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Neuroendoscopy in Epilepsy Surgery

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Abstract

Epilepsy surgery has constantly evolved in various fields of knowledge. Surgical criteria have shifted from standard procedures to individualized forms of treatment, depending on physiological tests and specific imagenology findings in an individual patient. New instruments and applications based upon older instruments have been described in the treatment of epilepsy surgery, including the use of endoscopes. Frequent indications of neuroendoscopy in epilepsy surgery have been mostly to assist in open procedures, particularly when fluid-filled spaces are present within the surgical field, such as cystic parasites, tumors, arachnoid, or other types of cysts. Other indications certainly include cases of temporal lobe epilepsy, where ventricular exploration precedes intraventricular electrode placing as a tool to localize epileptogenic zones. Although described several years ago, there has been a recent trend in performing endoscopy-assisted section of the corpus-callosum in patients with generalized seizures. As neurosurgical instruments and techniques continue their progress, endoscopy will be included more frequently as part of the armamentarium in epilepsy surgery.

Keywords

Neuroendoscopy, Epilepsy Surgery, Intracranial Cysts

1. Introduction

Minimally invasive surgical techniques for epilepsy surgery may represent a recent trend which include electrode placing for deep-brain and cortical monitoring and stimulation, disconnection, and ablation procedures. Some of these procedures may be performed through small craniotomies or through one or more burr-holes, depending on individual characteristics of the illness, but with the purpose of achieving better results with less morbidity and mortality [1]. This tendency has been reflected in increasing numbers of international literature contributions on the subject.

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Endoscopy has been used as well in the treatment of various types of intracranial or intra-spinal pathologies, or as an aid to obtain accurate diagnosis [2] [3]. Recently, epilepsy-associated pathologies, such as congenital cysts, cystic or solid tumors, parasites, abscesses, and blood-clots, have been included among endoscopy indications, demonstrating its usefulness particularly in limited settings [2].

2. Endoscopy-Assisted Epilepsy Surgery Indications

According to our review of the world literature, endoscopy-assisted epilepsy surgery has been indicated in the following settings.

Endoscopic-assisted temporal lobe epilepsy surgery. Intraventricular electrode placement has not been regularly used for the study of epilepsy surgery candidates, but some patients with temporal lobe epilepsy may benefit from this procedure, as previously mentioned by us [4] and others [5]. Endoscopic ventricle exploration followed by intraventricular electrode placing as part of accurate epileptic foci localization could be useful, so that affected brain tissue may then be resected without excessive manipulation of the brain. Intraventricular electrode-placement has been described by various authors as an alternative to determine with more precision the epileptiogenic zone in certain cases of temporal lobe epilepsy. Either intraventricular individual electrodes, or electrode arrays, in coordination with cortical surface electrodes have facilitatedthe localization and subsequent resection of the epileptogenic zone.

Endoscopy-assisted corpus callosotomy. Surgical section of the corpus callosum is an old procedure that has been used for tract interruption, and therefore epilepsy focus isolation. It is still useful in cases where tissue resection is not indicated, particularly when multiple ictal foci are present and lie in eloquent areas of the cortex, or in cases of generalized epilepsy syndromes. Traditionally, the extent of the callosotomy is determined by a postoperative MRI, or even as an intraoperative study, which may only be possible in few hospitals world-wide. In order to determine the extent of the corpus-callosotomy in the intraoperative period, endoscope-assisted operations have been an alternative. This procedure was previously performed and documented by our group in five patients [6], taking into account intracranial anatomical references obtained from preoperative image studies. Subsequent publications describe this procedure in accordance to intraoperative endoscopic images [7] and MR images, as well as with intraoperative MRI and neuronavigation [8]-[10]. These authors have also described the use of neuroendoscopy in minimally invasive hemispherotomy, both as an individual procedure, or in addition to the corpus-callosotomy.

Endoscopy-assisted intratumoral cyst exploration. Epilepsy associated cystic tumors may be explored with the endoscope, allowing clear images on the anatomy, vascularization, cystic content, and other features that might be helpful in selecting tumor sites where tissue samples may be taken from. Several authors [11] [12] have associated endoscopic images with the quality of the samples to obtain reliable histological diagnosis, hence an appropriate treatment. Eight of our cases underwent endoscopic sampling of cystic tumors, and in two, intracavitary electrode placement, with electrographic recordings from selected tumor areas were performed to increase sampling accuracy (**Figure 1**). This procedure was based upon the hypothesis that neoplastic activity in malignant tumors may cause local neuronal excitability, abnormal transmitter release, changes in blood-brain barrier, and other factors that may derive in network hyperexcitability [13]. Histopathological diagnosis has successfully confirmed the quality of the areas sampled, although a larger number of cases are needed to statistically demonstrate this hypothesis.

Endoscopy-based exploration and resection of deep brain intraparenchymal cystic lesions. Cases with multiple subcortical brain cysts of unknown etiology, have been explored and resected under endoscopic visualization. According to their characteristics, we have identified viable cysticerci and subsequent endoscopical extraction has been achieved (**Figure 2**).

Neurocysticercosis is the most frequent parasitic disease in the central and peripheral nervous system. It is considered endemic in various underdeveloped countries where efficient sanitary policies and procedures are not efficiently implemented. Neurocysticercosis may be diagnosed with variable precision criteria, where image studies and epidemiological data are considered essential [14]. However, these criteria may be absent in a significant number of cases, particularly when studies are performed with old and outdated scanners, which may be the case of many medical facilities in those countries. The use of endoscopy in this context, increase accurate diagnosis in neurocysticercosis, proving its invaluable importance in this setting [15].

Endoscopy-assisted arachnoid cyst fenestration. Epilepsy-associated arachnoid intracranial cysts represent a

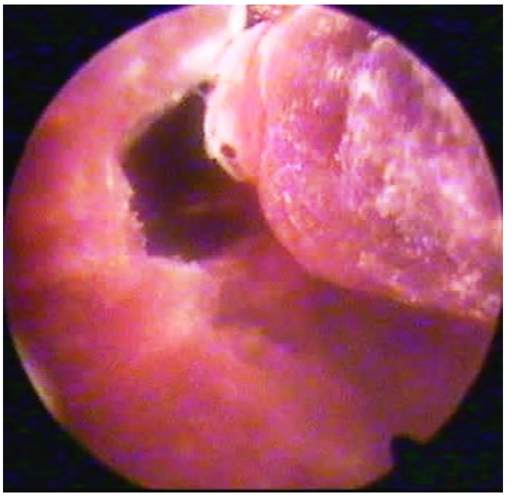

Figure 1. Endoscopic view of a cystic neoplasm. Selected areas were sampled for histological analysis.

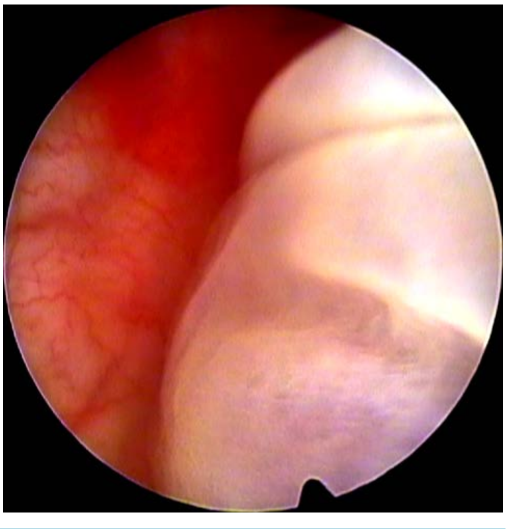

Figure 2. Intraventricuar cyst diagnosed endoscopically as a viable cysticercus (white area).

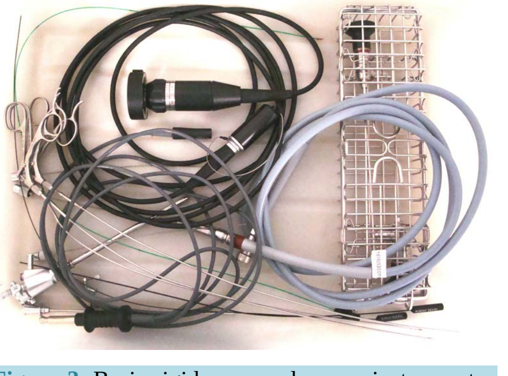

Figure 3. Basic rigid neuroendoscopy instrumentation (Richard Wolf GmbH. D-75434 Knittlingen, Germany).

small percentage of arachnoid cysts (15%). They have been considered benign intracranial lesions that may cause multiple signs and symptoms, including epilepsy. The treatment options for these lesions have been controversial and diverse, ranging from simple observation to various surgical procedures, including endoscopic cyst fenestrations to the basal cisterns or ventricles. This procedure may be considered the treatment of choice for many surgeons, since it is associated with 0% of complications [16]-[18], compared to the second procedure of choice, which is the craniotomy cyst decompression, with a 17% rate of complications, being the most frequent the formation of subdural clots [19].

3. Discussion

Surgical endoscope procedures have coupled a relatively low cost of the equipment, with a high yield of results, making this instrument an important component of the surgical armamentarium. High definition image studies have proved essential to determine which patients may be suitable candidates for surgical epilepsy procedures [20] [21]. Such image studies, as well as specialized surgical equipment, may not be available in public hospitals from developing countries. To overcome the lack of diagnostic technological resources, endoscopy-associated direct visualization and real-time intraoperative diagnosis has been performed [2].

Diagnostic endoscopic observations may then be followed by intraoperative adjustment to the original surgical plan in up to thirty five percent of the procedures, thus, immediate therapeutic changes may be applied at the time of the surgical intervention [2]. Such modifications have been associated with a reduction in the number of surgical interventions, with significant decrease in morbidity and mortality risks, as well as hospital costs. Surgical protocols before intervention in patients harboring a variety of diseases, with clear indication for endoscopic procedures, follow a similar course as in conventional procedures. Patients must be admitted to a second or third level hospital, where thorough image, laboratory, and functional studies must be obtained, including conventional or specialized Computed Tomography (CT) scans and 1.5 tesla Magnetic Resonance Images (MRI), as well as functional scans, depending on its availability. Additional preoperative screening include video-electroencephalograms, blood-cell count, and coagulation tests, cardiovascular risk evaluation, as well as psychometric and psychological interviews for testing memory, attention, psychiatric data and signed consent. Staff discussions based on the results, are crucial to determine the best approach for every individual. Flexible endoscopes may be used, although 6 mm external diameter rigid endoscope with Hopkins view system and three working channels[1], in our experience, is preferred (**Figure 3**).

4. Conclusion

Endoscopy may represent a useful instrument in the currently diagnosis and treatment of various intracranial cystic lesions, as well as in the assistance of open intracranial procedures as an aid in the treatment of lesions associated with epilepsy. More experience is required to determine its value in the long term.

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