Endoscopic Versus Microsurgical Resection of Colloid Cysts: A Systematic Review and Meta-Analysis of 1278 Patients

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Key words
- Colloid cyst
- Microsurgery
- Neuroendoscopy
- Systematic review
- Third ventricle

Abbreviations and Acronyms
CI: Confidence interval
CSF: Cerebrospinal fluid
GTR: Gross total resection
MRI: Magnetic resonance imaging


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■ OBJECTIVE: **Colloid cysts of the third ventricle have been successfully treated with transcranial microsurgical approaches. However, the endoscopic approach has recently been advocated as a lesser invasive technique. We conducted a systematic review and meta-analysis of published studies to compare the outcomes between the two approaches.**

■ METHODS: **A PubMED search of contemporary literature (1990–2014) was performed to identify surgical series of open and endoscopic treatment of colloid cysts. Relevant articles were identified and data were extracted concerning surgical treatment, extent of resection, and outcomes.**

■ RESULTS: **A meta-analysis was performed for recurrence rates based on treatment strategy. A total of 583 patients were included in the microsurgical group, and 695 patients in the endoscopic group. The microsurgical approach was found to have a significantly higher gross total resection rate (96.8% vs. 58.2%; $P < 0.0001$), lower recurrence rate (1.48% vs. 3.91%; $P = 0.0003$), and lower reoperation rate (0.38% vs. 3.0%; $P = 0.0006$) compared with the endoscopic group. There was no significant difference in mortality rate (1.4% vs. 0.6%) or shunt dependency (6.2% vs. 3.9%) between the two groups. The overall morbidity rate was lower in the endoscopic group (10.5%) than in the microsurgery group (16.3%). Within the microsurgery group, the transcallosal approach had a lower overall morbidity rate (14.4%) than the transcortical approach (24.5%).**

■ CONCLUSIONS: **Microsurgical resection of colloid cysts is associated with a higher rate of complete resection, lower rate of recurrence, and fewer reoperations than with endoscopic removal. However, the rate of morbidity is higher with microsurgery than with endoscopy.**

INTRODUCTION

Colloid cysts of the third ventricle are benign tumors that are thought to have a neuroectodermal origin (53, 57). These cysts arise from the roof of the third ventricle in close proximity to the interventricular foramen of Monro, typically obstructing the flow of cerebrospinal fluid (CSF) leading to hydrocephalus or in extreme cases sudden death (1, 10, 16, 53, 59). Colloid cysts are noted to have a thin collagen wall lined with a single layer of cuboidal epithelium that is ciliated and/or nonciliated (1, 26, 53, 57). Cyst contents are typically characterized by a mucinous suspension ranging in dark green to brown color, occasionally being solid (26). The incidence of colloid cyst ranges from 0.5% to 2.0% of all intracranial tumors (29, 31, 53, 57). Surgical resection is often chosen for large symptomatic colloid cysts, whereas small asymptomatic lesions can be managed by close observation with serial magnetic resonance imaging (MRI) (45, 46, 59). Currently, surgical interventions include CSF shunting, cyst aspiration, microsurgical resection, and more recently, endoscopic resection (19, 34, 41, 53).

Simple decompression of the cyst contents without complete removal of the cyst wall often results in recurrence, previously reported by Mathiesen et al. (41, 42), at a rate of 80% (27). Therefore, radical removal of the cyst wall and intracystic contents is necessary to minimize recurrence (27, 41). Traditionally, transcortical or transcallosal microsurgical approaches with a craniotomy have been the mainstay for surgical treatment of colloid cysts. This approach provides excellent access to the third ventricle and foramen of Monro, and allows for bimanual microdissection of the cyst wall from the critical structures such as the fornix, choroid plexus, and internal cerebral vein (6, 25, 49). However, one disadvantage may be the risk of postoperative morbidities associated with a craniotomy (21, 53). Recently, there has been increased interest in endoscopic approaches for colloid cyst resection because some investigators believe that it is a less invasive technique than traditional microsurgical approaches, which may potentially minimize postoperative complications and perioperative morbidity (1, 7, 9, 11, 14, 23, 24, 30, 41, 52, 59). One major criticism of the standard single-burr hole endoscopic approach is the inability to perform bimanual microdissection of the cyst wall from the critical structures as

this technique relies on cyst wall aspiration followed by coagulation of the residual cyst wall remnants (28). The presence of residual cyst wall increases the risk of future recurrence (7, 11, 20, 23, 48, 59). Microsurgical series have typically reported higher rates of complete resection, whereas endoscopic series have reported shorter hospital stays and decreased complication rates (21, 32, 49, 50, 59).

Currently, there is no consensus on which surgical intervention is the most effective. In the present study, we analyzed the differences in endoscopic and microsurgical management of colloid cysts of the third ventricle by performing a systematic review and meta-analysis on the current literature, focusing on the extent of resection, morbidities, recurrence rates, and shunt dependency.

METHODS

Literature Search Strategy

A systematic review of published literature on cases of colloid cysts was performed. The PubMed database was searched from 1990 to 2014 for "Colloid Cysts" and "Colloid AND cyst AND resection." Article titles were scanned to identify studies that included colloid cyst treatment data. Abstracts were then reviewed, followed by close inspection of acquired full-text articles. Finally, the bibliographies of the retrieved articles were examined for additional studies missed from the original PubMed search.

Institutional review board approval was not necessary as the present study qualified as nonhuman subject research.

Selection Criteria and Data Management

All English-language articles detailing colloid cysts were included. In addition, studies were only included if they reported presenting symptoms, diagnosis, treatment, recurrence, follow-up, and complication rate. Articles, which were excluded, had at least one of the following: nonhuman, radiologic, cadaveric, anatomic, histologic, molecular studies, and any sources with insufficient or nonextractable data. Full-text articles, which could not be obtained, were also excluded. The investigators also performed an evaluation of study quality of the case series analyzed using the Quality Assessment Tool for Quantitative Studies (Effective Public Health Project 2007). The studies, which were assessed in the present review, were labeled with an overall weak rating (3, 13, 56).

Data Extraction

Two independent observers extracted data and together came to a consensus about any discrepancies before inclusion into the database. Data extracted from articles included demographics (gender, age), presenting symptoms (headache, nausea/vomiting, dizziness, gait disturbance, memory deficits, papilledema, hydrocephalus, ataxia, visual deficits), number of incidental findings, radiographic imaging, surgical technique (microsurgical, endoscopic, transcallosal, transcortical), extent of resection (gross total, subtotal), complications during hospital stay, complications after hospital stay, recurrence, mortality, and follow-up. Several articles used bimanual dissection techniques by dual-port or dual instrumentation endoscopic techniques. Because the entire resection was achieved exclusively using endoscopic visualization, these data were included in the endoscopic pool (6, 18, 22, 59).

Extent of resection was defined as follows: gross total resection (GTR) was complete removal of the cyst wall and intracystic contents. Based on the information provided by each individual study, GTR was determined based on intraoperative inspection after dissection of the cyst capsule from surrounding neurovascular structures. Coagulation of cyst wall remnants and absence of residual cyst wall based purely on postoperative MRI were not considered a GTR. According to Wilson et al. (59), intraoperative inspection is a more accurate assessment of extent of resection than postoperative imaging alone, because the latter may not display a remnant cyst capsule that is visualized at surgery.

Data were also collected on morbidities after surgical treatments. The collected data distinguished complications of transcortical microsurgery, transcallosal microsurgery, and endoscopic surgery. A weighted average was calculated for each separate complication. Complications were counted individually, as most articles did not distinguish complications per patient.

Data Analysis

StatsDirect (StatsDirect Ltd., Altrincham, United Kingdom) was used for meta-analysis, forest plots, funnel plots, and to make 2×2 contingency tables to calculate χ^2 and Fisher's exact tests, when appropriate. A weighted parameter estimate was compiled for each treatment group from a pooled recurrence rate of colloid cysts, which was determined using DerSimonian and Laird's random-effects model. This model was implemented due to its assumption that the included studies are a sample of all potential studies, thus allowing an estimation of between-study variability. Publication bias was evaluated through visual inspection of the forest plot and funnel plot. Chi-square and Fisher's exact tests were used to determine differences in rates of radical resection, recurrence, reoperation, mortality, and shunt dependency based on the surgical technique.

RESULTS

Searching the PubMed database using the key words and manual bibliography search identified 773 studies (**Figure 1**). Exclusion criteria included studies published before 1990 (292), non-English language (150), nonsurgical (106), not third ventricular colloid cyst (64), non-human subject (35), insufficient data (23), could not locate (18), type of surgical technique (15), insufficient outcome or follow-up data (14), unextractable data (10), and different diagnosis (6). After using the previously mentioned selection criteria, a total of 40 studies with 1278 patients were included in the systematic review. Available information on age, sex, location of cyst, associated symptoms, radiographic imaging, surgical technique, recurrence, and morbidities was recorded (**Tables 1–4**).

Demographic Data

Sixteen studies were included in the microsurgical group, which included a total of 583 patients (2, 4, 5, 8, 16, 21, 25, 28, 31, 38, 41, 49-51, 53, 55). Twenty-six studies were included in the endoscopic group, which included a total of 695 patients (1, 4, 6, 7, 9, 11, 15, 18, 20-23, 27, 28, 30, 33, 35, 38, 39, 43, 44, 48, 52, 53, 58, 59). Five studies included both microsurgical and endoscopic data (4, 21, 28, 38, 53). Demographics of each treatment group were recorded in **Table 1**. The microsurgical group had a mean age of 40.0 years, a male-to-female ratio of 1.3:1,