ENDOSCOPIC SURGERY FOR PITUITARY ADENOMA: A HISTORICAL REVIEW

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Over the past century, pituitary adenoma surgery has undergone several revolutions in surgical technique and technological advances, leading to the development of modern endoscopic transsphenoidal surgery. Although transsphenoidal surgery is well documented in the modern neurosurgical literature, the historical maze that led to its development remains of interest because it allows us to appreciate the unique contributions and innovations of neurosurgical pioneers.

Key words: pituitary adenomas, endoscopic surgery pituitary adenomas.

Surgical treatment of patients with tumors of the chiasmal-sellar region, in particular with pituitary adenomas, is still a serious problem of modern neurosurgery. This is due to both the high prevalence of the disease and the location of tumors in the area surrounded by the most important anatomical structures, the involvement of which causes difficulty in choosing an adequate surgical approach, and also complicates radical resection of tumors. This becomes especially relevant in case of hormonally active pituitary tumors, when the radicality of adenoma removal is a criterion for curing the patient of diseases such as acromegaly, Itsenko-Cushing's disease, hyperprolactinemia. Vivid clinical manifestations of these diseases, as a rule, allow one to suspect and make a diagnosis at earlier stages of growth

tumors. In hormonally "inactive" adenomas, the tumor can grow to a significant size before any symptoms develop associated with the tumor's volumetric impact on surrounding anatomical structures.

At present, the priority of surgical treatment of pituitary adenomas is firmly established for the transsphenoidal approach, the vast majority of tumors are removed by it. Only a small proportion of patients are operated using the transcranial approach.

At the same time, the widespread transsphenoidal approach, carried out with the help of a microscope, has a number of limitations, such as the need to use a nasal dilator, the lack of a lateral view of the surgical field at the microscope. In this regard, the radicality of the removal of pituitary tumors is reduced, as well as the risk of

the risk of damage to important vascular-nerve structures of the chiasmatic-sellar region increases.

The use of endoscopic techniques allows to solve these problems in many ways, namely, to provide an adequate panoramic view of the surgical field by using endoscopes with angled optics, to expand the scope of manipulations in the chiasmal-sellar region due to the absence of a nasal mirror. Endoscopic transsphenoidal surgery of tumors of the chiasmal-sellar region is currently one of the most promising methods for removing pituitary adenomas. It is actively developing both in our country and abroad. And this is natural, since the use of endoscopic technologies in operations on the chiasmal-sellar region allows to minimize the trauma of the access itself, to achieve greater radicality of the operation and to reduce the duration of the patient's stay in the hospital in the postoperative period.

Endonasal endoscopic adenomectomy is a minimally invasive procedure with a low complication rate, which is generally well tolerated by patients. It has a number of advantages over the transsphenoidal adenomectomy technique performed using a microscope, such as good illumination of the surgical wound, the ability to zoom in and have a panoramic view of almost the entire surface of the surgical wound, and the ability for both the surgeon and assistant to work simultaneously. It also virtually eliminates the need for intraoperative fluoroscopy, which eliminates the risk of X-ray exposure for medical personnel and the patient.

Currently, three-dimensional endoscopes have already been developed at different levels of volumetric image transmission: from the presence of binocular rod systems to the transmission of volumetric images by means of computer processing in 3D mode, as well as systems that emulate a true three-dimensional image.

Evolution of pituitary adenoma surgery to the present day

A little over 100 years ago, in 1886, the French neurologist P. Marie was the first to link the development of acromegaly with the presence of a pituitary tumor [1]. Just 3 years later, in 1889, V. Horsley put forward the idea of the possibility of surgical treatment of pituitary tumors and in the same year made the first attempt to remove an adenoma using a bifrontal approach [2]. Since then, many surgeons (FT Paul, O. Kiliani, F. Krause) have attempted to remove pituitary adenomas using various intra- and extradural transcranial approaches (subfrontal, temporal, intradural, frontobasal, etc.) [3-9]. In Russia, this was first accomplished by the surgeon N.F. Bogoyavlensky in 1911 [10]. It must be said that the minimum mortality rate at that time was about 20% [11, 12].

Transsphenoidal intervention was first performed only after more than 15 years. In March 1907, H. Schloffer performed the first successful removal of a pituitary tumor using a lateral nasal approach, which, due to its traumatic nature, subsequently underwent a number of changes to the sublabial approach with submucous resection of the nasal septum in its final form [13]. It should be noted that the neurosurgeon H. Cushing was very interested in the transsphenoidal approach at one time, and actively used it, achieving a record-breaking minimum fatality rate at that time - 5.6% [14-16].

At the same time, radiation treatment of pituitary adenomas was proposed and initiated by A. Beclere and A. Gramegna in 1909 [17, 18], and in 1926 H. Cushing proposed using radiation therapy to prevent relapses [19].

In 1921, O. Hirch proposed introducing radiopharmaceuticals into the tumor stroma [20]. However , this and other similar methods (high-frequency thermocoagulation, cryodestruction, etc.) were subsequently abandoned due to the high level of development of both surgical and other alternative methods of treating pituitary adenomas.

Subsequently, H. Cushing abandoned the transsphenoidal approach, believing that the transcranial approach could better achieve decompression of the visual pathways. Due to his enormous authority, this approach has practically ceased to be used in the removal of tumors of the chiasmal-sellar localization. However, thanks to his followers, such as N. Dot, G. Guiot, J. Hardy [21-24], the transnasal approach was literally revived. This was especially facilitated by the use of X-ray television control and a microscope during the operation [25, 26]. A great contribution to the development of the transnasal approach in Russia was made by Yu.K. Trunin, A.V. Banin, N.S. Blagoveshchenskaya and others.

To date, both approaches, transcranial and transsphenoidal, have undergone many changes; they have become less traumatic and easier to perform. The current high level of diagnostics and surgical treatment, including selective microsurgical removal of pituitary microadenomas with preservation of normal pituitary tissue [27], the use of an endoscope in the removal of tumors with endo- and extrasellar growth [28-30], two-stage removal of pituitary adenomas [31, 32], modern anesthesiology and resuscitation care, and the use of replacement therapy have made it possible to significantly reduce the percentage of postoperative mortality to 1-2% after transsphenoidal operations [33-36] and to 4-5% after transcranial operations [33, 37], and also to minimize the frequency of complications with both approaches.

Modern medicine has a very powerful arsenal of tools for diagnosing and treating pituitary adenomas. It includes endoscopic technologies, intraoperative ultrasound machines, magnetic resonance imaging machines, and modern microscopes with navigation systems. Radiologists have at their disposal cutting-edge technologies for irradiation with directed beams (gamma knife, cyber knife, linear accelerator, proton beam). Therapy has a wide

a spectrum of drugs that act both directly on tumor tissue and on the receptor apparatus (analogues of sandostatin, dopamine agonists, growth hormone receptor antagonists, etc.).

Endoscopic surgery of pituitary adenomas

The use of an endoscope in the removal of tumors of the chiasmal-sellar region was a new milestone in transsphenoidal surgery. Endoscopic endonasal transsphenoidal approach made it possible to solve the main problem of transsphenoidal microscopic surgery - the lack of a panoramic view of the surgical field. The use of endoscopes with angled optics made it possible to significantly expand the inspection of the surgical intervention area in good lighting conditions, increase the volume of manipulations in the chiasmal-sellar region, which led to an increase in the radicality of surgical interventions, a decrease in the risk of developing intra- and postoperative complications associated with trauma to the pituitary gland and surrounding anatomical structures [28, 38-40].

The use of extended endoscopic approaches allows access to virtually any location in the cranial cavity where tumors may grow, in particular pituitary adenomas [41, 42]. The use of modern plastic synthetic materials (tachocomb, tissucol, etc.) in combination with autologous tissues (fatty tissue, sheets of the mucous membrane of the nasal septum, nasal turbinates) allows for a high guarantee of isolating the cranial cavity from the external environment during the development of cerebrospinal fluid rhinorrhea [28, 43, 44].

History of the development of neuroendoscopy

The development of endoscopy, first as a diagnostic and then as a surgical technique, went hand in hand with the development of surgery for tumors of the chiasmatic-sellar region. If the first ideas about the connection between a disease (acromegaly) and a pituitary tumor were published in 1886 [1], and the first attempt at neurosurgical removal of a pituitary adenoma was undertaken in 1889 [2], then the idea of an endoscopic examination of the human body was first voiced in 1795. The young doctor P. Bozzoni, at the age of 22, expressed the idea of penetrating deep into the human body through natural, and therefore safer, paths called endoscopic. He is credited with inventing the first endoscope in history, which he called "Lichtleiter". This design was proposed for examining the rectum and uterus, and a candle was used as a light source [45]. Unfortunately, due to the conservative nature of medicine at that time, this invention was never used on people, and the author himself was condemned by the Vienna Medical Society “for curiosity” (Fig. 1).

This ban slowed down the development of endoscopy for quite a long time, but already in 1853 the French urologist surgeon AJ Desormeaux proposed endoscopy as a method of examination. The endoscopic device he presented was a system of lenses and mirrors, and an alcohol burner was used as a light source. It was used to examine the urogenital tract. Obviously, the most common complications of this method were burns. All this time, endoscopy was at the stage of development of rigid endoscopes, which lasted from 1795 to 1932. During this period, two main ideas of endoscopy were formulated - this is an increase in the image of the organ being examined using lenses and direct illumination of the object being examined by means of an internal light source [46]. The next period in the development of endoscopy was the period of semi-flexible endoscopes, which lasted until 1958. Its founder is rightfully considered to be R. Schindler, who in 1932 developed and introduced a semi-rigid endoscope consisting of a system of short-focus lenses [47].

Then the period of semi-rigid endoscopes was replaced by the period of fiber-optic ones, which lasted until 1981. During this period, a cold light source began to be used (1960), which made it possible to reach and illuminate almost any area of the human body (Fig. 2).

During this period, the flexible fibrogastroscope was used in practice, although the idea of transmitting light through flexible glass fibers had already existed since 1927. During the same period, in the mid-60s, H. Hopkins created a system of rod lenses, which were inserted into the endoscope instead of the usual achromatic ones, which significantly expanded the viewing angle [48]. It became possible to perform endoscopic operations in any part of the human body, including operations on the brain and spinal cord (Fig. 3).

The modern stage of endoscopy development is electronic. It began at Bell Laboratories (AT&T), when Boyle and Smith in 1969 created a device with a charge-coupled device that converts optical signals into electrical impulses [49]. Ten years later, engineers at Welch Allyn created the first electronic endoscope - endoscopy entered the age of digital technologies. Electronic video endoscopy made it possible for several specialists to simultaneously see the entire process of endoscopic examination, enlarge the image and save it in a computer database (Fig. 4).

In parallel with the development of endoscopic technologies, neuroendoscopy also developed. The first data on the use of an endoscope in neurosurgery was published in 1917 by E. Doyen, who described the technique of transecting the roots of the trigeminal nerve in trigeminal neuralgia using an endoscope [50].

In the early stages of neuroendoscopy development, the endoscope was used mainly for ventriculoscopy in hydrocephalus. Given the insufficient quality of optics and the lack of good lighting, this technique was not actively introduced into practice at that time. After the invention (H. Hopkins) of the rod lens system, neuroendoscopy began to develop rapidly, reaching its highest activity in the 90s, when it became possible to use compact digital video cameras and powerful xenon light sources [51].

The scope of application of endoscopy in neurosurgery has expanded: endoscopic ventriculostomy [51-54], removal of intraventricular tumors [48, 55-57], skull base tumors of various etiologies [56, 58], pineal tumors [59, 60], etc.

The first endoscope to examine the contents of the sella turcica was used in 1963 by G. Giot. However, due to the low quality of optics and insufficient lighting, this technique was postponed.

The next step in this direction was taken by M. Apuzzo [46], K. Bushe and E. Halves [61].

Since this period, interest in endoscopic transsphenoidal surgery has increased sharply, and today this technique is extremely promising and promising.

It should be said that in Russia, the pioneer in the use of an endoscope in operations on the chiasmatic-sellar region is considered to be A.N. Shkarubo, who in 1995 was the first

applied the method of endoscopic control, when all stages of surgical intervention are carried out using a microscope, and an endoscope is used to control the totality of tumor removal [62, 63].

However, modern endoscopic endonasal transsphenoidal surgery involves a complete rejection of the use of a microscope. This is the so-called pure endoscopic transsphenoidal surgery, where the endoscope is used as the only visualization equipment. This technique was first used by the French rhinoplasty surgeon R. Jankowski [64], and in Russia by the neurosurgeon V. Yu. Cherebillo [65, 66].

We will not dwell in detail on the stages of development of endoscopic endonasal surgery. We will only dwell on the features that distinguish endoscopic surgical interventions in the chiasmal-sellar region from transsphenoidal interventions performed using a microscope.

An undoubted advantage of the technique of endoscopic removal of tumors of the chiasmal-sellar region is the availability of a panoramic view of the structures of this zone in good lighting conditions. This allows for a clear differentiation of the main anatomical structures, avoiding their damage, and correspondingly more radical removal of tumors.

The use of an endoscope allows one to do without a nasal speculum, which significantly narrows the manipulative possibilities even when using an endoscope. This also allows one to do without postoperative tamponade of the nasal cavity, which significantly reduces the severity of postoperative discomfort in patients.

However, in our experience, the use of a nasal dilator at the initial stages of the operation allows us to reduce blood loss in the case of severe bleeding of the mucous membrane, and at the stage of sealing the cavity of the sella turcica, when the materials that ensure the sealing of the cavity of the sella turcica are passed through the mucous membranes

nasal membranes, protects them from infection. When using an endoscope, the installation of a nasal dilator is quite harmless to the mucous membrane, which also allows you to do without postoperative tamponade.

In our opinion, the issue of intraoperative liquorrhea is somewhat debatable. A number of authors [29, 67, 68] consider it a feature of the operation, and not a complication. It seems to us that in the case of a defect in the diaphragm of the dura mater, widening of the natural opening through which the stalk of the pituitary gland enters the sella cavity, as well as in the formation of a defect in the case of suprasellar tumor growth, intraoperative liquorrhea can be considered a feature of the operation. In the case where this defect formed as a result of excessive manipulations by the surgeon, the development of liquorrhea can be considered a complication.

Conducting repeated transsphenoidal operations is significantly easier and safer using endoscopic techniques. This is important to consider when performing repeated interventions for tumor recurrence.

An absolute advantage of endoscopic interventions is the elimination of the use of intraoperative fluoroscopy, which allows for the practical minimization of radiation exposure for both medical personnel and the patient [67, 69-71].

The disadvantages of the endoscopic technique include a two-dimensional image, the so-called loss of "real depth of field", which can significantly complicate the course of the operation, especially for surgeons with significant experience in transsphenoidal surgery using a microscope that best provides binocular imaging.

Currently, three-dimensional endoscopes have already been developed at different levels of volumetric image transmission: from the presence of binocular rod systems to the transmission of volumetric images by means of computer processing in 3D mode, as well as systems that emulate a true three-dimensional image.

The presence of an easily injured, uneven, gradually narrowing surgical canal, the need to use unfamiliar instruments, and the lack of necessary experience in endoscopic operations also complicate the widespread use of this technique and lead to a significant prolongation of the time of the intervention itself.

Another difficulty in performing endoscopic interventions is the difficulty in ensuring rapid and effective hemostasis, especially when severe bleeding develops. In this situation, the clear and coordinated work of the entire surgical team is of great importance [40, 72].

To a large extent, the problem of adequate hemostasis was associated with the lack of bipolar coagulation adapted to the needs of endoscopic surgery [73]. The installation of a nasal dilator at the access stages allowed this problem to be solved to some extent, but only at the level of the possibility of manipulations limited by the mirrors of the nasal dilator.

An absolute limitation to the spread of endonasal transsphenoidal surgery, particularly in Russia, is the lack of schools. Since this technique has appeared relatively recently, its adequate use requires the accumulation of one's own surgical experience. At present, this technique is adequately developed only in large centers, where the bulk of patients with pathological formations of the chiasmal-sellar region accumulate and where there are all the opportunities to acquire this experience. According to foreign authors, only after performing about 70-100 interventions, as well as regularly performing at least 20-30 operations per year, can one sufficiently maintain the qualifications of a neurosurgeon [57, 72].

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