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CHRONIC SUBDURAL HEMATOMA: PATHOPHYSIOLOGY, DIAGNOSIS, AND MANAGEMENT – A REVIEW WITH 45 OPERATED CASES IN A SINGLE CENTER

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ABSTRACT

Background : Chronic subdural hematoma (cSDH) is a common neurosurgical condition with rising prevalence due to aging populations and increased use of anticoagulant/antiplatelet therapies. It presents with varied symptoms, from headaches to neurological deficits. Diagnosis is usually via CT scan, with MRI used in unclear cases. Treatment options include conservative management for small hematomas and surgery for larger or symptomatic ones. Surgical techniques such as twist drill craniostomy, burr-hole craniostomy (with drainage), and craniotomy are used, with burr-hole craniosto-

my being the most common due to its effectiveness and low complication rate. The two-burr hole approach has shown better outcomes in terms of lower recurrence, shorter hospital stays, and reduced infection risk. This study confirms that two-burr hole craniostomy is a safe, effective method for treating cSDH, offering good recovery and low mortality.

Methods : This prospective study assessed the effectiveness of two-burr hole craniostomy in treating chronic subdural hematoma (cSDH) in 47 patients aged 40–75 years with GCS ≥ 4 , conducted at SVP Hospital and Smt. NHL Medical College from January 2022 to March 2025. The procedure in-

involved creating two burr holes in the frontal and parietal regions, followed by irrigation and drainage. Patients received postoperative care including head-down positioning, oral hydration, spirometry, and a 7-day antibiotic course. Most patients showed significant clinical improvement and were discharged within a week. Follow-up CT scans on day 5 confirmed good outcomes. Statistical analysis revealed favorable results in safety, low recurrence, and recovery. The study concludes that two-burr hole craniostomy is a safe, effective, minimally invasive option for cSDH with low morbidity and rapid functional recovery.

RESULTS

This prospective study evaluated the effectiveness of two-burr hole craniostomy in treating chronic subdural hematoma (cSDH) in 45 patients aged 40–75 years. Most patients were male (80%), with a mean age of 68 years. Common symptoms included headache (82%), motor deficits (62%), and gait disturbance (44%). CT scans showed unilateral hematomas in 80% of patients, mostly with mixed density (69%). All underwent two-burr hole craniostomy with irrigation and drainage, resulting in symptom relief in 44 patients. The average hospital stay was 5 days. Postoperative imaging showed residual fluid but anatomical improvement. No recurrence occurred within 6 weeks. Two patients (4.44%) developed intraparenchymal hemorrhage; one died from pneumonia. Statistical analysis confirmed favorable outcomes in safety, recovery, and low recurrence. The study supports two-burr hole craniostomy as a safe, effective, minimally invasive procedure for cSDH with rapid recovery and low complication rates.

CONCLUSION

The patient demographics and clinical features in this study align with global trends, confirming that chronic subdural hematoma (cSDH) primarily affects elderly males, often with a history of minor trauma. Surgical outcomes were favorable, with no recurrence observed, matching or exceeding international standards. The low complication rate is attributed to the use of two-burr hole craniostomy with drainage and standardized postoperative monitoring, underscoring the effectiveness of this approach in managing cSDH.

Key words: *Chronic subdural hematoma, cSDH, burr hole, recurrence, elderly, neurosurgery, case series*

INTRODUCTION

Chronic subdural hematoma is one of the most commonly occurring diseases a neurosurgeon comes across incidence being 1–5.3 cases per 1,00,000 populations annually. [2] Our understanding of the pathophysiology of cSDH has evolved considerably over the decades, and continued research in the field may eventually modify current theories. Presently, it is generally well accepted that the initial hemorrhage in cSDH derives from bleeding of bridging veins as they traverse the dural cell layer of the dural border. This can occur due to traumatic events, anatomical changes that result in cranio-cerebral disproportion (i.e. brain-shrinkage with age), intracranial hypotension, or through anatomical manipulation (cranial surgery) [3]. The singular most important factor affecting progression

and clinical outcome is neurological status at presentation. [4] Chronic subdural hematoma may present with headache, vomiting, personality changes, symptoms related to focal deficits for example altered consciousness, hemiplegia, dysphasia, seizures. An increase in size may occur over time implying that acute re-bleed is not the only cause. By definition, chronic SDH is the accumulation of old liquefied blood between the dura and arachnoid layers surrounded by a capsule. Traditionally, SDH is categorized in relation to the time of occurrence as acute, sub-acute, or chronic. Hematomas that become clinically apparent within 72 hours of injury are labeled as acute. If symptoms are delayed to 3 weeks, the hematoma is subacute. Symptoms of chronic SDH become apparent 3-weeks after injury. A duration of 4-5 weeks is usually observed in admitted cases of chronic SDH. [6] Seemingly trivial head trauma which might be overlooked by the patients might also cause CSD. [8-14] The incidence is increasing due to increase in aging population, associated medical diseases such as hemodialysis, anticoagulant, and/or antiplatelet therapy. [15-16] Most cases of chronic SDH are 50 years of age or older due to brain atrophy and stretching of vessels traversing the subdural space, although younger patients including children might also be victims. CSDH is bilateral in 11 – 35% of cases. [17,18] Simultaneous treatment of bilateral hematomas is recommended as the evacuation of only one of the two hematomas may precipitate magnification of the contralateral untreated hematoma. [19] CT Scan brain is the investigation of choice for diagnosis of SDH, appearing as hypodense lenticular collections under the dura. Nevertheless, due to recurrent bleeding from the vascular membrane, a chronic SDH can appear as a mixture of hypo and hyperdense material. [20] The lesions may also be isodense, sometimes not readily distinguishable on a CT film, such cases prompt further investigation using MRI to identify chronic SDH. [21-25] A variety of management options have been proposed for chronic SD. [25,26] Some of the small CSDHs after antiplatelet drug use can be managed conservatively by stopping the antiplatelet drugs and follow-up with repeat CT scans. When surgery is necessary, its delay, if the patient's condition permits, allows metabolizing the drug and platelet renewal. This delay could minimize the risk of hemorrhage. If urgent burr holes are indicated, measures to improve platelet function should be undertaken. [27] There is general agreement that significant coagulopathy should be reversed expeditiously in CSDH before surgery is undertaken. [28] Surgery is the best option in moderate to large hematoma with neuro deficit. One surgical technique may not be appropriate for all CSDHs. The selection of an ideal treatment strategy for an individual patient should be the target. [29] The TDC [Twist Drill Craniostomy] drainage is indicated in high-risk surgical candidates in non-septated CSDH. [28] TDC can be performed at the bedside and is effective in treating CSDHs. [30] Burr-hole craniostomy is the most efficient. After the surgical procedure, no recurrence or mortality has occurred till date. After the surgical procedure, no recurrence or mortality has occurred till date. choice for surgical drainage of uncomplicated CSDH. Burr-hole craniostomy is associated with a low recurrence rate and lesser complications. [31-35] Treatment of CSDH through a burr-hole irrigation and closed-system drainage under local anesthesia is simple, safe, and effective. [36] Surgeons differ in

their choice regarding usage of one or two burr holes. The one burr hole craniostomy with closed drainage could be sufficient to evacuate CSDH with lower or similar recurrence rate, as compared to two burr hole group.[37-39] On the other hand, treatment of CSDH with one burr hole has been found to be associated with a significantly higher postoperative recurrence rate, longer hospitalization length, and higher wound infection rate, as compared to treatment with two burr hole.[40] Craniotomy is indicated in CSDH with significant membranes,[28] multiloculated,[41] organized,[42,43] and calcified or ossified CSDH.[44-46] The use of primary craniotomy for resection of hematoma along with its membranes carries a 30% mortality rate. This method is recommended only for repeated recurrence or solid consistency of hematoma. [23] McKissock and Richardson mastered simple burr hole drainage for the chronic SDH in the 1960s. [47] Mortality rates of < 2% have been reported with burr hole treatment in recent years. [48] It is believed that this neovascularization is supplied by branches of the middle meningeal artery (MMA), wherefore MMA-embolization has gathered a growing interest, particularly in the treatment of recurrent cSDH (68). This procedure is an anti-angiogenic modulation that is believed to stop the rebleeding and inflammation cascade. This study determined the most commonly employed Two Burr hole craniostomy technique for drainage of chronic subdural hematoma. We assessed the efficacy of the surgical procedure and studied the improvement in clinical outcome.

METHODS

Study Type & Setting

This prospective observational study included cases of surgically treated patients with chronic SDH, who were admitted between January 2022 and July 2025 in the Department of Neurosurgery, SVP Hospital and smt. NHL Medical College, Ahmedabad.

Sampling Technique & Sample Size

45 patients who underwent two burr hole evacuation for chronic subdural hematoma between January 2022 and July 2025 were included according to inclusion criteria.

Selection Criteria

Patients chosen had ages between 40 – 75 years with a GCS not less than 4/15 with or without any co-morbidity conditions acquired more than 5 years or having stood longer than 10 years. A similar criterion was used for all these cases and they remained under the care of one neurosurgeon and his team. Diagnosis relied on physical findings consistent with an appearance on CT- Scan brain.

Exclusion Criteria

Patients having GCS less than 4 or treated medically were excluded from this study.

Data Collection

The presentation was within 7 to 90 days of the appearance of symptoms. The level of consciousness was considered for grading purposes. Routine hematological and biochemical investigations were done in all cases. Fresh frozen plasma/plate-

lets were given in case of coagulopathy. All the procedures were performed under general or local anesthesia according to the patient's general and medical condition. For GCS calculations, the mild condition was considered under GCS level between 12 – 15, the moderate condition was considered under GCS level between 8 – 11 and severe condition was considered under GCS level between 4 – 7.

Surgical Operative Technique

The surgical technique involved the formation of a double burr hole at the point of maximum density at the frontal and parietal region. Two burr-holes are typically positioned on the anterior (in front of coronal suture) and posterior (approximately 8 cm posterior to the first hole, on tuber parietalis). Both holes are positioned cranial to the superior temporal line, which typically aligns with the hematoma's cranio-caudal centre and minimises the possibility of harming expressive brain regions (such as the operculum or primary motor cortex). A cruciate incision made to persist by using diathermy. After opening the dura in a cruciate fashion, an outer membrane will be present and coagulated. A blackish-brown colored liquid poured out with pressure on opening the external membrane. Isotonic saline wash was used for rinsing to obtain a clear disease-free cavity. Patients were asked to cough during the procedure which helped the evacuation of the clot if the procedure was done under local anaesthesia. Dark brown fluid was seen oozing out upon coughing. Isotonic saline was filled in the cavity to remove air and after adequate hemostasis, skin was closed with nylon sutures.

Figure 01 shows superior and lateral view of important anatomical landmarks to consider during surgical treatment

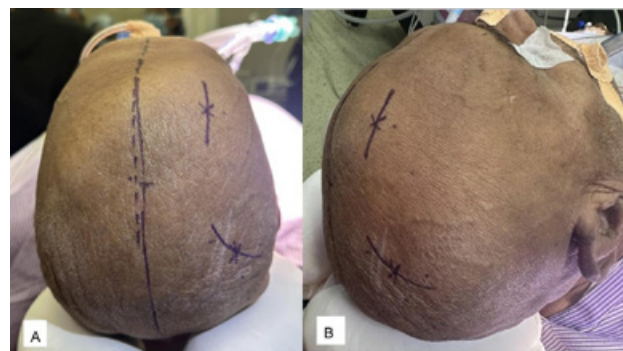


Figure 01. Illustrations of a superior and lateral view of skin incision marking consider during surgical treatment of cSDH. A) The superior view highlights the placements of the burr-holes, with consideration of the motor cortex. B) The lateral view demonstrated the same Burr-hole placements

Post-Operative Management & Follow- Up

Postoperatively, patients were nursed in head- down position for 24 to 48 hours and were advised to take plenty of oral fluids and spirometry was given to help expand the brain. Perioperative antibiotics prophylaxis was used in all cases. Postoperative antibiotics were given to all patients for seven days. A follow-up CT scan was done 5 days postoperatively. Most cases were discharged within 7 days because of clinical improvement.

Statistical analysis

Frequencies or percentages of variables and means and

standard deviations for continuous variables were used to present data. Data were presented as the frequency or percentage for categorical variables. The analysis was carried out using the independent t-test and the Fisher's exact test. A $p \leq 0.05$ was considered to indicate statistical significance. Confidence interval (CI) was set at 95%.

RESULTS

Between January 2022 and July 2025, 47 patients of chronic SDH were admitted at our institution. Out of which, 45 patients who underwent two burr hole evacuation for chronic subdural hematoma between January 2022 and July 2025 were included according to inclusion criteria. Two patients were excluded as they were managed conservatively with steroids..

Demographics Data

The mean age was 68 years (ranging from 40 to 75 years), and 36 (80 %) patients were male (36:9) . The mean follow-up period was 12 months. About 55.55% (n=25) used anticoagulants or antiplatelet agents, 20 % (n=9) had some degree of cognitive deficit, 57.78 % (n=26) had motor deficits and 37.78 % (n=17) had a history of head trauma. On the other hand, only 86.67 % (n=39) had a previous associated comorbidity (such as hypertension or diabetes).

Clinical Features

Out of 45 patients, 37 patients had complaints of headache (82%) and 28 patients (62%) had motor deficit in the form of hemi or paraparesis on the opposite side of hematoma. Cognitive impairment was seen in only 26% of patients (12) and 20 patients had complaints of gait disturbance (44%) and one patient had seizure (2.22%).

Radiological Findings

Unilateral hematoma was present in 36 patients (80%) out of which the right side was in 25 (66%) and the left side was 11 (30.55%). 9 patients (20%) were present with Bilateral hematoma. CT Scan show mixed density in 31 patients (69%) and hypodense hematoma in 14 patients (31%)

Surgical Details

All patients underwent double burr hole craniostomy with drainage of hematoma with irrigation or negative drain tube. Duration of hospital stay was approx. 5 days (range: 3–10 days) in all patients except one patient due to post op complication. At the discharge, 44 patients were relieved of their symptoms. However, in all these cases on CT scan, a minute amount of fluid remained in the subdural space. Nevertheless, a reduction in the size of the effusion was observed accompanied by restoration of normal anatomy on the radiological study.



Figure 02: Patient treated with Double burr hole for cSDH : A ; Pre- Op CT Brain , B; Post Op CT brain showing Residual Haemorrhage

Outcome and Follow-Up

Most patients experience significant improvement post-surgery, particularly when treated early. After the surgical procedure, no recurrence was observed within 03 months post surgery. No major complications such as meningitis, CSF leak, or tension pneumocephalus were observed. Two patients (4.44%) developed intraparenchymal haemorrhage. Out of which one patient was successfully managed by means of medical management and one patient expired due to pneumonia.

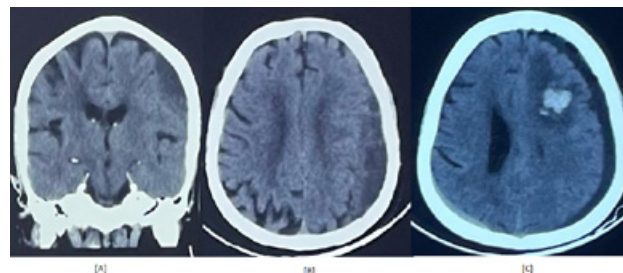


Figure 03: Patient treated with Double burr hole for cSDH : A,B ; Pre- Op CT Brain , C; Post Op CT brain showing intraparenchymal haemorrhage

DISCUSSION

In chronic SDH, subdural space has dark brown to a black colored fluid which produces a mass effect on the brain which results in different types of neurological deficits. Chronic subdural hematoma sometimes develops due to coagulopathies but in most cases, it develops in old age people due to mild head injury. It has been documented earlier as well that chronic SDH happens most commonly in the 50s and 60s with a mean 56 – 63 years of age. [49-51] Most of our patients had cognitive deficit, motor deficit and/or history of trauma. These results are similar to other studies that sought to identify the epidemiological profile of cSDH patients treated surgically. A high prevalence of trauma history and diseases related to the nervous system, motor deficit and headache were observed in the literature.[52,53] Untreated chronic SDH may prove fatal but with proper evacuation, 80 to 90% of patients recover to normal. CT scan (brain) is the best investigation for chronic SDH that can disclose the size/site/density of the clot, along with its formation and severity. Sometimes an MRI brain is helpful in cases where hematoma is isodense. In our series at smt. NHL Medical College, we found the CT scan (brain) the most useful diagnostic modality. Evacuation using burr holes has been the most employed treatment of chronic SDH for more than 50 years. [54-58] A single burr hole is usually sufficient, although two are sometimes useful. In our institute we prefer double burr hole craniotomy for all patients. The residual hematoma is quite common regardless of the operative technique used.

To contextualize our findings, we compared our case series of 45 patients treated with burr hole evacuation for chronic subdural hematoma (cSDH) to established studies

and meta-analyses in the literature. The key variables—demographics, clinical presentation, recurrence rates, and outcomes.

Demographics

Our cohort had a slightly older mean age and higher proportion of males, which aligns with trends seen in other studies. Anticoagulant use was relatively high in our group, possi-

bly reflecting the increasing prevalence of elderly patients on such medications. And most of the population were elderly, who might not remember history of trauma, that's why there may be a reason in our study history of trauma variable was low comparative to other studies.

Variable	Our Study (n=45)	Weigel et al. [59] (n=1044)	Fujishima et al. [60] (n=186)	Chen et al. [61] (n=327)
Mean age	68 years	69 years	70 years	73 years
Male:Female ratio	80% male	74% male	72% male	78% male
History of trauma	37.78%	60–70%	68%	70%
Anticoagulant/antiplatelet use	55.55%	40%	38%	42%

Table 1: comparison of our study and other meta analyses in view of demographic data

Clinical Presentation

The symptom profile in our cohort was broadly consistent with published literature except, cognitive impairment and hemiparesis. Cognitive impairment was low and incidence of motor deficit was high compared to other studies.

Symptom	Our Study (%) (n=45)	Weigel et al. [59] (%)	Tsutsumi et al. [62] (%)	Joaquim et al. [63] (%)
Headache	82%	65%	60%	68%
Cognitive impairment	26%	55%	50%	58%
Gait disturbance	44%	40%	42%	45%
Hemiparesis	62%	30%	28%	32%

Table 2: comparison of our study and other meta analyses in view of clinical presentation

Radiological Features

similar pathophysiological mechanisms across populations.

Distribution of unilateral vs bilateral hematomas and CT characteristics were comparable to major studies, suggesting

Feature	Our Study (%) (n=45)	Weigel et al. [59] (%)	Fujishima et al. [60] (%)	Tsutsumi et al. [62] (%)
Unilateral cSDH	80%	75%	72%	82%
Bilateral cSDH	20%	25%	28%	18%
Mixed density on CT	69%	60%	65%	70%
Hypodense hematoma	31%	40%	35%	30%

Table 3: comparison of our study and other meta analyses in view of Radiological feature

Our study showed a low complication rate, favorable functional outcomes, and a zero recurrence rate within expected ranges, indicating effective surgical management and postoperative care. The absence of complications like CSF leak or

meningitis suggests adherence to best practices during surgery. Unfortunately, only one mortality occurred due to pneumonia and two patients developed intraparenchymal haemorrhage.

Parameter	Our Study (n=45)	Santarius et al. [64]	Fujishima et al. [60]	Tsutsumi et al. [62]
Surgical technique	Burr hole	Burr hole	Burr hole	Burr hole

Recurrence rate	~0%	~10%	~15%	~12%
Hospital stay	5 days (mean)	5–7 days	6 days	5–7 days
Complication rate	4.44%	5–10%	~8%	~6%
Good outcome (GOS 4–5)	96%	~85–90%	~88%	~85%

Table 4: comparison of our study and other meta analyses in view of Surgical Outcome

Mortality after surgical treatment varies in the literature. Some revisions show a high variation, ranging between 0 and 32 %,[65] while in others this variation is lower, ranging between 0 and 17 %.[66,67] The mortality rate in our center sits

on the lower end of the spectrum (4 %). Recurrence rates also vary, ranging from 3 to 33 %, with some studies finding even higher rates.[66] Our rate of recurrence was 0 %, which once again sits in the lower end of the spectrum.

Parameter	Our Study	Huang et al. (2022) [69]	Kolias et al. (2014) [70]	Thavara et al. (2019) [71]	Nouri et al. (2021) [72]
Study Type	Prospective single-center case series (n=45)	Systematic review & meta-analysis (13 studies, n=3,559)	Narrative review	Retrospective comparative study (BHC n=63, TDC n=46)	Narrative review
Surgical Techniques Compared	Two-burr-hole BHC only	BHC vs. MC	BHC, TDC, Craniotomy	Single BHC vs. TDC	BHC (gold standard), TDC, Craniotomy, MMA embolization
Recurrence Rate	0% (within 6 weeks)	BHC: 12% MC: 16% OR 0.56, p=0.02	BHC: 10–20% TDC: up to 33% Craniotomy: ~11%	BHC: 1.58% TDC: 13.04% p<0.05	9–33% overall Lower with drains & MMA embolization (~3.6%)
Reoperation Rate	0%	BHC: 9% MC: 12% OR 0.45, p=0.008	Not explicitly quantified	BHC: 6.35% TDC: 17.39% NS (p>0.05)	Not quantified
Operative Time	Not reported	BHC: ~20 min shorter MD –20.15 min, p<0.00001	TDC fastest → BHC → Craniotomy slowest	BHC: 79.2 min TDC: 27.5 min p<0.001	TDC < BHC < Craniotomy
Complication Rate	4.44% (2 IPH)	BHC: 12% MC: 21% NS (p=0.28)	Craniotomy: 12.3% BHC: 3.8% TDC: 3.0%	BHC: 9.52% TDC: 15.21% NS	BHC: low morbidity Drains reduce recurrence

Parameter	Our Study	Huang et al. (2022) [69]	Kolias et al. (2014) [70]	Thavara et al. (2019) [71]	Nouri et al. (2021) [72]
Mortality	2.2% (1 death from pneumonia)	BHC: 9.9% MC: 6.6% NS (p=0.16)	0–32% (highly variable)	BHC: 4.76% TDC: 10.87% NS	0–32%
Hospital Stay (days)	Mean 5 days	NS (MD 1.59, p=0.14)	Not specified	BHC: 8.9 TDC: 7.0 NS	Not specified
Follow up period	03 months	1 month to 12 months	6-month follow-up	limited to the in-hospital period only	short-term (6–8 weeks) and medium-term (2–6 months)
Outcome	96% (GOS 4–5)	BHC: 84% MC: 77% NS (p=0.10)	>80% favorable with surgery	Not explicitly stated (90.5% vs. 84.8% clinical improvement)	~66% improve by ≥ 1 mRS grade

Table 5: comparison of our study and other study on Small craniostomy

Huang et al. has Strong evidence favoring BHC over MC with lower recurrence, reoperation, and shorter surgery. There is no difference in mortality or functional outcomes. Kolias et al. suggest BHC as global standard and TDC is faster but with higher recurrence and craniotomy has more morbidity. It Emphasizes role of drains in reducing recurrence. Thavara et

al. shows TDC is significantly faster and avoids GA, but with higher residual hematoma requiring reoperation. Nouri et al. highlights emerging therapies (e.g., MMA embolization), reaffirms BHC + drainage as gold standard.

Parameter	Our Study	Gonçalves et al. (2025) [73]	Zhang et al. (2024) [74]	Gillespie et al. (2025) [75]
Study Type	Prospective single-center case series	Meta-analysis of 6 RCTs	Systematic review & meta-analysis (12 studies + institutional data)	Meta-analysis of 3 RCTs (MAGIC-MT, EMBOLIZE, STEM)
Population (n)	45 (All underwent two-burr-hole craniostomy)	1,422 (700 MMAE + 722 surgery)	57,16 (1,065 adjunct MMAE; 56,100 surgery alone)	1,432 (Surgical cohort: 1,114; Nonsurgical: 257)
Intervention vs Control	No MMAE group – surgery-only cohort	Adjunct MMAE vs surgery alone	Adjunct MMAE vs surgery alone	MMAE + surgery vs surgery alone AND MMAE vs observation

Parameter	Our Study	Gonçalves et al. (2025) [73]	Zhang et al. (2024) [74]	Gillespie et al. (2025) [75]
Recurrence / Treatment Failure	0% recurrence at 6 weeks	↓ RR 0.482 (95% CI 0.328–0.708; p<0.001)	↓ OR 0.43 (95% CI 0.23–0.83; p=0.01)	Overall: NS RR 0.50 (p=0.058) Surgical subgroup: NS RR 0.60 (p=0.194) Nonsurgical: ↓ RR 0.36 (p<0.001)
Reoperation Rate	0%	↓ RR 0.333 (95% CI 0.212–0.521; p<0.001)	↓ OR 0.45 (95% CI 0.22–0.90; p=0.02)	Surgical subgroup (90-day): ↓ RR 0.43 (p=0.012)
Mortality	2.2% (1 death from pneumonia)	NS RR 0.970 (p=0.946)	NS OR 1.05 (p=0.78)	Not separately reported
Functional Outcome (mRS)	96% good outcome (GOS 4–5)	NS RR 1.000 for mRS >2 (p=0.705)	NS mRS >2: OR 0.91 (p=0.83)	NS mRS 0–2: RR 1.01 (p=0.790) mRS 0–3: RR 1.01 (p=0.443)
Complications	4.44% (2 intraparenchymal hemorrhages)	NS surgical complications Very low embolization-related (RR 0.013)	NS OR 0.89 (p=0.67)	Not formally analyzed (noted as favorable in trials)
Length of Stay	Mean 5 days	NS MD +0.576 days (p=0.088)	NS MD +2.49 days (p=0.10)	Not reported
Follow up period	03 months	between 3 and 6 months (i.e., 90 to 180 days)	Not reported	90 to 180 days

Table 6: comparison of our study and other study on MMA embolisation

Gonçalves et al. is Strongest evidence from RCTs which confirms MMAE significantly reduces recurrence and reoperation, with no increase in mortality or functional decline and Very low embolization-specific complications support safety. Zhang et al. Including real-world data shows consistent benefit of adjunct MMAE in reducing recurrence/reoperation. There is no difference in mortality, complications, or functional outcomes. Gillespie et al. is the most nuanced analysis which separates surgical vs nonsurgical cohorts and shows MMAE benefit is significant only in nonsurgical pa-

tients whereas In surgical patients, recurrence reduction is not statistically significant, though 90-day reoperation was lower. Given the small size of most studies on this topic, with a level of evidence lower than II in reported series, the best information derives from a systematic review indicating a recurrence rate after MMA-embolization of only 0–4.80% with no notable complications. Several embolization materials were used (polyvinyl alcohol, N-butyl-2-cyanoacrylate, Onyx, coils and gelatin), with no differences in outcome. It is still unclear which population would benefit most and would be ideal can-

didates for MMA-embolization. Accordingly, proposals for randomized controlled trials (RCTs) should probably target a minimally symptomatic cohort with mass effect but without major deficits or radiographic progression of disease, as those patients could potentially tolerate the delay between a potential need for surgical treatment and the expected progressive reduction of the hematoma.

CONCLUSION

Our patient demographics and clinical features are consistent with global trends, confirming cSDH as a condition predominantly affecting elderly males with minor trauma history. Surgical outcomes in our cohort were favorable and aligned with or better than those reported in large series. Recurrence rate was low (0%), comparable to international standards, highlighting the importance of early diagnosis and proper surgical technique. The use of double burr hole craniostomy and drainage of hematoma and standardized post-op monitoring likely contributed to the low complication rate.

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CONFLICTS OF INTEREST

The authors have no conflict of interest in any capacity.

INFORMED CONSENT

This type of study does not require informed consent.

STUDY LIMITATIONS:

This study has several limitations. First, it includes data from a single tertiary care institution. Second include the non-randomized patient groups. The other limitation relates to known or unknown bias such as different surgical indications and surgical techniques and/or lateralization of the patients in this area.

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