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Endoscopic Versus Open Surgical Approaches for Colloid Cyst of the Third Ventricle: A 10-Years Retrospective Study

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Abstract---Colloid cysts are benign lesions of the anterior part of the third ventricle. Surgery is the main line of treatment. Endoscopic treatment gained wide acceptance among neurosurgeons. However, open microsurgical approaches still recommended by many surgeons. Each approach had its own advantages and drawbacks. The current study designed to explore the outcome of endoscopic versus open colloid cystectomy for the colloid cyst of the third ventricle. This is a retrospective study of patients who submitted to third ventricle colloid cystectomy during a duration of 10 years. A total number of 41 patients were included (20 managed by endoscopic approach and 21 by open surgery). Files were reviewed for preoperative (clinical examination and radiological investigations), operative (e.g, operative time, the size of the cyst and additional interventions) and postoperative outcome. Both approaches were comparable regarding demographics, preoperative, operative and postoperative data, except significant reduction of operative time and total duration of hospital stay among endoscopy than open group (127.95 ± 18.32 , 5.30 ± 1.69 vs 178.33 ± 20.51 and 8.95 ± 1.62 respectively). The recurrence was reported among 3 patients (7.3%) (2 in the endoscopy and 1 in the open group). Among 90.0% of endoscopy group, their neurological condition was improved compared to 95.2% of open group. The difference between both groups was statistically non-significant. Conclusion: Endoscopic excision of colloid cysts is as effective as open surgical approach for colloid cystectomy with a shorter operative time and duration of hospital stay.

Keywords---Colloid Cyst, Endoscopic, Third Ventricle, Open Surgical, Retrospective.

Introduction

Colloid cyst is a benign unilocular cyst of neuroepithelial origin, located on the midline, rostral and anterior third of the ventricle, in proximity of the foramen of Monro. It accounts for 1-2% of the all-intracranial tumors (1-3). Patients usually affected at their second to fifth decades of life, with nearly equal sex distribution. Clinically, it may be discovered accidentally (asymptomatic) or presented with mild to severe paroxysmal headache. Other presentations are due to progressive or fluctuating nature of hydrocephalous (developed by foramen of Monro Obstruction by the cyst). Rarely, the first presentation may be sudden death and the cyst discovered at postmortem examination (4).

The only curative therapeutic modality is the surgical excision, which could be performed by open microsurgical or endoscopic approaches. Endoscopic surgery gained wide acceptance among neurosurgeons during the last decades, although both approaches are feasible with their inherent complications (5-7). The most common microsurgical approaches are transcortical, transcallosal or infratentorial-supracerebellar approaches. The transventricular transforaminal technique is the mostly used endoscopic approach (8). The endoscopy associated complications could be reduced by proper selection of an optimal entry point and trajectory, to traverse Foramen of Monro without any need to swing the endoscope (9). Regardless the technological advances of the endoscopy and wide popularity of endoscopic surgery, it is difficult to recognize the optimal surgical approach for colloid cystectomy. Thus, the current work aimed to discover if one approach is superior than the other from the clinical outcome point of view.

Patients and Methods

The current work is a retrospective analysis of patients who submitted to colloid cystectomy of the third ventricle during a duration of 10 years (from June 2011 to June 2021). Data of all patients with colloid cyst who were managed by surgical intervention, either endoscopy or open microsurgery, during the specified period were eligible and were included. All were selected from Al-Azhar University Hospital and Al-Asar Specialized Hospital (Damietta). However, patients who received conservative treatment or with incomplete data were excluded from the study. A total number of 41 patients were included (20 managed by endoscopic approach and 21 by open surgery). Figure (1) describes the flow chart of patient selection.

Files were reviewed for preoperative data (e.g., patient demographics (age, gender, and body mass index), clinical manifestations (symptoms and signs), and data obtained from the clinical and radiological assessment). In addition, all files had the results of ophthalmological examination (fundus examination, visual acuity and visual field assessment). The radiological assessment included pre-and post-operative computed tomography (CT) and magnetic resonance imaging (MRI) of

the brain to recognize the cyst size, site, and density. In addition to determination of the size of the third ventricle. Finally, results of routine pre-operative laboratory assessment were included.

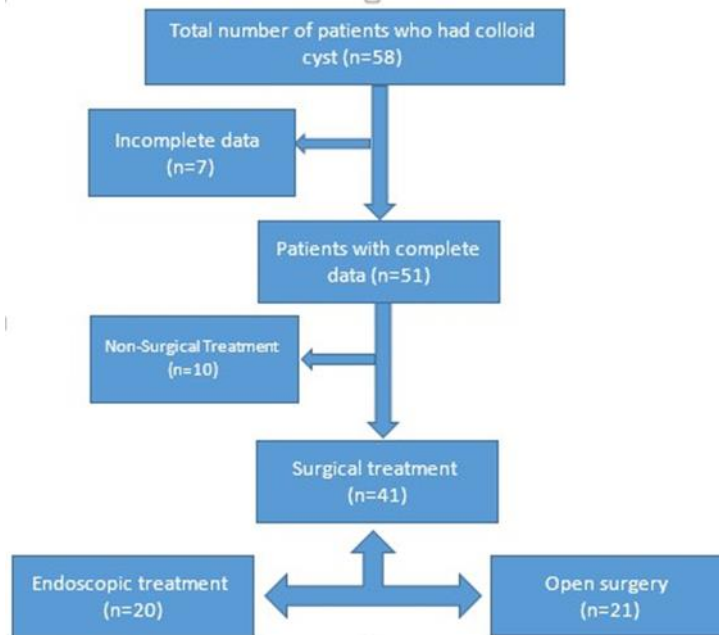


Figure (1): Flow chart of patient selection

Endoscopic approach

All surgeries were completed under general anesthesia, where the patient was in supine position with elevated head 10 to 30 degree. The trajectory was created to avoid the fornix, internal cerebral and septal veins, and the center of the cyst was targeted. The technique was carried out through the lateral ventricle by a rigid neuroendoscope 4 mm diameter, 30 cm in length (Karl Storz, Tuttlingen, Germany), prepared by straight instruments. A 3 cm long incision was drawn, longitudinal and parallel to the midline, followed by the trephine operation. Monopolar cautery was used to coagulate and perforate the underlying pia followed by perforation of the lateral ventricle and insertion of the neuroendoscope. The anatomical landmarks (e.g., septal vein, thalamo-striate vein, choroid plexus and the foramen of Monro) were identified. The cyst capsule was coagulation after proper identification. A thin catheter was then inserted through the neuroendoscope working channel for aspiration of the cyst contents, followed by cyst excision. Finally, hemostasis and closure of the wound was done after insertion of the surgical gel foam.

Open surgery:

Open approaches were completed as conventional or nanotubular techniques via a frontal craniotomy just anterior to the coronal suture. Conventional approaches were completed without the use of neuro-navigation. Mini-tubular method was performed as described by **Barlas and Karadereler**⁽¹⁰⁾. Briefly, a 14 mm cylindrical retractor was inserted in the instrument holder of the Leksell® stereotactic frame (Elekta AB, Stockholm, Sweden) and focused on the target (a point in the frontal horn just lateral to the foramen of Monro), and the cyst was removed in a microsurgical pattern through the retractor.

Postoperative evaluation:

All patients were assessed by physical general and neurological examination. Postoperative imaging study was performed directly postoperative (at the second postoperative day). Then, repeated at 3 and 6 months postoperatively (cases without imaging studies at 3 and 6 months were excluded). All postoperative follow up visits included examination for recurrence, complications, hydrocephalus, and degree of cyst excision on CT. All patients were graded on Barrow Neurological Institute scale ⁽¹¹⁾. A mean follow-up period of 12 months are a requirement to be included in the current study.

Ethical consideration:

The study protocol was approved by the local research and ethics committee of Damietta Faculty of Medicine, Al-Azhar University, Egypt. An administrative consent was obtained from the administration board of the same institution. Patient consent did not apply and the research was done taking into considerations the research ethical code of Helsinki declaration. Data used in analysis are available on request.

Statistical Analysis:

Data were coded to conceal patient identity and fed to the Statistical Package for Social Science (IBM corporation, Armonk, New York, USA) version 23. The data was expressed in relative frequency and percentages if qualitative. However, it presented as arithmetic mean, standard deviation, minimum and maximum if quantitative. The chi-square test (or its equivalent) was used to investigate the association between categorical variables, while *t*- test was used for comparison between two continuous variables. A two-side P value of less than 0.05 considered statistically significant.

Results

In the current work, patient age ranged between 21 to 60 years (mean±SD 38.31±11.08 years), and 56.1% of all patients were males. Diabetes mellitus was reported among 24.4%, hypertension among 17.1% and both diabetes with hypertension among 7.3%. Headache was the clinical presetting symptom among 95.1%, followed by blurring of vision (73.2%), vomiting among 53.7%, seizures among 29.3%, memory deficits among 12.2%, and headache was the sole

presenting symptoms among 17.1%. Papilledema was discovered by fundus examination among 85.4%, and hydrocephalus among 68.3%. the cyst was on the right side among 78.0% and the largest diameter of the cyst ranged between 12 and 21 mm (mean±SD 16.78±1.96 mm). There was no significant difference between endoscopy and open surgery groups regarding patient demographics or clinical data (Table 1).

Regarding need for external ventricular drain, it was required for 39.0% of studied patients, the need was before surgery among 9.8% and during surgery for 29.3% of patients. The ventriculo-peritoneal shunt required among 12.2% of patients and all were during surgery. The overall complications were reported among 14.6% (seizures 7.3%, pneumocephalus 7.3%, intraventricular hemorrhage 2.4%, transient loss of memory 7.3%, cerebrospinal fluid leak 2.4% and subdural hemorrhage among 4.9%). The mean operative time was 153.75±31.93, and the mean ICU stay duration was (1.7±1.04 days), while the mean duration of hospital stay was 7.17±2.46 days. Both groups were comparable as regards to operative and postoperative data, except significant decrease of operative time and total duration of hospital stay among endoscopy than open group (127.95±18.32, 5.30±1.69 vs 178.33±20.51 and 8.95±1.62 respectively). The recurrence was reported among 3 patients (7.3%) (2 in the endoscopy and 1 in the open group). Among 90.0% of endoscopy group, their neurological condition was improved compared to 95.2% of open group. The difference between both groups was statistically non-significant (Table 2).

Table (1): Patient demographics, associated medical diseases and clinical presentations among studied populations

Variable		Endoscopic (n=20)	Open (n=21)	Total	Test	P
Age (years)	Mean±SD Min.-Max.	37.50±11.92; 21-60	39.09±10.46; 22-58	38.31±11.08; 21-60	0.45	0.65
Gender (n, %)	Male	12(60.0%)	11(52.4%)	23(56.1%)	0.24	0.62
	Female	8(40.0%)	10(47.6%)	18(43.9%)		
Associated Comorbidities	Diabetes mellitus	4(20.0%)	6(28.6%)	10(24.4%)	0.41	0.52
	Hypertension	3(15.0%)	4(19.0%)	7(17.1%)	0.12	0.73
	DM + hypertension	2(10.0%)	1(4.8%)	3(7.3%)	0.41	0.52
	None	15(75.0%)	12(57.1%)	27(65.9%)	1.45	0.23
Presentation	Headache	20(100.0%)	19(90.5%)	39(95.1%)	2.00	0.15
	Vomiting	12(60.0%)	10(47.6%)	22(53.7%)	0.63	0.42
	Blurring of vision	16(80.0%)	14(66.7%)	30(73.2%)	0.92	0.33
	Seizures	4(20.0%)	8(38.1%)	12(29.3%)	1.62	0.20
	Memory deficits	2(10.0%)	3(14.3%)	5(12.2%)	0.17	0.67
	Only headache	3(15.0%)	4(19.0%)	7(17.1%)	0.12	0.73
Clinical examination And Investigations	Papilledema	18(90.0%)	17(81.0%)	35(85.4%)	0.67	0.41
	Hydrocephalus	15(75.0%)	13(61.9%)	28(68.3%)	0.81	0.36
	Cyst largest diameter	16.40±2.19; 12-21	17.14±1.68; 14-20	16.78±1.96; 12-21	1.22	0.23
Laterality	Right	15(75.0%)	17(81.0%)	32(78.0%)	0.21	0.64
	Left	5(25.0%)	4(19.0%)	9(22.0%)		

Table (2): Operative and postoperative data among studied populations

Variable		Endoscopic (n=20)	Open (n=21)	Total	Test	P
Need for external ventricular drain		8(40.0%)	8(38.1%)	16(39.0%)	0.02	0.90
Timing of drain	Before surgery	1(5.0%)	3(14.3%)	4(9.8%)	1.35	0.51
	During surgery	7(35.0%)	5(23.8%)	12(29.3%)		
Need for ventriculo-peritoneal shunt		3(15.0%)	2(9.5%)	5(12.2%)	0.28	0.59
Complications	Overall	2(10.0%)	4(19.0%)	6(14.6%)	0.67	0.41
	Seizures	1(5.0%)	2 (9.5%)	3(7.3%)	0.31	0.57
	Pneumocephalus	2(10.0%)	1(4.8%)	3(7.3%)	0.41	0.52
	Intraventricular hemorrhage	0(0.0%)	1(4.8%)	1(2.4%)	0.97	0.32
	Transient loss of memory	1(5.0%)	2 (9.5%)	3(7.3%)	0.31	0.57
	CSF leak	1(5.0%)	0(0.0%)	1(2.4%)	1.07	0.30
	Subdural hemorrhage	0(0.0%)	2 (9.5%)	2(4.9%)	2.0	0.15
	Meningitis	1(5.0%)	1(4.8%)	2(4.9%)	0.001	0.99
Operative time (min)		127.95±18.32	178.33±20.51	153.75±31.93	8.27	<0.001*
ICU (days)		1.70±0.92	1.81±1.17	1.76±1.04	0.33	0.74
Hospital stay duration (days)		5.30±1.69	8.95±1.62	7.17±2.46	7.05	<0.001*
Recurrence		2(10.0%)	1(4.8%)	3(7.3%)	0.41	0.52
Outcome	Improved	18 (90.0%)	20(95.2%)	38(92.7%)	0.41	0.52
	Non-changed	2(10.0%)	1(4.8%)	3(7.3%)		

Discussion

Open microsurgical cystectomy was traditionally considered the "gold standard" treatment. However, operative approaches are not without risks. Endoscopic approach continually gains wide acceptance among neurosurgeons. The current work retrospectively analyzed the outcome of both endoscopic and open surgery for third ventricle colloid cyst removal. The results of the current study

demonstrated that, endoscopy is as effective as open surgery for colloid cystectomy. It is associated with significant shorter operative time and significantly shorter duration of total days of hospital stay. But the recurrence rate was higher with endoscopy than open surgery. However, the difference did not reach statistical significance. These results are in line with **Rangel-Castilla et al.** ⁽¹²⁾ who reported that, endoscopic approaches for colloid cystectomy are effective and safe. They considered endoscopy as the first line technique for the resection of the third ventricle colloid cysts. They added, endoscopic resection of colloid cysts able to produce complete removal of the cyst with high patient satisfaction rate. The main advantages of endoscopic approach include shorter operative time, lower complication rate, and lower rate of postoperative seizures. **Stachura et al.** ⁽¹³⁾ also supports the use of endoscopic approach for removal of third ventricle colloid cysts, and attributed the global acceptance of endoscopic approach to continuous development and advances of endoscopic approaches and instruments with good long-term favorable outcome.

In the line with results of the current work, **Ragae and Ismail** ⁽¹⁴⁾ reported headache as the main and commonest presenting symptom of patients with colloid cyst (92.9%). In addition, **Samadian et al.** ⁽¹⁵⁾ reported on 112 patients, and headache was the presenting symptom among 84.1%.

While the current results revealed papilledema among 85.4%, **Decq at al.** ⁽¹⁶⁾ reported on papilledema in the series of 15 patients and showed that, all patients had papilledema. The small number of patients in their study could explain the difference than the current work.

Regarding overall outcome, **Mishra et al.** ⁽⁵⁾ reported that total excision was achieved for 78% and partial excision with aspiration was achieved for 11% of patients. In addition, **Vorbau et al.** ⁽¹⁷⁾ in a retrospective study on 20 patients underwent endoscopic resection of colloid cyst, reported excellent long-term outcome. **Dhandapani et al.** ⁽¹⁸⁾ studied 22 patients submitted for endoscopic resection of a third ventricle colloid cyst, and reported that total resection accomplished in all, and none of patients had a recurrence, ventriculomegaly, or required retreatment. **Isaacs et al.** ⁽¹⁹⁾ reported a complete aspiration of the cyst among 98.6%, with postoperative improvement for all patients.

In the current work, the recurrence rate was 7.3% (10.0% in endoscopic compared to 4.8% in open surgery group). **Isaacs et al.** ⁽¹⁹⁾ reported a recurrence rate of 8.1%. They reported no major complications or mortality. These results agree with the current work. **Sheikh et al.** ⁽²⁰⁾ reported a rate of 10.5% for postoperative complications. But they reported a recurrence rate of 3.91% which is lower than ours. **Levine et al.** ⁽²¹⁾ reported 6.3% recurrence rate after endoscopic resection.

In a recent study by **Alkhaibary et al.** ⁽²²⁾ reported that, their analysis revealed that both endoscopic and open surgical approaches were feasible, with satisfactory surgical outcomes. In addition, previous studies reported on the advantages of endoscopic over open approach. The main advantages were the use of burr holes instead of craniotomies, did not associated with retraction of the brain, less operative time and total hospital stay duration, and higher levels of

patient satisfaction ⁽²³⁾. Also, the endoscopic technique had more safety and effectiveness with lower rate of complications ^(5, 24).

Boogaarts et al. ⁽²⁵⁾ reported that an open approach provides a better vision to allow complete resection of colloid cysts. They recommended the transcallosal technique to avoid cortical tissue injury. **Sabanci et al.** ⁽²⁶⁾ analyzed the outcome of different transcortical methods for colloid cystectomy. Postoperatively, seizures and neurological deficits were significantly low in endoscopic approach.

The debate regarding the optimal surgical approach for the resection of third ventricle colloid cysts is continuing. This could be attributed to the anatomy of the cyst (roof of the third ventricle) ⁽¹⁶⁾ and the introduction of new approaches due to neurological complications of others. Thus, careful patient selection, full preoperative assessment, and meticulous planning of the surgical objectives are the key factors for an excellent postoperative outcome.

Haider et al. ⁽²⁷⁾ concluded that, many surgical approaches are available for colloid cyst resection and regardless of the surgical approach, colloid cystectomy is a challenging, however, safe surgery. No single approach could be described as the best for all patients. However, the paradigm is shifting to the endoscopic approach.

Elshamy et al. ⁽²⁸⁾ in a recent meta-analysis, concluded that, open approaches are recommended as they are associated with a greater extent of resection than the endoscopic approach, with lower recurrence rate. However, each approach had its merits of advantages and disadvantages. Thus, they recommended that, the surgical intervention technique could be individualized according to the surgeon's experience and flexibility, with the ultimate goal of maximizing benefits for the patient.

Conclusion: Endoscopic excision of colloid cysts is as effective as open surgical approach for colloid cystectomy with a shorter operative time and duration of hospital stay. Thus, it is recommended for the third ventricle colloid cystectomy.

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