle is readily found at the porus acusticus, 55 mm deep to the craniotomy. The facial nerve lies most anteriorly, and can be followed medially to the root entry zone where the offending vessel, usually the anterior, posterior or common trunk of the inferior cerebellar artery (Fukushima, 1995) can be found and decompressed.

Vestibular nerve section

Vestibular nerve section is indicated for recalcitrant unilateral peripheral vestibular syndromes. In order to safely section the vestibular nerve the facial nerve must first be identified. This lies in an anterosuperior position at the crista falciformis, but rotates inferiorly to lie inferior to the vestibulocochlear nerve at the root entry zone. Secondly, the plane of cleavage between the cochlear and vestibular nerves must be sought, there is often a small artery which can be identified as a landmark for this

plane. However in 25 per cent of cases there is no plane of cleavage visible because the cleavage site lies within the internal auditory canal, lateral to the internal auditory meatus. This can be found by drilling the posterior lip of bone off the internal auditory canal (Silverstein *et al.*, 1990). The role of the endoscope in vestibular nerve section is to firstly demonstrate the anatomy in the CPA of the vestibular nerve and its relation particularly to the facial nerve and the plane of cleavage between it and the cochlear nerve. Some authors have described a technique whereby a neurotome is used to divide the vestibular nerve under endoscopic control (Oppel and Handrock, 1984). Most endoscopists however use an operating microscope to divide the vestibular nerve. The endoscope can be used at the end of the procedure to check the completeness of the division.

The use of the endoscope in vestibular nerve section has been described by three authors. Oppel and Handrock (1984) wrote up six patients on whom they had sectioned the vestibular nerve using the endoscope alone. They felt that the view of the anatomy was better than with a microscope. Magnan (O'Donoghue *et al.*, 1994) described a similar technique on two patients. He was not over enthused by the use of the endoscope in such operations because he felt he needed two hands to perform the section. Magnan has continued to use CPA endoscopy to complement the microscope for vestibular nerve section (Magnan, 1997). Rosenberg *et al.* (1994) described using the endoscope only for mapping, substituting it for the microscope for sectioning the nerve. In cases where the posterior lip of bone is taken down the endoscope could be of value for inspecting the anatomy of the neuroanatomical structures in the internal auditory canal, particularly the cleavage of the audiovestibular nerve.

Conclusion

The endoscope is a new tool for the neurologist. Its major role is in the anatomical mapping of the neurovascular structures within the CPA without the need for dissection and retraction. In the removal of small acoustic neuromas utilization of the endoscope has very definite advantages. The initial mapping of the area and endoscopic re-examination of the lateral aspect of the internal auditory canal ensures complete excision with minimal risk to the labyrinth. The advantage conferred using the endoscope in the CPA for nerve decompression is unproven because few surgeons use it. However the technique may gain acceptance in time. In vestibular nerve section the advantage of the endoscope is less convincing and needs the development of appropriate instrumentation to make endoscopic nerve section safer.

The advantages of the endoscope over the operating microscope lie in its minimal access insertion and panoramic visualization. The major disadvantage is that it has to be held during the procedure, leaving the surgeon only one free hand with which to operate. The problem of anchoring the endoscope whilst operating has largely been over-

come by the flexible tension arm device, commonly known as 'the snake'. However, readjusting this is cumbersome and fine adjustments are difficult. The microscope may therefore remain a more usable option in situations where two hands are needed.

The future may witness the greater versatility of the endoscope leading to the greater complementarity with the operating microscope in CPA procedures. It is important that training in endoscopic CPA surgery is undertaken and assessed. Cadaver dissection is an integral feature of such training. Caution must be exercised to avoid the highly publicised disasters that plagued the advent of endoscopic sinus surgery.

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