The current role of endoscopes in intracranial tumor surgery

Since the first endoscopic biopsy in 1973 by Fukushima, the advances in instrumentation and optics have considerably widened the field of endoscopic surgery in intracranial lesions. Endoscopic techniques have been used for tumors located in intraventricular and paraventricular locations as well as in the intracranial extracerebral locations.[1] The location of the tumors within the ventricles makes them ideal candidates for endoscopic approaches as the CSF is an excellent medium for transmission of light and the images. In the extracerebral locations, endoscopes have been passed along the naturally occurring CSF spaces (cisterns) or in the subarachnoid spaces with minimal retraction of the brain.

Various endoscopic approaches

Several variations of usage of endoscopic techniques in neurosurgery have been described in literature. Hopf and Perneczky classified the endoscopic usages in neurosurgery as pure endoscopic neurosurgery, endoscopic-assisted neurosurgery, endoscopic-controlled microsurgery, and endoscopic inspection.[2] In *pure endoscopic neurosurgery*, the surgical procedure is performed through a burr hole, and endoscopic instruments are advanced through the endoscopes operating channel. The term *endoscopic-assisted microsurgery* is used when the endoscopic surgery is performed in conjunction with microsurgical manipulations under the operating microscope. In *endoscopic-controlled microsurgery,* the surgery is performed with conventional microsurgical instruments advanced and manipulated outside the endoscopes confines but is guided by the video image provided by the endoscope. *Endoscopic inspection* is considered when the endoscope is used as an adjunct during the microsurgical procedure with the usage being limited to inspection purposes. Pure endoscopic neurosurgery has been used mostly for CSF diversion procedures, cyst fenestrations, and tumor biopsies while endoscopic-assisted procedures have been preferred for tumor debulking and excision.

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In intracranial tumor surgery, endoscopes have been widely used for obtaining a diagnostic biopsy, performing a concurrent CSF diversion procedure, and to look around the corner for assessment of any residual tumor after debulking by microscopic techniques.[1] Additionally, in transnasal and skull base surgeries, endoscopes also have been used as a viewing tool with the instruments passed outside the confines of the endoscope. This has the advantage of usage of larger instruments with rapid debulking and coagulating capabilities, which otherwise would have been difficult to be introduced through the endoscope's working channel. However, this approach has not been very popular in surgery for intracranial tumors and tumors located in the intra and periventricular regions. One of the reasons has been the potential to injure vital neural structures and blood vessels during the repeated passage of instruments outside the confines of the scope. There have been reports of usage of two endoscopes, one predominantly used for viewing and another for the instrumentation during removal of tumors and tumor like cysts in the intracranial compartment.

With the currently available endoscopic techniques, gross total removal of most of the intracranial tumors appears to be difficult. The ideal tumor for total endoscopic resection is considered to be soft, less than 2 cm in diameter, located completely inside the ventricles, has associated hydrocephalus, is mild to moderately vascular, and should be accessible through a straight trajectory.[3] Considering this, it is apparent that only a small percentage of tumors will be suitable for endoscopic resection, and there have been only few reports of usage of pure endoscopic techniques through a burr hole for tumor removal in the intracranial compartment.[1,4] Most lesions have been intraventricular in location and are relatively avascular. A recent report, which surveyed 15 neuroendoscopists from 10 countries, concluded that with the currently available instrumentation, endoscopic techniques can be safely applied to small avascular solid intraventricular tumors and colloid cysts of the third ventricle.[5] The authors noted that the majority of the complications are based on the potential to achieve hemostasis during the surgery.

The predominant concerns have been the lack of a rapid debulking tool, which can be passed along the scopes instrument channel and can simultaneously achieve hemostasis. This is quite important in deep-seated periventricular tumors as even minor bleeding during the procedure often obscures the field by mixing with the CSF, which becomes "muddy," thus requiring constant irrigation and prolonging the overall operative time.

In the recent years, there have been developments of tissue debulking tools, which can be passed through the endoscopes operating channel and are worth mentioning. Development of an ultrasonic aspiration system, which fits into the Gaab neuroendoscopic system (Karl Storz GmbH and Co.), has been described by Oertel *et al*.[6] The ultrasonic hand piece was used in patients with pituitary macroadenoma, intraventricular hemorrhage with obstruction of aqueduct and one patient of intraventricular craniopharyngioma. The authors reported effective aspiration of the lesion without complications.

Another promising tool has been the development of NICO Myriad system. It uses a high speed reciprocating inner canula with a stationary outer canula and an electronically-controlled variable suction. A side aperture with a cutting aspiration system is located 0.6 mm from the tip of the blunt dissector. A combination of suction and reciprocating cutting action is used to fragment the tissue and aspirate it into the side aperture. The suction draws the desired tissue into the side aperture while the reciprocating cutting action of the inner canula resects the tissue. The side aperture can be rotated by a control knob on the hand piece. The device is operated by two foot controls allowing the operator to regulate the strength of the suction and initiation and stoppage of the action of the reciprocating inner blade. The NICO system is non-thermogenic unlike the ultrasonic or laser devices. The system is currently compatible with several currently available endoscopes. This system has been used in endoscopic intracranial procedures and endoscopic-assisted open keyhole craniotomy.[7]

Both the above systems can rapidly debulk the tumor and operate through the endoscopes working channel, thus reducing injury to the structures outside the sheath of the endoscope. Unfortunately, both the above systems do not devascularize the tumor prior to the decompression and thus are not ideal for vascular tumors, which thus need to be pre-coagulated.

In the report by Chowdhury,[8] which appears in the current issue of this journal, the authors have used the endoscopic-controlled microsurgery to resect a cerebellopontine angle epidermoid tumor. I would agree with the authors' selection of the case as epidermoids are avascular and can be removed with minimal dissection, which can often be performed without much difficulty with the available endoscopic systems. Endoscopes also offer a panoramic visualization than the microscopes and often are useful in "looking around the corners." It is often useful with epidermoids as these grow into the various crevices in the cisterns and the subarachnoid spaces. Apart from fogging of the scope, the major concern in such an approach would be repeated passage of the instruments outside the confines of the scope, which can injure the lower cranial nerves or the adjacent neural and vascular structures. However, with experience, these complications can be avoided.

With the above in mind, is it fair to assume that endoscopic resection will become a "standard of care" in future in these tumors? Considering that endoscopic instrumentation is still in its infancy and the enormous expertise and experience with microsurgical techniques, it is difficult to conclude that endoscopic resection would be considered as an initial choice in tumors located in intra and extracerebral locations until more advanced instrumentation and experience is available.

Aaron Mohanty

Division of Neurosurgery, University of Texas Medical Branch at Galveston, Galveston, TX, USA

Address for correspondence:
Dr. Aaron Mohanty,
301 University Boulevard, Rt 0517,
Galveston, Tx 77555 - 0517, USA.
E-mail: aarmohanty@yahoo.com

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