Minimally Invasive Option for Colloid Cysts Treatment.

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Citation

Abstract
In this work a group of authors is looking into perspective of minimal invasive procedures in treatment of colloid cysts. An extensive literature review is accompanied by a number of own observations and treatments of cranial colloid cysts by open and endoscopic methods.

INTRODUCTION
Beginning from pioneers (W. Dendi, 1922; F. Gutierrez-Lara, 1975) colloid cyst (CC) is known as relatively small, perfectly round, benign neoplasm with thick capsule and viscous content. It has well-defined border with adjacent brain tissue and localized into CSF pathway (usually near foramen of Monro). CC is usually situated near pericallosal and septal veins, anterior communicating and anterior cerebral artery, near integrative emotionally-cognitive centers (Paget’s circle, major cerebral commissure) [1-2].

Hamlat et al. (2004) report that CC is present in 2 % of intracranial tumors and 15 % of the 3rd ventricle neoplasm. CC can also grow in the brainstem, the cerebellum, and the subarachnoid spaces. The authors notice that late CC diagnostics can lead to serious vital complications up to 34 % cases. Authors also mark family cases of CC. It is noted that multiple CCs are frequently associated with other tumors [3].

Contemporary CC treatment approach includes two main treatment methods as open microsurgery and endoscopic cyst excision. There are followers for each approach. Nowadays, the other palliative methods as shunting or stereotactic intervention are rarely used. It must be noted that all approaches have their virtues and defaults. So the choice of surgery technique should depend on expected and possible benefits and complications.

Nowadays, endoscopic surgery is performed as first choice treatment. Even in the case of microsurgical intervention, the endoscopic assistance is useful for intra-operative diagnostics, adjacent brain structures evaluation, and resection totality assessment [4-7].

In this study we present series of CC cases treated both by microsurgical and endoscopic method. In this report several aspects of endoscopic and microsurgical approaches are analyzed.

MATERIALS AND METHODS
PATIENTS
Between 1999 and 2007, a total number of 20 patients with newly diagnosed CC were admitted and surgically treated at The Russian Polenov Neurosurgical Institute. The main demographic and clinical characteristics of the study population are presented in Table 1. The mean age was 16.5 years of age (range 1-43), 65 % was male.
Fourteen patients underwent endoscopic CC removal and composed the group of endoscopy (E-group): mean age 22 years, 79 % male. Six other cases treated by open microsurgery formed MS-group: mean age 3.7 years, 33 % male. Two groups of patients were similar by clinical presentation and CC localization (Tab.1). Mean volume of CC was 2.1 cm$^3$ in E-group and 3.1 cm$^3$ in MS-group.

All the patients were undergone routine preoperative neurological, ophthalmologic exams, EEG, MRI/CT-scans. CT-scans with 3D reconstruction were performed before and after intervention (fig. 1).  

MRI is considered as a gold standard for CC diagnosis and provides important information about CC localization, its size, growth form, relation with adjacent brain structures. MR-angiography allows evaluate the vessels involvement in the pathological process. MRI examination appears to be principal method to estimate histobiological nature of neoplastic process.

Functional MRI and MR-tractography allow obtaining additional information about the choice of surgical approach: microsurgical open operation, endoscopic intervention, stereotactic surgery, shunting operations.

We utilised Trans-cranial Doppler ultrasound in regular manner and it allowed us to characterize adequately cerebral blood flow.

Both microsurgical and endoscopic cyst excision was executed. But in the case of inadequate control of hydrocephalus after first step surgery shunt is placed. Microsurgical treatment includes osteoplastic craniotomy and transcerebral approach. Place of craniotomy depended from CC localization. In the case of lateral ventricles or anterior part of the 3$^{rd}$ ventricle localization of CC, the craniotomy has been performed in fronto-temporal region. If the CC localized in posterior part of the 3$^{rd}$ ventricle or posterior cranial fossa, we preferred suboccipital access. Standard zones for transventricular access were used during endoscopic interventions.

**ENDOSCOPIC SURGICAL TECHNIQUE**

All procedures were performed with the patient supine with the head slightly anteflexed in slight left rotation. Antibiotic medications were routinely prescribed 12-24 hs before...
interventions. In a state of general anesthesia the 
hydropreparation with physiological saline in the right 
frontal area was done. A skin incision and a bur hole were 
made in the right point of Kocher. After opening and 
coagulation of the dura mater, the operating sheath 
containing the trocar was introduced into the lateral 
ventricle, and the endoscope was fixed at the endoscope 
holder.

In the case of the 3rd ventricle localization of CC, the lateral 
ventricle and the foramen of Monro were inspected with the 
rigid Karl Storz 0° diagnostic optic after removal of the 
trocar. Usually, there was dilatation and tension of the septal 
vein. The foramen of Monro appeared to be enlarged from 
1.5 to 2.5 cm in diameter and almost completely blocked by 
vault of CC that was grown from anterosuperior area of the 
3rd ventricle and was closely attached to its walls. CC 
capsule resection was done after cyst puncture and colloid 
mass evacuation. Final inspection was performed to identify 
the left foramen of Monro disengagement (fig. 2).

Fig. 2. Intraoperative images of the endoscopy of the patient P.

**Figure 3**
Fig. 2a. CC appearance through Monro foramen;

**Figure 4**
Fig. 2b. Micro perforations;

**Figure 5**
Fig. 2c. Colloid masses appearance through the capsule aperture;
In the case of interventricular septum localization of CC (Fig. 3 and 4) we used rigid Karl Storz 30° endoscope diagnostic optic having 3 mm operating sheath diameter. During lateral ventricle inspection we usually found tension of septal vein, balloning of the interventricular septum wall, inferior displacing of choroid plexus and changes of vascular pattern. The wall of the interventricular septum has been coagulated before the CC’s wall perforation at the point of its maximal fluctuation. Aspiration of CC contents was performed under the visual control. The opening in the wall of interventricular septum was enlarged linearly up to 2-3 cm to remove cyst walls easily. Contralateral foramens of Monro and lateral ventricle were inspected. The endoscope was taken away. Cranial opening was tamponed with fragment of a sponge and a bone shaving.

Fig. 3. Patient P., axial (a) and coronal (b) T1-weighted MRI of CC of inter-ventricular septum before operation. The hydrocephalus is absent.
MICROSURGICAL TECHNIQUE

Microsurgical interventions for the 3rd ventricle CC localization include a standard cranitomy, transcortical-transventricular, transcallosal, or supracerebellar-subtentorial approaches. Intraoperative microscope (in this study – Leica) allow increasing field-of-vision angle from 45° to 60-75°. However, brain traction and vascular damages during open surgery can frequently lead to the development of haemodynamic disturbances, others important complications. One of the weak sides of the open surgery is lack of adequate intraoperative control of pathological mass removal. For this reason we used frequently endoscopic assistance by rigid Karl Storz 0°-60° endoscope diagnostic optic.

RESULTS

All patients from E-group had underwent endoscopic CC removal. Two from this group also had shunt placement because of inadequate hydrocephalus control after CC excision. All patients from MS-group had underwent open CC removal. Four transcortical-transventricular (Fig. 5), one transcallosal (Fig. 6) approaches were done. In one case of CC, localized in pineal area we used supracerebellar-infratentorial approach for microsurgical cyst excision. In 4 cases from this group the endoscopical assistance was done.
Figure 11
Fig. 6. Patient P. CT-scan, 10 days after CC excision from the 3 ventricle using transcallosal approach. The arrow notes cyst fragment.

There were small residual cysts of $0.2 \text{ cm}^3$ in two cases from E-group and in one case of residual cysts of $0.6 \text{ cm}^3$ from MS-group (Tab. 2).

Figure 12
Table 2. Treatment and early outcome.

In the postoperative period the CT-scan was necessarily performed for the control of changes in hydrocephalus (Fig. 7).

Figure 13
Fig. 7. Patient C. CT. 10 days after endoscopic cyst excision: regression of the hydrocephalus.

All the patients have tolerated endoscopic interventions well.
Average duration of endoscopy was 28 minutes (range 18-41) while microsurgical cyst removal usually continues 106 minutes. Intraoperative haemorrhage does not exceed 25 ml and the size of encephalotomy was about 10 mm. As a rule, intra-operative haemorrhage from the cortical vessels was not important and stopped easily. The postoperative period was usually without complications. The subcutaneous liquor accumulation was noted in 1 case and subdural liquor accumulation – in the other. In both cases accumulation regressed spontaneously within 72 hours. No infection, seizures, or persistent endocrine dysfunction occurred. The local neurological signs had occurred or deepened in 3 cases. They had temporary character and did not demand special correction. There were 2 shunt dependent cases in E-group. Hospital stay duration was 8 days for E-group and 15 days for MS-group.

So, based on our clinical experience and on the preliminary results of this study during last five years we preferred to use only endoscopic interventions for CC excision.

At the admission 12 patients from E-group presented symptoms of hydrocephalus. Eight patients from 12 also had intracranial hypertension. Two other patients from E-group presented endocrine disorders not linked with the brain lesion so CC was revealed incidentally by CT-scan. Duration of symptoms lasted from 1 to 3 years before admission. Different forms of hydrocephalus were diagnosed to all the patients: 1 case of monoventricular, 9 cases of biventricular and 2 cases of triventricular hydrocephalus. In 75% of cases hydrocephalus had progressive character.

The main CC clinical presentation includes the signs of increased ICP. Brainstem distotion syndrome has been usually presented as a mesencephalic syndrome when CC occupied posterior part of 3rd ventricle. Intensity of dislocation syndrome depended from CC volume, degree of CSF patency disturbance and morphological particularity of tentorium incisure. Neurological general symptoms were presented as marked adynamia, somnolence, and coordination disorders. Papilledema was incipient in 43 % and marked in 37 % cases.

According to our data EEG changes had no value for topical diagnosis. They reflected general functional changes of the brain. By CT-scan data CCs appeared to be hypodence in 3/4 of cases. Their sizes varied from 1.2 to 3.6 cm³ (on the average 1.8 cm³).

CC matrix was located on the interventricular septum in 45%, on the crus of the fornix in 25%, and in the choroid plexus in 30 %.

Cyst sizes varied from 1 to 3 cm. Intraoperative visualization confirmed observations.

We made 12 operative interventions in which neuroendoscopy was used as the basic method. In the case of 2 other patients we had to implant ventriculoperitoneal shunt because of continuous CSF circulation disorders. Patients became more active on the 2nd day after operation. The average length of hospital stay was 9 days.

**HISTOLOGICAL EXAMINATION OF EXCISED CYST WALLS**

During histological examination internal layer of CC is usually presented by a single-layered ciliated cylindrical epithelium (fig. 8a). In some cases it may be also presented by cubical epithelium that resembles epithelium of choroid plexus (fig. 8b). The sites of transition from cylindrical to cubical epithelium can be found (fig. 8c). Epithelial tissue placed on the layer of conjunctive tissue presents more or less compact collagen fibers with thin-walled vessels. The basal membrane of the epithelial layer is not seen by conventional light microscopy. Almost of whole CC liquid component has been evacuated during surgery. Only dense colloid rests enriched by proteins can be visualised as homogeneous eosinophilic mass with exfoliated degenerated epithelial cells. Typical structure of CC includes a zone of proliferation where a single layer epithelium becomes multilayer. Sometimes this epithelium layer becomes flattened and difficult to designate by microscopy. It represents a membrane of the flat extended cells and reminds endothelium (fig. 8d).

Fig. 8. Microscopic structure of CC walls.
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**Figure 14**
Fig. 8a: ciliated cylindrical epithelium settles down on well presented stroma of connective tissue, consisting from closely packed collagen fibers. Magnification is 400;

**Figure 15**
Fig. 8b – cubical epithelium settles down on loose connective tissue stroma;

**Figure 16**
Fig. 8c – the site of transition of ciliated cylindrical epithelium to cubical epithelium. Magnification is 200.

**Figure 17**
Fig. 8d – cubical epithelium with the sites of proliferation (on the left); on the right cyst wall with flattened epithelium; connective tissue stroma with vessels, infiltrated with lymphoid elements. Magnification is 400. Hematoxylin and eosin

Dystrophic changes also can be present in the CC walls. Desquamation can lead to the absence of the epithelial layer where conjunctive tissue is exposed to sclerosis and hyalnosis (fig. 9 a,b).

Fig. 9. Dystrophic changes in cyst walls.
Figure 18
Fig. 9a – thickened, sclerosed cyst wall, flattened epithelium desquamation (on the right). Magnification is 400;

Figure 19
Fig. 9b – thickening and hyalinosis of stroma with angiomatous or hyaline degenerated vessels; cubic cyst epithelium is intact. Magnification is 400.

Figure 20
Fig. 9c – sclerosed cyst stroma with exfoliated epithelial cells (on the right) and adjacent substance of the brain with hyalinosis (on the left). Magnification is 200

Figure 21
Fig. 9d – part of the cyst wall is presented by fibrous gliosis without connective tissue stroma and epithelial lining, on the right - eosinophilic aggregates of cyst contents. Magnification is 400. Hematoxylin and eosin stain.

The cyst walls can be closely attached to the brain tissue. In this case it represents triple-layer formation including internal epithelial layer, intermediate conjunctive and external gliotic brain tissue. If internal epithelial and intermediate conjunctive layers were completely degenerated, CC wall could be presented only by gliotic brain tissue. (fig. 9 c,d).

Often fragments of choroid plexus can be found in CC histological material. Sometimes it is possible to follow area of transition from cyst wall to papillary structures of choroid plexus (fig. 10).

Fig. 10. Relation of cyst with vascular plexus.
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Figure 22
Fig. 10a – CC wall transferring into papillary structures of vascular plexus. Magnification is 100;

Figure 23
Fig. 10b – choroids-like evaginations in cyst cavity, stroma with plentiful lymphocyte infiltration, homogeneous protein colloid in cyst cavity. Magnification is 400. Hematoxylin and eosin stain.

In one of the cases CC has been presented by one large and some small compartment covered by cubical epithelium as a choroid plexus (fig. 11). Some cavities contained protein colloid with exfoliated epithelial cells, but the others did not.

Fig. 11. Multichamber CC:

Thus, in our study we observed that CC walls may undergo secondary dystrophic changes that miss its epithelium layer and represent a sac formed by coarse-fibered connective tissue or brain gliosis substance. Intensive epithelial proliferation can indicate colloid production and cyst growth. Histological resemblance and frequent transition area of CC with choroid plexus does not exclude CC origin from choroid plexus.

DISCUSSION
According to the study totally 20 cases of CC treated in our
institution during 1999-2007 which composed 2.5% of the initially-removed tumors.

According to our experience colloid cysts can be successfully removed using either microsurgical operation, or endoscopic technique. In our study postoperative mortality is zero and postoperative complications are transient. As it was expected, during open surgeries wide surgical area and good visualization makes possible more radical CC removal. Demerit of this approach includes danger of fornix structure, major cerebral commissure, thalamus, and caudate nucleus injuries.

From our point of view the use of endoscopic approach in surgical CC treatment is the most appropriate. Advantages of this approach are obvious, as in pediatric neurosurgery this trend allows to reach not only minimal tissue traumatism (it will influence on the length of postoperative period), but also to decrease quantity of possible complications and shorten terms of patient’s activation after operation.

According to literature CC size can vary from 10 to 90 mm depending on cysts location. Usually CCs are of larger size in children, and of smaller one in adults [8-11]. This trend is evident in our study too (Fig. 12).

**Figure 26**

Figure 12. The greater CC volume accords to the smaller age of clinical manifestation.

Other minimally invasive approach as stereotaxis surgery is indicated only for very small and deep localized CC. This method has very limited application and is often used as method for biopsy.

Because of the high level of the injury, open CC excision should have additional indications to be used for their treatment. This method is used rarely at children's age. It can be used for excision of cysts in case of their large sizes or when for several reasons endoscopic operation is impossible. There is a tendency to use combined operations when endoscopic operation turned out to be inconsistent to end with microsurgery, then it becomes necessary to perform craniotomy and carry out cyst excision under endoscopic assistance.

In the case of persistence of CSF circulation disorders the last stage of treatment consists in shunting operations.

The history of CC surgery totals more than a century. For the first time CC transventricular removal had been performed by Walter Dandy in 1922 [1]. Much later (1949) he described transcallosal approach for this pathology treatment. However, this method didn’t take root in view of complications: injury of bridge veins and fornix, short-term memory impairment.

In 1975 F. Gutierrez-Lara et al. used stereotactic CC puncture for the first time [2]. In 1978 Bosch et al. used CT stereotactic cyst aspiration. However, this manipulation didn’t take root in view of high density colloid mass, catheter displacement and uncontrollable aspiration [6].

In 1983 Powell et al. used rigid endoscope for colloid cyst treatment for the 6 patients. This manipulation was successful in 5 cases [12]. In 1992 Zamorano L. et al. first described impossibility of total bleeding control because of small visual angle and recommended to combine rigid inflexible endoscope with flexible endoscope [13].

Ahnagmoosh et al. (2006) operated 43 patients with colloid cysts during the period from 1977 to 2005. In this series of patients only 16 % were children. The small proportion of pediatric cases has been explained by grate reserve of the children's cranial-cerebral spaces [8].

Jaskolski et al. (2003) consider that, as a rule, CC is localized in the anterior parts of the 3rd ventricle that causes of CSF pathway obstruction. It is possible that CC as a disembyrogenetic neoplasm is a result of neuroepithelial locus separation between telencephalon and diencephalon. However, Jaskolski et al. (2003) describe rare CC localization in prepostine cistern which has been also resected endoscopically [14]. Another rare localization of CC in parietal area was described by Efkan et al. (2000). CC was found occasionally and resected by microsurgical technique [15].

During 10 years Charalampaki et al. (2006) performed 28
microsurgical CC resections. They describe that more often CC has been localized near the right foramen of Monro and 13 patients had two foramens of Monro obstruction [16].

There were cases when disease manifested with cardiology complaints. In particular Jarquin-Valdivia et al. (2005) describe the case in which disease manifested by heart failure, and only MRI showed CC of the 3rd ventricle [17].

In 1999 Lancon et al. made comparative evaluation of the neoplasm of anterior one-third of the 3rd ventricle, having compared frequency of astrocytomas and CC of given localization. They showed that MRI is of primary importance in solving problems of differential diagnostics [18].

Kachhara et al. (1999) demonstrated that CCs were iso-dense or hypo-dense in 1/3 cases on the CT-scans, and hyper-dense in 2/3 cases depending on presence of blood or mainly cholesterol crystals in cysts contents. After carrying out shunting operations the density increase was marked on CT [19]. Other authors, Beems et al. (2006), describe 4 cases of hemorrhage in CC. On their opinion, intervention is necessary even in case of asymptomatic CC because of high risk of hemorrhage, hydrocephalic-hypertensive syndrome, occlusive hydrocephalus (6-42%) [20].

Veerman et al. (1998) studied chemical composition of colloid cysts. They didn’t offer any new explanation of CC contents – the basic components of these pathological formations nevertheless were cholesterol crystals, and only in 5-10% of cases authors marked laky blood impurity, microvilli, epithelial cells [21].

During histological examination of colloid cysts Landolt-Weber (1973) found 3 various types of epithelial cells. Ciliated cells are the most frequent type. Their apical surface is covered by large quantity of villi and ciliae. The second type consists of cells, producing mucin that is excreted in cyst cavity. The third type is cells with PAS positive granules. Secreted product is accumulated in these cells, and the type of secretion is holocrine [22].

The analysis of literature for the last 20 years shows that there is no agreement on methods of surgical treatment of this pathology.

Vialogo (2000) used endoscopic transeptointerfirnical approach to CC described by Bush in 1944. Trehpination was made in Kocher point, the right wall of pellucid septum was opened behind septal veins. And the cyst was located behind crus of fornix. The cyst was opened and its walls were removed. Intervention had been finished with the third ventriculocisternostomy. Later the author used various approaches to the 3rd ventricle cysts. At the same time transventricular approach is accompanied by traction of frontal lobe, its secondary damage, injury of cortical arteries, sometimes – veins. In the postoperative period seizures can be observed. Advantage of transcallosal access is small depth of a wound, good visualization of the 3rd ventricle, but there are also some disadvantages, namely possible damage of venous structures – venous infarctions. Because of fornix damage, muteness can develop [23].

During 1979-1991 Cetinalp et al. (1994) carried out analysis of diagnostics and treatment using microsurgical approach of the 13 patients. Nine patients were operated using transventricular approach, and 4 patients – transcallosal one. Three patients died of infectious complications. The authors considered transcallosal approach as the most rational in the absence of hydrocephaly, transventricular one – in the case of hydrocephaly [7].

Alnaghmoosh et al. (2006), Yüceer et al. (1996) give preference to transventricular approach because of minimal injury and possibility to control vascular collectors [8, 11].

Timurkaynak et al. (2006) used approach through pellucidum and transforrnical septum when patient had cavity of pellucid septum and colloid cyst of the 3rd ventricle. The method is as follows: a bone flap was formed (1/3 posteriorly and 2/3 anteriorly coronal suture). Transcallosal approach was used. Corpus callosum was dissected for the space of 2 cm; structures of the 3rd ventricle and septum pellucidum were examined. Bilateral resection of septum pellucidum walls was performed, CC was visualized and removed [24].

Longatti et al. (2006) carried out the retrospective analysis of endoscopic treatment of CC for 61 patients, performed in 11 Italian clinics from 1994 to 2005. Cyst diameter varied from 6 mm to 32 mm. Average length of postoperative hospital stay was 6.7 days. Four patients had been operated earlier: 1 case of craniotomy and 3 cases of stereotactic surgery. Eight patients had no hydrocephalus, and endoscopic operation was performed under navigation. In total there were 66 procedures performed on 61 patients. Two cases of misdiagnosis (cavernoma and glioma) were verified during surgery. In all the cases fenestration, in 80% cases capsule and internal walls coagulation was performed. In 52.4% partial cyst excision and in 9.8% total excision was made. Intraoperative hemorrhage was observed in 3 patients. In conclusion authors recommend that CT aspiration is
accompanied by high risk of cognitive disorders development, and its efficiency depends on size and cyst content consistence. Microsurgery resulted in postoperative disability in 27% of cases, and the death-rate reached 5% of cases. Transcallosal approach more often led to vascular disruptions (infarctions), injury of fornix (cognitive disorders). The minimal quantity of complications (6% of cases) was observed only after endoscopic surgery [9].

Bristol et al. (2005) report a great number of microsurgical removals over endoscopic for CC excision (13 and 8 accordingly), in spite of the fact that the results of the latter are better. Authors note that if the cyst is located lower than fornix, endoscopic approach makes possible CC excision without damaging caudate nucleus and vascular plexus [25]. Grondin et al. (2004) adhere the same opinion. They consider that the outcome is approximately identical for microsurgery and endoscopy, but endoscopy is more sparing method [25].

Use of microsurgical method during endoscopic operations increases efficiency of endoscopic procedures, reduces level of injury, making ridiculous comparison between endoscopic and microsurgical operations.

Nitta and Symon (1985) are of the opposite opinion. They describe results of treatment of 36 patients from 1949 to 1983, using direct transventricular approach through the right foramen of Monro, and characterize results of treatment as good in 68%, satisfactory in 32% of cases. At the same time before 1950s surgical mortality was more than 20% that was even above, than in the case of other tumors [26].

According to Hernesniemi et al. (1996) analysis of literature since 1858 there were 1167 cases of CC that made 0.5–1.5% of all intracranial mass lesions. At the same time surgical mortality reached 36%. Contemporary literature notes low morbidity and the absence of mortality. During 14 years (1980-1995) authors had their own material: 40 patients with colloid cysts of the 3rd ventricle. They used transcallosal approach, and characterize the results as excellent in 32 cases and good in 5 cases. Critical steps in the surgery are as follows: rupture or thrombosis of bridge veins during traction of cerebral hemispheres; damage of perforans branches of pericallosal arteries; fornix injury; difficulties of identification foramen of Monro; damage of small veins around capsule; bleeding [27].

Authors opinions about results of interventions are also various.

During 11 years Nomikos et al. (1999) examined 69 patients. All of them were operated by transsphenoidal approach. In the postoperative period 89% of the patients had endocrine disorders in clinical presentation. The authors insist on surgical treatment in the presence of symptoms only [28].

During the period from 1974 to 1988 Fritsch (1988) analyzed 19 CC cases. Average patients’ age was from 17 to 58 years (34 years). In all the cases cyst excision was performed using transventricular approach. Previously two patients had shunts, but they were removed after CC excision. In 3 cases after microsurgical operations ventriculoperineal shunting was made as a result of development of postoperative posthemorragic hydrocephaly. In 68% of patients hydrocephaly regressed after operation. Authors described following complications: 4 patients had temporary mental and memory disorders. One patient had hemiparesis and general seizure 2 years after surgery [29].

From 1995 to 2002 Solaroglu et al. (2004) examined 27 patients with CC, 26 operations were made. Mortality rate was 0%, infection rate was 4%. There were no relapses. In postoperative period seizures were noted in two patients. They noted that endoscopy approach became less traumatic, but there remained some complications: injury of fornix as a result of endoscope manipulations, thermal injuries owing to electrocoagulation and potential complication – aseptic meningitis. In comparison with microsurgery, complete resection of CC walls was not often possible during endoscopy [10].

Kondziolka and Lunsford (1991) report about successful stereotactic CC excision only in the half of the cases, and in the others reoperations needed [30].

Introduction of modern endoscopic systems and new knowledge about surgical microanatomy of ventricular systems allows creating a stable well visualized wound. Thus, minimally invasive CC excision is carrying out using endoscope. Endoscopic microsurgery is a method of choice in the cases of CC excision. This approach has all advantages of open interventions and completely accords with the definition of minimally invasive neurosurgery.

Thus, introduction of endoscopic surgery of CC using principles of minimally invasive neurosurgery allows improving existing results of CC treatment.
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