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**Original Research Article**

# Mini craniotomy for chronic subdural haematoma: surgical outcome from a single institution experience and predictors of success

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## ABSTRACT

**Background:** Chronic subdural hematoma (CSDH) is an increasingly common neurological disease in daily neurosurgical practice. Despite the wide prevalence of CSDH, there remains a lack of consensus regarding numerous aspects of its surgical management. The diagnosis and treatment are well established but there are different surgical procedures and outcome related to these procedures are not completely understood.
**Methods:** The study conducted was conducted in department of neurosurgery at Ibrahim cardiac hospital and research institute, Dhaka, Bangladesh between January 2019 to July 2020, 105 patients were treated for chronic subdural haematoma This study evaluated the clinical features, radiological findings and surgical outcome by mini craniotomy assessed by modified Rankin scale (mRS) score and Glasgow outcome scale (GOS) score in a large series of patients treated at single institution.
**Results:** At 6 months follow up, only one patient died (0.95%) because of co-morbidities and not directly related to the chronic subdural haematoma, 15 patients (14.3%) improved to mRS 0, 33.33% showed only mild symptoms without any significant disability-mRS 1, slight disability was observed in 28.5% patients, moderate disability was observed in 17.14% patients-mRS 3, moderately severe disability was observed in 5.7%-mRS 4.
**Conclusions:** GOS score at 6 months follow up which shows majority of the patient improved to GOS score 4 (45.71%) and 5 (38.09%). Based on these results, among various method of surgical management, mini craniotomy provides better outcome.

**Keywords:** CSDH, Surgical outcome by mini craniotomy, Outcome

## INTRODUCTION

Chronic subdural haematoma (CSDH) is one of the commonest neurosurgical conditions usually affects the elder; prevalence is 58 per 100000 per year. Surgical treatment usually results in speedy improvement of neurological symptoms and post-operative prognosis is better. Recurrence of CSDH may be encountered 5-30% post operatively.[1]

Most CSDH can be diagnosed with computed tomography (CT)/magnetic resonance (MRI) scan. CT scan is currently the investigation of choice in CSDH. Based on CT scan findings, type of CSDH might be-1. Homogenous- iso dense, hyper dense, hypo dense; 2. Laminar; 3. Separated and 4. Trabecular.[1] Although small haematoma may resolve spontaneously, treatment of CSDH is by surgical evacuation.[13] Some studies have shown that concurrent use of high dose steroids

accelerates the resolution of subdural collection while use of statins may accelerate resolution of CSDH.

Surgical options of CSDH are-(1) Burr hole (with or without drainage); (2) Twist drill craniotomy, (3) Craniotomy.[1] In post-operative period, CSDH may resolve within 30 days considered as-Early resolution, may resolve within 1-3 months considered as delayed resolution or late resolution which occurs after 3 months or more. If no resolution, recurrence of CSDH may develops which may be recurrent without resolution, early recurrence after resolution within 3 months after surgery, late recurrence after resolution after 3 months or more and recurrent and spontaneously resolve.

Co-morbid condition like hypertension, diabetes mellitus, respiratory disease, anti-coagulant therapy and anti-platelet therapy are the important risk factor for developing CSDH and recurrence.[2]

### *Epidemiology*

Estimates of the incidence of CSDH range from 8.2 to 14.0 per 100,000 person-years. According to the United Nations, the population above the age of 65 years is likely to double between 2010 and 2050, and the burden of CSDH is expected to follow suit. CSDH predominantly affects males, with an approximately 3:1 male to female ratio across all age groups.[3]

### *Pathogenesis*

CSDH arises at the dural border cell layer which is a thin layer of cells between the dura mater and arachnoid mater with comparatively little extracellular collagen, and intercellular connections that are disposed to separation. A predisposing factor of a shrinking volume within the cranial vault, as seen in elderly individuals or those abusing alcohol, and a precipitant trauma that can often be minor may lead to development of CSDH. [11]

There are two possible aetiologias for CSDH: First one is an acute subdural haematoma (ASDH). These may occur due to tearing of the bridging veins that traverse the dural border cell layer or, less commonly, tearing of cortical arteries or veins. An ASDH that is not acutely evacuated will usually be resorbed or otherwise this process is incomplete and the haematoma becomes chronic as the acute clot lyses. The second aetiologic is a subdural hygroma, a collection of cerebrospinal fluid (CSF) in the subdural space caused by splitting of the dural border cell layer at points of tension between the dura mater and arachnoid mater. In the subdural space, neovascularization occurs; haemorrhage from these new vessels leads to the formation of a CSDH. Regardless of the primary insult, the opening of the dural border cell layer triggers a complex reparatory response that aims to heal the injured tissues. The main features of this response are proliferation of the dural border cells, formation of granulation tissue with collagen fibers, and macrophage deposition. This process is often successfully completed, resulting in resolution of the hematoma or hygroma. On the other hand, haematoma enlargement is thought to be attributable to a localized inflammatory reaction which results in hyperfibrinolysis of the clot and production of angiogenic factors that promote neovascularization and bleeding from fragile capillaries. Formation of neo membranes is one of the main features of CSDH-the inner (visceral) membrane is less vascular and usually thinner than the outer (parietal) membrane.

Risk factors like advancing age, a history of falls, minor head injury, use of anticoagulants or antiplatelet drugs, bleeding diatheses, alcohol (contributing to globalized brain atrophy, increased risk of falls, and hepatogenic coagulopathy), epilepsy, low intracranial pressure states, and hemodialysis contribute to the occurrence of CSDH. Use of anticoagulant and antiplatelet medication is the most important risk factor for increasing incidence of CSDH. The widespread use of these agents has made quantification of risk difficult, but they have been shown to increase the incidence of both ‘atraumatic’ CSDH (whereby the trauma is so minor that it is not recollected) and recurrent CSDH.[8]

## METHODS

The study was conducted during the period from January 2019 to July 2020, 105 patients were treated for chronic subdural haematoma in department of neurosurgery at Ibrahim cardiac hospital and research institute, Dhaka, Bangladesh were treated as study participants. The study was approved by the respective department. All patients were analyzed prospectively concerning preoperative clinical appearance and preoperatively computed tomography. Both postoperative clinical outcome and postoperative computed tomography were evaluated. The clinical symptoms presented in this study were headache, altered level of consciousness, paresis, aphasia, disorientation and occurrence of seizures. Age and sex distribution as well as the side of the hematoma were also investigated. All patients were treated surgically by Mini craniotomy (4.5×3.5 cm) and post-operative outcome was assessed mRS score, GOS score. Additionally, the patient’s clinical outcome was regarded whether they were discharged home, to a rehabilitation clinic, another specialist department or to a nursing home. All data were analyzed using SPSS software.

### *Surgical technique for the treatment of CSDH*

In 105 patients, the approach was done by mini osteoplastic craniotomy approximately 4.5×3.5 cm in the most dependent part over fronto parietal convexity. After dural incision, the outer membrane of the chronic hematoma was coagulated and opened. Hematoma evacuated placing a cotton and gentle suction with increased infusion of normal saline at the same time to prevent rapid decompression. After evacuation of the fluid hematoma a careful irrigation with Ringer’s solution

followed in every operation-until the irrigation solution remained clear. In every case, the internal membrane of the hematoma was also opened. In 42 patients, a subdural drainage with a low vacuum suction reservoir was placed; no drainage was placed in 63 cases. Within the first 2 days after surgery, the drainage was removed, and the skin was closed with an additional single suture.

## RESULTS

A total 105 surgical procedures were performed in patients suffering from CSDH during the above-mentioned period. Patient age comprised 35-105 years. The mean age was 67.5 years. Seventy patients (66%) were male and thirty-five patients were female (34%). The CSDH was left hemispheric in 53 cases (48%), right hemispheric in 34 cases (35%) and bilateral in 18 (17%) cases. A therapy with anticoagulants or antiplatelet agents was present in 60% (n 28), coagulopathy in 3% (2) and an alcohol abuse in 2% (1).

**Table 1: Age and gender distribution of the study patients, (n=105).**

| Variables | N | Percentage (%) |
|---|---|---|
| **Age (years)** | | |
| 35-60 | 20 | 16.5 |
| 60-85 | 77 | 64.5 |
| 85-105 | 24 | 19.0 |
| **Mean±SD** | 67.5±12.64 | |
| **Range (min-max)** | 35-105 | |
| **Gender** | | |
| Male | 70 | 66 |
| Female | 35 | 34 |
| Male to female ratio | 2:1 | |

### *Clinical signs and CT*

Hemiparesis was the most common presenting feature in 63 (60%) cases followed by decreased consciousness in 27 (25%) cases and headache with aphasia in 15 (15%) cases. In every patient (n=105), computed tomography of head shows a space occupying unilateral or bilateral CSDH. Radiological findings almost always correlate with the clinical findings. After confirmation of diagnosis, a decision regarding surgical management was taken. After surgery symptom improved in 89 cases (93%), static/no changed in 16 (7%) cases. A satisfactory post-operative computed tomography result was found 89 cases (93%) where as in 16 (7%) cases space occupying residual hematoma with irrigation fluid was found. There was no recurrence of CSDH during this period.

### *History of head trauma*

Sixty-eight patients or their relatives (65%) claimed history of a head trauma. The shortest interval between the injury and the appearance of clinical signs due to the CSDH was 15 days, the longest interval was 180 days, and the mean interval scored 55.3 days.

### *Surgical technique*

One-hundred-five patients were treated with an osteoplastic craniotomy and a subdural drainage with a low suction vacuum reservoir was given in 42 patients (44%). No drainage was used in 63 patients (56%). In all procedures, careful irrigation with Ringer's solution was done until the solution remained clear. Brain expansion tendency did not observe immediately after evacuation of hematoma in most of the cases (78% in 81 patients), but immediate brain expansion was noticed in rest of the cases (22% in 24 patients). Bone flap was repositioned in all cases and fixed with mini plate and screw or non-absorbable suture. All patients were rehabilitated in our own facility and recovered completely.

### *Recovering of the patient*

Patients' recovery was assessed using mRS score and GOS score during discharge at 3 months and at 6 month follow up. Only one patient died (0.95%) because of co-morbidities and not directly related to the CSDH. The 15 patients (14.3%) showed no symptoms at all at 6 months follow up signifies mRS O, thirty-five patients (33.33%) showed only mild symptoms without any significant disability-mRS 1, slight disability was observed in thirty patients (28.5%), moderate disability was observed in eighteen patients (17.14%)-mRS 3, moderately severe disability was observed in six patients (5.7%)-mRS 4.

GOS score was assessed and at 6 months follow up, GOS score 1 was 0.95%, 3 was observed in 6.3%, 4 was found in 45.71% and 5 was assessed in 38.09% patients.

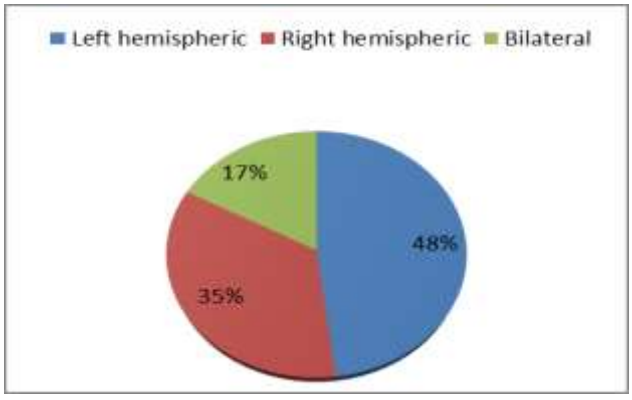


**Figure 1: Site of haematoma on CT scan.**

**Table 2: Presenting complaints of the study patients, (n=105).**

| Complaints | N | Percentage (%) |
|---|---|---|
| **Hemi paresis** | 63 | 60 |
| **Altered consciousness** | 27 | 25 |
| **Headache with aphasia** | 15 | 15 |

**Table 3: Distribution of the study patients by co-morbidity, (n=105).**

| Co-morbidity | N | Percentage (%) |
|---|---|---|
| **HTN** | 48 | 45.71 |
| **DM** | 37 | 35.23 |
| **Cardiac disease** | 16 | 15.23 |
| **Respiratory disease** | 4 | 3.81 |

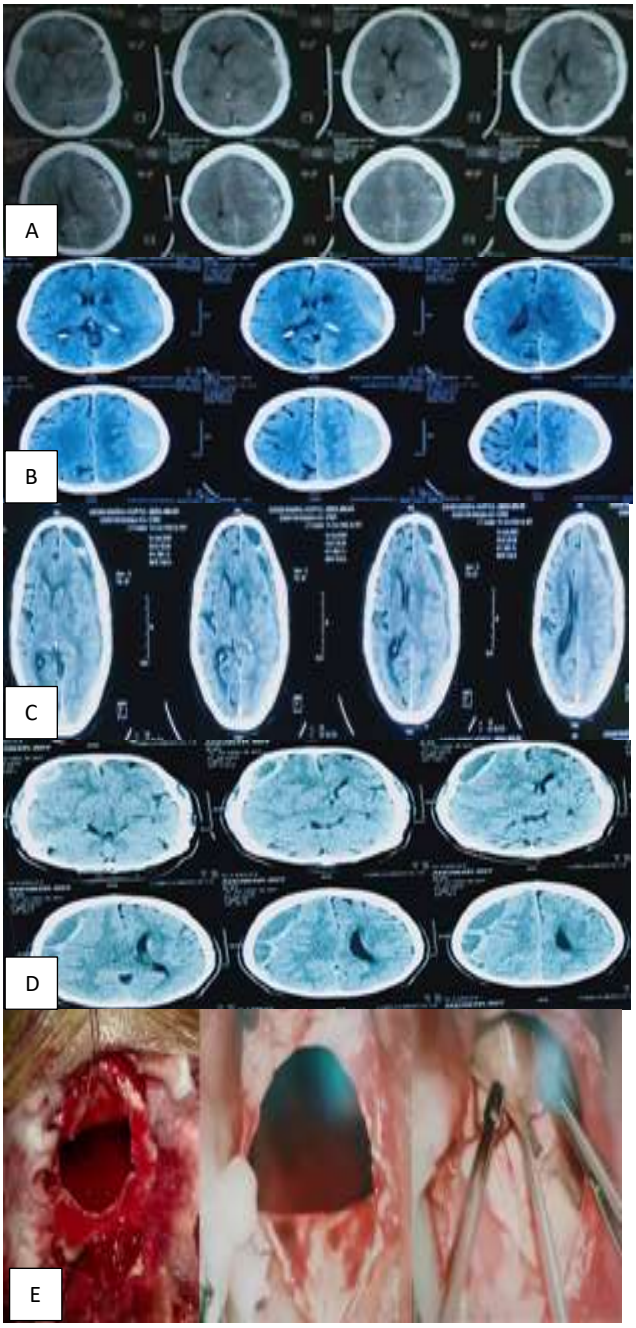


**Figure 2 (A, B, C, D and E): CT scan findings of CSDH. Separated variety of CSDH, homogenous variety of CSDH, mixed type (Trabecular and 2 or more type of CT density), trabecular type: haematoma was separated by several high-density septa and per op view after mini craniotomy of CSDH with excision of pseudo membrane using microscope.**

**Table 4: Change in mRS score from discharge to after 6 months of the patients with CSDH, (n=105).**

| mRS score | At 6 months, (%) |
|---|---|
| **0 (No symptoms)** | 15 (14.3) |
| **1 (No significant disability)** | 35 (33.33) |
| **2 (Slight disability)** | 30 (28.5) |
| **3 (Moderate disability)** | 18 (17.14) |
| **4 (Moderately severe disability)** | 6 (5.7) |
| **5 (Severe disability)** | 0 (0) |
| **6 (Dead)** | 1 (0.95) |

**Table 5: Change in GOS score from discharge to after 6 months of the patients with CSDH, (n=105).**

| GOS score | At 6 months, (%) |
|---|---|
| **1 (Death)** | 1 (0.95) |
| **2 (Persistent vegetative state)** | 0 (0) |
| **3 (Severe disability)** | 6 (6.3) |
| **4 (Moderate disability)** | 48 (45.71) |
| **5 (Mild or no disability)** | 40 (38.09) |

## DISCUSSION

CSDH incidence is increasing day by day in developing countries. It is one of the most rewarding surgical procedure and outcome usually satisfactory. Different options of surgical procedure are available for neurosurgical practice. This hospital based longitudinal study was based on finding the outcome of CSDH patient managed surgically by mini craniotomy.

In the present study, one hundred and five patients were surgically managed by mini craniotomy and evacuation of CSDH. The mean age of the patient suffering from CSDH scored 67.5 years. There was a male predominance of almost 66%. Sixty percent were on anticoagulants or antiplatelet agents. Three percent patient had coagulopathy. Sixty-eight (65%) patients had a history of head trauma. Every patient was successfully treated and discharged home without newly onset neurological deficit. There are different options of surgical management and in this series only mini craniotomy were done, therefore, some peculiar findings have to be discussed.

In this current study it was observed that mean age was found 67.5 years with ranged from 35-105 years. The average age of CSDH manifestation lies between 56 and 63 years (Sambasivan, 1997), but patients older than 70 years are affected most often (Ko et al and Yamamoto et al) which is comparable with the current study.

In this present study, there is male predominance (66% in CSDH. Male suffers cardiac problem and trauma more than female which may be one of the factors responsible for CSDH. Similarly.[10] also found male predominant, where they found male 73.3% and 66.8% respectively,

which is consistent with the current study. Similar observations were also observed.[6,7] Thus, the CSDH can be considered to be a disease of the seventh decade of life predominating in male patients which is also observed.[14]

Hemiparesis was the most common presenting feature observed in our series (65%) followed by decreased consciousness 25% and Headache with aphasia in 15% patients. But in current study we did not find any convulsion although prophylactically anti-convulsant was used in every patient. Chen et al compared preoperative computed tomographic appearance of CSDH with the need of postoperative seizure prophylaxis. They concluded that the postoperative seizure rate appeared high in the group with mixed density type lesions on computed tomography and in those with left unilateral CSDH. But in our prospective study, we have not found any correlation between seizure incidence and computed tomography findings. These findings may be evaluated in further studies.

Various surgical strategies have been considered by different neurosurgical center for surgical management of CSDH. Usually, craniotomy has been advocated for complicated and recurrent CSDH. Type of CSDH is strong predictor of recurrence. Separated type of CSDH is associated with recurrence which is consistent with study done.[5] In our study, we did not want to take chance of recurrence in our patient, so we choose mini craniotomy. Our observations are: 1. There is no recurrence of CSDH by craniotomy in one year follow up of 105 cases managed surgically in our center. 2. post-operative agitation, restlessness is less. 3. There is less chance of wound infection. Most of the reported case of wound infection in CSDH is due to CSF leak from burr hole which lead to infection. But mini craniotomy leads to replacement of bone flap with water tight dural closure, so there is no chance of wound infection. 3. Patient can be discharge on 2$^{nd}$ post-operative day.[9] regarded the postoperative hospitalization in 40 patients, 20 of them were treated by burr hole irrigation and the other 20 patients were treated by burr hole drainage. They found a postoperative hospitalization of 14.1 days in the drainage group and 25.5 days in the irrigation group. But in our study, most of the patient discharged on 2$^{nd}$ post-operative day (72%), drainage group discharged on 5$^{th}$ post-operative day (26%). Rest of the patient (2%) had to stay longer due to co-morbid medical condition. 4. Burr hole and drainage can lead to syndrome of trephined. Moreover, there is visible pulsation over scalp which causes psychological trauma to patient and their relatives. But mini craniotomy has no chance of developing psychological trauma or development of syndrome of trephined. 5. Pseudo membrane can be excised precisely using microscope by mini craniotomy method but with burr hole and twist drill craniotomy, excision of pseudo membrane cannot be possible. 6. Coagulation of active bleeding point from emissary vein is possible with mini craniotomy. We found 5 patients with active bleeding point from emissary vein and coagulate thus prevent recurrence of CSDH which cannot be done by burr hole method.

Patients' recovery was assessed using mRS score and GOS score. At 6 months follow up only one patient died (0.95%) because of co-morbidities and not directly related to the CSDH. The 15 patients (14.3%) improved to mRS O, thirty-five patients (33.33%) showed only mild symptoms without any significant disability- mRS 1, slight disability was observed in thirty patients (28.5%), moderate disability was observed in eighteen patients (17.14%)-mRS 3, moderately severe disability was observed in six patients (5.7%)-mRS 4.

GOS score was assessed and at 6 months follow up which shows majority of the patient improved to GOS score 4 (45.71%) and 5 (38.09%).

Perhaps the most important complication of CSDH is recurrence necessitating reoperation, which has been shown to markedly affect postoperative functional outcomes and quality of life. Recurrence rates in the literature vary widely from 0-76% observed but the contemporary consensus is that the reoperation rate is 10-20%.[4,12] showed that postoperative volume more than 80 ml was associated with more prone of recurrence. In our observation, mini craniotomy leads to complete evacuation of CSDH, coagulation of active bleeding point followed by irrigation with normal saline to fill the cavity and water tight dural closure and replacement of bone flap prevent re accumulation of further bleeding and thus prevent recurrence.

There are three common techniques for surgical management of CSDH. Outcomes between twist drill craniotomy, burr hole craniotomy and craniotomy have been compared by various systemic reviews and meta-analyses found no difference in the cure rates a mortality among the three techniques, but reported a significantly higher rate of recurrence with TDC (33.0%) compared to BHC (12.1%, $p<0.001$) or craniotomy (10.8%, $p<0.001$). Moreover, morbidity was higher after craniotomy (12.3%) compared to TDC (3.0%, $p<0.001$) or BHC (3.8%, $p<0.001$). However, found that BHC resulted in a higher rate of complications (9.3%) compared to TDC (2.5%, $p<0.001$) and craniotomy (3.9%, $p<0.005$), but demonstrated that BHC resulted in fewer recurrences (11.7%) than TDC (28.1%, $p<0.001$) and craniotomy (19.4%, $p=0.002$).[4] Therefore, TDC as the first-line intervention, and craniotomy for patients with significant membrane formation. In our study we have seen membrane formation in most of cases, so our technique of mini craniotomy is supported by other literatures.

***Limitations***

This was a single center study with shorter follow up period and small sample size**.** There was no comparison group or other surgical procedure. Factors influencing outcome like initial admission GCS, haematoma volume,

brain expansion in post-operative period, post-operative GCS, multiple co morbid condition were not considered during statistical analysis.

## CONCLUSION

The present study reports the clinical presentation, surgical technique by mini craniotomy and outcome of CSDH treated in a single institution for a period of one year with one year follow up. A history of head trauma has been observed in 65% cases with mean interval 55.3 days between the injury and the appearance of clinical signs. Most of the patient's age belonged to 45-75 years and male predominant. Hemiparesis, altered consciousness, headache and language were more common complaints. Hypertension, Diabetes mellitus and cardiac disease were more frequent co-morbidity and unilateral was more common. Mini craniotomy provides excellent outcome observed in mRS score and GOS score at 6 month follow up of these patients with no recurrence of CSDH during this period.

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