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Three decades of colloid cyst resection. A single-centre retrospective analysis of 59 cases (1990-2020)

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Keywords
colloid cyst, resection, transcallosal, endoscopic

Abstract

Purpose: To analyse 59 colloid cyst resections over 30 years at a single institution.
Methods: Retrospective review of electronic health records, including surgical approaches: transcortical (18), transcallosal (36), and endoscopic (5).
Results: Mean age at resection: 45.8 years. Cyst diameter: 4-27mm. Headache was the primary symptom (57.6%). Complications included memory deficits, infection, and neurological deficits; no mortality. Most cases were high-risk per Colloid Cyst Risk Score. Histology revealed pseudostratified epithelium (35%) and unique eosinophils. Craniotomy rate: 93%. Endoscopy had the highest reoperation rate; the transcallosal approach had more seizures and infections. Post-operative short-term memory issues: 40% (craniotomy), 50% (endoscopy).
Conclusions: Findings largely align with literature, with notable differences in headache prevalence, gender ratio, histology, and endoscopy outcomes.
This version reduces the word count by about 40% while retaining the essential information from each section. It maintains the structure and key points of the original abstract, allowing readers to quickly grasp the study's scope, methods, main findings, and conclusions.

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Introduction

Benign and rare, the colloid cyst or neuroepithelial cyst is an intracranial tumour, representing 0.5%-2% of all brain tumors[1–3]. The aetiology behind colloid cysts is not well understood. They have been postulated to be congenital in origin, deriving from the embryological remnants of the third ventricle, from the tela choroidea or endoderm[4,5]. Cases have been reported of 1st degree family relatives having colloid cysts, including identical twins. However, as of August 2022, only 23 familial cases were reported in the literature, suggesting that this is unlikely to be merely a genetic phenomenon[6].

Colloid cysts typically occur in the anterior third ventricle, frequently causing obstructive hydrocephalus. The presence of ventriculomegaly can cause a wide range of symptoms due to increased intracranial

pressure[5]. The most common of these symptoms is that of a persistent headache[5,7], and these symptoms can aid the calculation of the Colloid Cyst Risk Score (CCRS)[7]. The Colloid cyst risk score is not an official Score recommended by NICE guidelines; there are multiple versions of it available and determine which patients are at most immediate risk of complications as a result of their colloid cyst, guiding treatment. CCRS gives one point for each of the following:

- Age <65 years – because of fear the cyst will get bigger over time as a younger person on average will live longer.
- Headache - a sign of hydrocephalus causing brain damage.
- Axial diameter 7mm or above - greater size can cause more complete obstruction of the ventricular system
- Location of the cyst – the anterior third of the third ventricle increasing blockage risk
- FLAIR hyperintensity suggesting calcification of brain matter

This is the version used by our trust; however, modified versions exist, such as mCCRS - score out of 7 instead of 5, where an extra point is given for being female as this is believed to increase risk and for axial diameter one point is given for over 10mm instead of 7mm and a second point is given if over 15mm [5]. In this retrospective review, we will calculate the CCRS for resection cases to see what proportion of the risk score encouraged resection and what proportion was due to other factors such as patient desire for tumour resection for psychological reasons. However, this paper will primarily communicate the experience of our neurosurgical unit in resecting these colloid cysts.

One of the most severe consequences of concern in patients presenting with an untreated, predominantly large colloid cyst over 10mm is acute hydrocephalus and brain herniation. 86% of patients who die directly from their colloid cyst report having headaches as a symptom of brain damage before death, as shown in a systematic review of fatal colloid cysts in 2017 of literature over 15 decades [8]. These cysts are often found to be over 10mm in diameter [9]. The mechanism of sudden death is uncertain. One theory suggests that ventriculomegaly causes the mass effect of the cyst against the hypothalamus, triggering catecholamine release. This is linked to increased intracellular calcium and reactive nitrogen species, causing lipid peroxidation in cardiomyocytes and potentially resulting in cardiac arrest [8]. A less commonly argued hypothesis is that lumbar puncture prior to Computer tomography is a precipitant for sudden death linked to colloid cysts [8].

However, despite the risk of mortality, the risk of surgery must also be counterbalanced. Historical management favoured resection, but recent data supports initial conservative monitoring as many cysts remain asymptomatic.

A recent retrospective study with 82 patients found that only three required surgery [9]. The Colloid Cyst risk score is used to help gauge whether surgery is preferable. Alternative options include open craniotomy (interhemispheric transcallosal and transcortical) or endoscopic resection, which have a lower recurrence but higher complication rate like Transcranial resection or with lower complication but a greater chance of future surgery in the case of endoscopic resection; however, the expertise of the surgeon is the most important factor according to a recent meta-analysis [10]. Aspiration can be used to drain the cyst; however, it is known to have a higher recurrence, limiting its usefulness as a long-term solution; hence, this latter option is less likely to be used [4]. This is also reflected in our unit's choice of intervention.

Methods and Materials

In this study, we present a retrospective review of all patients at our hospital who underwent colloid cyst resection of the third ventricle. Our data covers 59 cases over 30 years, from January 1991 to November 2021. Sex was defined as biological unless otherwise specified in the iPortal records (no such specifications occurred in this study).

Due to the extended retrospective period, not all scans were readily available, as medical records were only accessible back to 2004. Consequently, the Colloid Cyst Risk Score (CCRS) could not be retrospectively calculated for all cases. Post-surgical follow-up, examining clinical features and CT radiological scans, was conducted for an average of 21.5 months for cases without recurrence. Seven cases are still ongoing and were not included in this calculation.

Resections were performed either via craniotomy or endoscopically. The craniotomy approaches included:

Transcortical: Involves creating a bone flap over the frontal area and navigating through the brain parenchyma to access the ventricle.

Transcallosal: Accesses the ventricle through the corpus callosum.

Endoscopic resection, a minimally invasive technique, utilizes endoscopes and specialized instruments inserted through a burr hole to access the ventricle and resect the cyst. Neuronavigation was employed for both open and endoscopic procedures.

Results

The mean age at resection was 45.8 years (range 17-76, SD 15.86). The age distribution of patients is shown in (Figure 1) including one patient under 18 years old. There was no significant difference between males (31 cases) and females (28 cases) in our study. The cyst sizes ranged between 4-27mm. A recurring theme in our analysis is that our sample size is too small for any statistically significant interpretation.

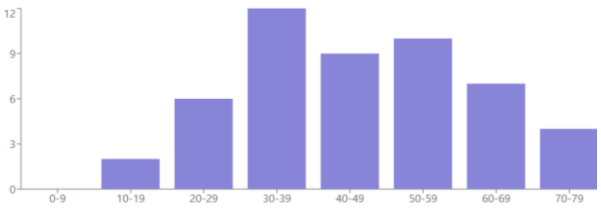

Figure 1. Shows the distribution of patients by age.

Histological findings (Table 1) included pseudostratified cuboidal epithelium in 35% of cases and columnar epithelium in 29%. Other findings were eosinophils, goblet cells, cilia, blood, and psammoma bodies.

Common presenting clinical features (Table 2) included headaches in most cases. Other frequent symptoms were memory problems, balance issues, collapse, visual disturbance, nausea, and vomiting. Interestingly, in six cases, the cyst was found incidentally, with two of these patients later found to have headaches. There were also singular symptoms like numbness. Common post-resection complications (Table 3) included memory problems, infection, neurological deficits, and seizures. Six patients passed away during follow-up; however, none were found to have died from causes related to the colloid cyst or its resection.

The Colloid Cyst Risk Score (CCRS) was calculable in 32 cases (not all radiology scans were available over the 30 years). The majority scored three or above, with a mode of 4 (Figure 2). Only 11 resections had a CCRS of 1 or 2. We investigated potential correlations between CCRS and post-surgical complications, as well as between cyst diameter and complication likelihood or symptoms, but found no significant correlations.

Table 1. Shows the percentages of histological findings of resected cysts.

Histology	%
Pseudostratified cuboidal	35%
Columnar	29%
Uncertain	12%
Cuboidal	9%
Other	6%
Cuboidal and columnar	6%
Pseudostratified columnar	3%

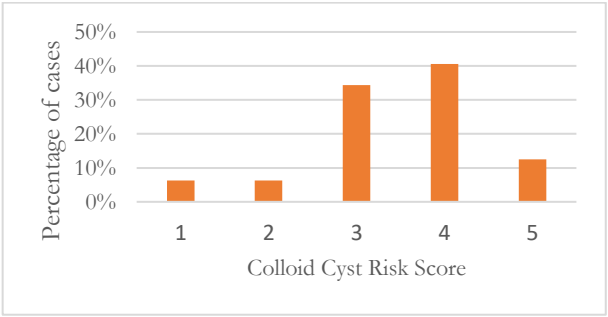

Figure 2. Show the percentages of colloid cyst risk scores in operated patients.

Table 2. Shows the frequency of patients' presenting symptoms.

Symptoms	
Headache	34
Visual Disturbances	10
Nausea & Vomiting	10
Hearing deficits	3
Seizures	2
Sensory Disturbances	4
Incidental Findings	6
Gait Disturbance	7
Balance Disturbance	12
Incontinence	6
Cognition	1
Confusion	4

Memory Issues	14
Collapse	12
Other	22

Table 3. Shows the frequency of complications postoperatively.

Complications	
Infection	7
Transient Neurological Deficits	7
Long-Term Neurological Deficits	4
Seizure	2
Short-term Memory Deficits	22
Long-Term Memory Deficits	7

Craniotomy was performed in 93% of cases (18 transcortical, 36 transcallosal), while only 7% were endoscopic (5 cases). Most patients were white (85%). Common radiological findings included ventriculomegaly, mass effect, ischemia, and haemorrhage.

We analysed complications by surgical approach. Memory issues occurred in 50% of endoscopic, 37.5% of transcortical, and 40% of transcallosal cases. Seizures were noted twice as often after the transcallosal approach. Postoperative infection rates were: endoscopic 0%, transcortical 11.11%, and transcallosal 11.11%. Return to theatre rates were: endoscopic 20%, transcortical 0%, and transcallosal 13.89%. Most resections were routine (72.22%), followed by urgent (18.52%) and semi-urgent (9.26%).

The complication rate was highest for the transcallosal approach, followed by endoscopic and transcortical. The most frequent approach was transcallosal, followed by transcortical and endoscopic.

Discussion

Our results represent the unique experience of our unit and, while not universally applicable, provide valuable insights and draw important parallels to existing literature.

At our centre, the mean age at resection was 45.8 years (range: 17-76, SD: 15.86); (see Fig. 1). This is in line with the statistics reported within other case reviews. Colloid cysts are reported to account for around 0.5%-2% of all brain tumours [1–3]. These findings reported by other papers are comparable to our centre's experience.

The resected cases had a CCRS score mode of 4, and very few scored 1 or 2, (see Figure 2). This makes logical sense as symptomatic patients would be expected to be more eager to have a resection than asymptomatic patients and symptomatic patients mostly scored 4 or 5 in research on risk analysis for colloid cysts[11]. We investigated whether higher CCRS and cyst diameter correlated with an increased risk of post-surgical complications, which might influence surgical decisions. However, no significant correlations were found. Colloid cysts are mostly found incidentally while investigating other conditions. There is a 5-15% chance within five years of diagnosis that progression will have taken place requiring management; conservative management is therefore often opted for, including neuroimaging [5]. Another paper found that 3/82 of conservatively managed patients required surgical management over ten years [9]. This shows how a large quantity of patients are best managed conservatively, which validates the management of our unit.

The histological findings were coherent with the rest of the literature, pseudostratified cuboidal or columnar with occasional evidence of calcification, cilia and goblet cells[12]. We found no evidence in the literature for the presence of eosinophils in histological samples of colloid cysts, which might suggest inflammation due to cellular damage. Whether this was due to hydrocephalus or surgery is uncertain, and this matter would benefit from further research. The features found frequently included cilia and goblet cells, supporting claims that colloid cysts share developmental origins with sinus epithelium[13].

Hyperintense was the most common FLAIR sign, followed by hypointense, Mirroring other retrospective research of resections[3]. This makes logical sense as a higher CCRS encourages resection, and Hyperintense FLAIR scores an extra point.

Of the 59 cases in our study, there did not seem to be a significant difference in prevalence between sexes, with 31 cases in males and 28 in females. The literature has found no definitive answer to the query as to whether one sex is more likely to have colloid cysts. A 105-patients study from Mumbai, India, found there was a 3:2 ratio for male: female[3]. Contrary to this, an 84-patients retrospective study found no link [14]. Another paper found that in 82 patients, conservatively managed men were more likely than women to be represented[9].

There was little diversity data available on the ethnic background of patients, preventing us from

making comparisons based on ethnicity as the vast majority were white due to the local population being white. Of the patients within our centre, no patients reported having any family members who had also previously suffered from a colloid cyst. Despite evidence of this being available in the literature[6]. Overall research on genetic aetiology has rarely yielded fruit.

The symptoms found within our retrospective review show that the symptoms were similar to those of other comparable research [1–3]; for instance, headache has been the most common finding, [15]. The same conclusion can be drawn from the post-surgical complications.

Patients presented with various signs suggestive of increased intracranial pressure. This included headache, hydrocephalus, vertigo, diplopia, mass effect, behaviour change, memory deficit, oedema, a decrease in Glasgow Coma Scale (GCS) score, sensory or motor loss, tinnitus, incontinence, syncope, and confusion. The most common symptom was headache appearing in 57.63% of our recorded cases, which was also found in a smaller retrospective study 90% of the time [2], as well as the more extensive Mumbai study of 105 cases [3] where it appeared in 92% of cases. This suggests documenting headaches at our centre is done less commonly, perhaps with a threshold of higher intensity of pain, or that patients in the other studies were effectively managed more conservatively for longer. The Mumbai paper had several patients come in comatose and several died, unlike 0% in our study where resection were rarely urgent and hence symptoms less pronounced. Patients at our Hospital are operated on if they are determined to be at moderate or high risk. Except for headache, the symptoms closely correlated with fatal outcomes were not common at our centre: change in gait, decreased GCS, seizure, emesis and nausea to a degree [8]. In the Mumbai paper, 4.7% of patients out of 105 cases died from surgery [8], this is higher than in our data sample, where 0% died because of surgery; it should be acknowledged the medical demands are likely much higher in Mumbai.

The radiological findings are in keeping with the rest of the literature: ventriculomegaly was often found logically following the tumour's obstruction of the foramen of Monroe.

Larger tumours found in older patients might be expected to be due to a greater length of time for the tumour to grow, It may seem intuitive to conclude that the risk of death would therefore be higher at greater age, but the literature suggests that it is more likely to happen earlier in life [9]. This is coherent with the congenital hypothesis about their origins as if the colloid cyst is congenital in origin then the harm caused would be more likely to transpire in the younger years of life. Our data shows no significant correlation of age at resection against diameter. This does not concord with the hypothesis that they enlarge to become a problem across a lifespan. According to the literature, people under 18 are said to be less likely to have hydrocephalus [16]. Our data only had one patient 18 or under, so we cannot comment on this reliably. According to a recent meta-analysis, transcallosal, endoscopic and transcortical approaches did not show any difference in the chance of seizure [10]. Other studies found that compared to other approaches, transcallosal increased the risk of seizures [3,9]. Our data only showed two seizures in resected patients, both transcallosal. We cannot weigh in on this controversy decisively with this sample size. Research has shown an increased risk of short-term memory loss with the transcallosal approach [9,10,17,18]. Our data showed short-term memory issues: endoscopic 50%, transcortical 37.5%, and transcallosal 40%; our data does not support this proposed hypothesis; one possibility for the difference is surgical techniques and ability have changed over the decades confounding results. Our Data shows that transcallosal had the highest mean complication rate, followed by endoscopic and finally transcortical. Other research found that endoscopic should have a lower but statistically insignificant complication rate than transcranial[19], which does not contradict our results.

According to several studies, endoscopic resection is commonly linked to a lower complication rate, yet surprisingly, some research has been linked to an increased risk of infection like ventriculitis and meningitis [18–20]. Our data disagrees; Infection as a complication happened the least endoscopically, 0% and 11.11% transcallosal and 11.11% transcortical, supporting the general notion that endoscopic is less likely to cause infection due to smaller incision. Endoscopic was more likely to require a return to theatre at 20% compared to 0% transcortical and 13.8% transcallosal. The surgical methodology has been 93.22% craniotomy and only

6.68% endoscopic because the former has a lower risk of return to theatre at any point after surgery than the latter, which is why it is opted for.

Overall, our data shows transcortical had the lowest risk of return to theatre whilst still having a lower risk of infection than transcallosal yet is only used half as much as transcallosal; furthermore, transcallosal appears to have the highest complication rate, whereas transcortical had the lowest suggesting our unit might possibility benefit from opting for a transcortical approach more often, likely due to higher surgical skill level despite been use less often than transcallosal. Endoscopic is rarely used, so whilst endoscopic could be suggested to have a lower chance of complications due to smaller incisions, this is less important than the surgeon's skill with a given technique.

Conclusion

Our unit's 30-year experience with 59 colloid cyst resections largely affirms findings reported in the literature while providing valuable insights into our specific management practices. We found no notable sex difference in colloid cyst prevalence or resection rates, with 31 male and 27 female patients. The mean age at resection was 45.8 years, and most patients had a high Colloid Cyst Risk Score (CCRS) of 3 or 4, indicating higher-risk cases.

Histological findings were consistent with the literature, except for the presence of eosinophils, which was not reported in other studies and may warrant further investigation. Cyst diameters ranged from 4 to 27 mm, aligning with ranges reported in other studies. Presenting symptoms were generally as expected, but headaches were reported in only 57.63% of our cases, significantly lower than the 90-92% reported in other studies. Radiological findings were typical, with hyperintense Fluid-Attenuated Inversion Recovery (FLAIR) signals being most common, and ventriculomegaly frequently observed.

Of the 59 cases, 36 (61%) were resected using the transcallosal approach, 18 (31%) transcortical, and only 5 (8%) endoscopically. Post-operative seizures were rare, with only two cases observed, both following the transcallosal approach. Post-operative infections were most common in transcallosal and transcortical approaches (both 11.11%), while no infections were observed in endoscopic cases. Short-term memory loss was observed in 50% of endoscopic cases and approximately 40% of craniotomy cases (37.5% transcortical, 40% transcallosal). The rate of return to the theater was highest for the endoscopic approach (20%), compared to 13.89% for transcallosal and 0% for transcortical approaches.

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