Burr-Hole Craniostomy Versus Open Craniotomy for Treatment of Combined Chronic and Subacute Subdural Haemorrhage in Patients Above 90 Years Old

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Abstract

Objective: To compare the results of either craniotomy or burr hole surgery in highly old patients with subdural haemorrhage.

Methods: 48 patients with chronic subdural haemorrhage (34 patients showed combined subacute blood in CT scan) were collected and followed preoperatively, immediate post-operative and 6 months after surgery. Patients were classified into two groups; (Group I): 26 patients were operated by two Purr-hole craniostomies about 2cm width for each with subdural drain for subsequent few days. (Group II): 22 patients were operated by open craniotomy with subdural drain. They were assessed clinically (GCS, motor, sensory or speech deficits) and radiologically by CT scan preoperatively and in postoperative follow-up periods.

Results: Statistically non-significant better clinical outcome for group I compared to Group II regarding GCS, improvement of neurological deficits, hospital stay (p<0.001) and postoperative morbidity. In spite of that, follow-up CT scan showed higher incidence of postoperative radiological complications in group I which were clinically insignificant.

Conclusion: In spite of the high incidence of combined acute and subacute incidence of subdural haemorrhage, burr hole craniostomy still offers better outcome for those patients with higher safe margin.

Key Words: Subdural haemorrhage — Combined chronic SDH—Patients above 90 years old.

Introduction

CHRONIC subdural haemorrhage is a common disorder in neurosurgical practice, it usually affect persons about 63 years old, its incidence is about 5 per 100000 per year in the general population, but it is higher in age more than 70 (58 per 100000 per year) [1-4]. Head trauma, and other risk factors like alcohol abuse, seizures, CSF shunts, coagulopathies and patients at risk for falls (e.g. hemiplegic) are strongly contributed to the aetiology of subdural haemorrhage [5,6].

Treatment of subdural haemorrhage could be conservative if there is insignificant amount of blood that is not compromising the cerebral cortex with no clinically significant manifestations. In spite of this, management of subdural however is usually surgical and frequently done by one of three procedures; twist drill craniostomy (opening less than 0.5cm), Burr hole craniostomy (0.5-3cm), and craniotomy [4]. Of the three procedures, burr-hole craniostomy is the most commonly used technique for evacuation of subdural haemorrhage. This is because of the high rate of recurrence in twist drill procedure and higher morbidity and mortality of the craniotomy technique [5-8].

Subdural haemorrhage in old patients above 90 years old has special characters. Failure of brain recoil and high incidence of continuous acute bleeding combined with the chronic blood due to usual use of oral anticoagulants and the fragility of the brain combined with significant brain atrophy of that advanced age.

Burr-hole evacuation in those patients could be insufficient because of higher rate of recurrence due to previously mentioned criteria in this special age, and the usual presentation by sub-acute form. Craniothomy seems to have more morbidity and mortality for those fragile patients. Our aim is to compare the two procedures in those old people and analyse the benefits, hazards, complications, clinical and radiological outcomes of both techniques.

Abbreviations:
SDH : Subdural Haemorrhage.
GCS : Glasgow Coma Scale.
CT : Computerized Tomography.
MM : Magnetic Resonance Imaging.
UTI : Urinary Tract Infection.
DVT : Deep Venous Thrombosis.
TDC : Twist drill craniostomy.
BHC : Burr Hole craniostomy.
Material and Methods

A prospective randomized study between Mars 2009 and January 2013 including consecutive series of 48 patients aged 90 years or older (average 91 to 129 years old with mean of 99.6) who were presented to the department of neurosurgery with clinical and radiological manifestations of chronic with subacute subdural haemorrhage who were eligible for surgical evacuation (34 patients had combined subdural elements with only 14 patients had only chronic blood in CT scan). We were working in a region (part of Sinai Peninsula and part of southern Saudi-arabia) where percentage of people aged above 90 years old is higher than other regions else. That is why incidence of subdural haemorrhage is higher in this region, also, the concepts, aetiology, risk factors and consequently the method of management is different than well known chronic subdural haemorrhage.

Decision of surgical intervention was taken by the author shared with the committee of neurosurgical department; surgery was decided in any patient with radiologically significant chronic or sub-acute subdural haemorrhage with any clinical manifestations like drowsiness, disturbed conscious level, hemi-paresis, dysphasia, or other neurological deficits. Patients with radiologically insignificant haemorrhage with mild clinical symptoms; mild infrequent headache, were considered for strict observation, and any deterioration of the clinical conditions changed the decision toward surgical intervention, otherwise conservative plan was continued.

Patients were categorized randomizy into two groups:
Group I: 26 patients were operated by two Purr-hole craniostomies about 2cm width with subdural drain for subsequent few days.
Group II: 22 patients were operated by open craniotomy with subdural drain.

Surgical Procedures:

For group I:
General anaesthesia was preferred, but local anaesthesia was used when the surgeon judged it to be safest. In the operating theatre the patient was positioned supine on a horseshoe headrest. Two 20mm burr holes about 7cm apart were drilled over the maximum width of the haematoma. The dura mater was opened with a cruciate incision, and coagulated with bipolar diathermy. The subdural collection was washed out with warm Ringer’s saline with a 50mL syringe. The subdural membrane loculations were not disrupted apart from those easily accessible via the burr holes. A subdural drain was inserted and the scalp was closed in two layers.

For group II:
All paints had general anaesthesia; Fronto-temporal skin incision was used. After muscle dissection, fronto-temporal craniotomy was done. Dura was opened in C-shape fashion. Subdural fluid was evacuated. Blood clot was removed, fibrous septic were removed, any bleeding source was coagulated then surgicel and sometimes gel foam was used to cover the oozing areas. Dura was closed again in water tight fashion. Subdural drain was inserted from small separate hole in the dura and tunneled subcutaneously to exit from skin. Bone flab was re-inserted and fixed by plates and screws. Muscle and skin were closed.

Clinical assessment:
All patients were clinically assessed with an average follow-up period of 13.3 months (range 6-27) postoperatively. In addition to clinical assessment of conscious level using Glasgow coma scale (GCS), complete neurological examination including motor, sensory and reflexes was done. Operative details, hospital stay, blood loss, and operative and postoperative complications either general or local cranial were all assessed. Any preoperative neurological deficit was thoroughly followed postoperatively if improved, stable, or further deteriorated. Also any newly-developed neurological deficit postoperatively was assessed and followed.

Neuro-radiological assessment:
Computerized tomography (CT) scan was the standard procedure in all patients. It was done preoperatively, immediate postoperatively, at six months postoperative. The following factors were measured accurately:
- Type of hematoma: Acute, subacute or chronic according to density of blood in CT scanning.
- Size of hematoma: It is measured as multiply of maximum thickness of the hematoma in three planes divided by two.
- Midline shift: By measuring the maximum deviation of the midline structures from the midline.
- Bilaterality: Any chronic or subacute blood in the other side is considered bilateral haemorrhage.
- Brain expansion: The rate and degree of brain expansion were measured comparing similar points in the preoperative and postoperative CT scans.
- Recurrence: It was defined as occurrence of symptoms and signs attributable to an ipsi-lateral haematoma seen on a CT scan within 6 months of the original drainage procedure.

- Radiologically important complications: Any clinically-insignificant radiological finding; recurrence, intracerebral haemorrhage, empyema, or pneumocephalus will be recorded.

Statistical analysis:
The Microsoft Excel-sum test was used to analyze differences in preoperative clinical and demographic characteristics, and in variables affecting the outcome (motor and sensory deficit improvement). Statistical significance was set at p<0.05. Instructions to use bull hole or craniotomy surgery were kept in sealed envelopes labelled with sequential study numbers, which were opened at surgery after drain insertion was judged to be safe. The nature of this intervention did not allow for masking of treatment allocation. However, data were anonymised and clinicians were masked to outcomes when possible.

Results

Demographic results:
Forty-one males and seven females were included in this study. Mean age of the patients was 99.6 (range from average 91 to 129 years old).

Clinical results:
At the day of admission, patients had presented by a variety of symptoms and signs ranged from mild headache to significant disturbance of conscious level with major neurological deficits (limb weakness, dysphasia).

In group I:
Glasgow coma scale: before surgery, five patients (19%) had GCS of 15, 16 (62%) 9-14, and 5 (19%) less than 8 At discharge, 21 patients had GCS of 15; 5 patients had a GCS score between 9 and 14. After 6 months, twenty-six patients had GCS of 15, and only two patients still had GCS of 11 (Table 1).

Neurological deficits: Motor deficit was remaining in 6 patients (23%) out of 18 patients (69%) presented by preoperative limb weakness. At six months follow-up; only four patients still had neurological deficit.

Operative details: Average blood loss was of 55 ml. Hospital stay ranged from 3 to 55 days (average 12 days).

Mortality and morbidity: No mortality was shown in this group before discharge. At average 6 months follow-up, one patient had died by cardiac diseases. During period of postoperative hospitalization, three patients had pneumonia, four patients had UTI, but all patients were responded well to intravenous antibiotics. Persistent fever more than two weeks happened in two cases but eventually subsided.

In group II:
Glasgow coma scale: Preoperative conscious level was as follow: One patient (4%) had GCS of 15, 18 patients had GCS between 9 and 14 (82%), and 3 (14%) less than 8. At discharge, 7 (32%) patients had GCS of 15; 11 (50%) patients had a GCS score between 9 and 14, and three patients (14%) less than 8, one patient (4%) was died. Six months later, ten patients had GCS of 15, and 9 patients had a score between 9 and 14, and one patient still had a GCS below 8 (Table 1).

Neurological deficits: Preoperatively; 19 patients (86%) had Motor or speech deficit preoperatively. At discharge, 11 patients (50%) showed remaining deficits. At six months follow-up; four patients (18%) still had neurological deficit.

Operative details: Average blood loss was of 550 ml. Hospital stay ranged from 12 to 67 days (average 44 days). Duration of stay was much lesser in cases of first group than in craniotomy group (p<0.0001).

Mortality and morbidity: One patient was died 26 days post-operative of sepsis. At 6 months follow-up, another patient had died by unknown cause (? cardiac). During period of hospitalization; 9 patients had pneumonia improved by many trials of intravenous antibiotics and repeated cultures and sensitivity tests, two patients had UTI, one patient had DVT of left lower limb with no pulmonary showers, no anticoagulants were given only immobilization of the limb was enough for 2 months. Gastritis was shown in one patient. Three patients had bed sores; one patient had occipital bed sore needed plastic surgery revision and the other two had Jumbo-sacral bed sore healed by daily dressing and local applicants. One patient had high level of phenytoin (15Oug/d1) treated by stopping of the medications and he had improved conscious level after reversal of the phenytoin level (phenytoin toxicity).

Radiological results:
Of the 48 patients of the study, preoperative CT scan showed 34 patients had combined chronic
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(hypodense or isodense signal) and subacute (hypodense signal) blood in CT. Only 14 patients showed chronic blood in CT scan (hypodense or isodense signal).

1- Midline shift. At discharge, in group I, midline shift was improved from a mean of 8.3 (range 0-19.2 mm) to a mean of 2.2 mm (range 0-6.3 mm), while in group II it was changed from a preoperative mean of 11.1 mm (range 2-22) to a mean of 7.2 (range 0-8.3).

2- Bilateral hematomas: In group I, there was bilateral subdural collection in three patients; one of them deserved bilateral evacuation and the other two cases deserved only unilateral evacuation and the contra-lateral side was small amount not deserving surgery. In group II; no patient had preoperative contra-lateral subdural collection, but in one patient we had acute postoperative contra-lateral hematoma that deserved urgent surgical evacuation.

3- Brain expansion: Brain expansion showed poor results in both groups, but it has mild better results in craniotomy group rather than the craniosotomy group. In group I, complete brain recoil was noticed in 17 cases (65%) of patients, while partial recoil was shown in 9 cases (35%) one month postoperative after evacuation of the recurrent hematomas (Fig. 1). In group II, however, complete brain recoil was shown in 17 cases also but with higher percentage (77%) while partial recoil was happened in 4 cases (18%); (one patient had died) considering that subdural drain was inserted in all cases for a period of 2-3 days postoperative.

4- Recurrence: In group I: Ipsi-lateral recurrence of hematoma was shown in 6 patients (23%), only two of them required re-evacuation using the same burr-holes, and the other four deserved only observation. In group II: Recurrence was shown in 4 patients (18%), all of them required reopening end evacuation of the hematoma. The remaining collections were resolved gradually in the subdural drain with conservative treatment (Fig. 2).

5- Complications: We recorded postoperatively one subdural empyema in group I deserved evacuation and lavage with antibiotics after culture and sensitivity, it responded well to intravenous antibiotics.

Fig. (1): A- Preoperative CT scan shows left chronic fronto-temporo-parietal subdural haemorrhage with mild midline shift and effacement of the ipsilateral sulci, gyri and ventricle. B- Postoperative CT scan after burr-hole surgery shows accumulation of subdural fluid used for washing with obstruction of the burr hole by bold clot. C- Subdural drain was inserted but not correctly placed (put under outer membrane above dura, so subdural fluid was not drained. D- Repositioning of the subdural drain into subdural space with excellent draining of fluid and brain expansion.
Fig. (2): A- Preoperative CT scan shows Rt. Fronto-temporo-parietal combined chronic and subacute subdural haemorrhage with midline shift and compression of ipsilateral cortex. B- Post-craniotomy CT shows collection of acute blood with fluid and air compressing the brain with midline shift. C- After opening of the craniotomy flap and evacuation of acute blood and insertion of subdural drain-midline shift improved ipsilateral ventricle opened and compression improved. D- At discharge CT brain, showed significant improvement of subdural collection, and midline shift with opened sulci and gyri.

Table (1): Outcome measures in burr-hole and craniotomy groups.

<table>
<thead>
<tr>
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<th>Group I (Burr-hole)</th>
<th>Group II (Craniotomy)</th>
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<tbody>
<tr>
<td>GCS at admission</td>
<td>81% GCS 9 or more</td>
<td>97% GCS 9 or more</td>
</tr>
<tr>
<td>GCS at discharge</td>
<td>100% GCS 9 or more</td>
<td>97% GCS 9 or more</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>12</td>
<td>44</td>
</tr>
<tr>
<td>Gross focal deficit</td>
<td>23/69</td>
<td>50/86</td>
</tr>
<tr>
<td>Complications</td>
<td>9 patients (35%)</td>
<td>16 patients (73%)</td>
</tr>
<tr>
<td>Mortality</td>
<td>None</td>
<td>1 patient</td>
</tr>
<tr>
<td>Recurrence</td>
<td>23%</td>
<td>18%</td>
</tr>
<tr>
<td>Midline shift (mean)</td>
<td>6.1</td>
<td>3.9</td>
</tr>
</tbody>
</table>

Brain expansion:
- Complete: 65% vs 77%
- Partial: 35% vs 18%

Discussion

Chronic subdural haemorrhage is a common disorder which frequently encounter in neurosurgical practice. Multiple standard surgical techniques exist for the evacuation of chronic SDH, including twist drill craniostomy (TDC), burr-hole craniostomy (BHC), and craniotomy.

In our study we compared open craniotomy versus burr-hole craniostomy regarding clinical and radiological outcome of both approaches in those old people. In spite of the commonly used burr-hole surgery, some surgeons consider the craniotomy technique as the first choice. Imaizumi S et al., agreed that despite the increased risks, craniotomy remains the best option for evacuation of organized, calcified, or chronic SDH with numerous thick membranes [9].

According to clinical outcome, we found that significant clinical improvement was shown in
group I (burr-hole group) compared to craniotomy group; improvement of conscious level and neurological deficits was more rapid and more apparent in group I rather than group II. Blood loss and general complications also were less in burr hole group; it may be caused by the early ambulation and less operative manipulation in group I than in group II.

In a meta-analysis comparing rates of complications, mortality, recurrence/reoperation, and clinical outcome of burr-hole craniostomy (BHC) versus twist drill craniostomy (TDC) and craniotomy, similar results to ours were shown in this study; it was found that frequency of good outcome/neurological improvement, on the other hand, was the highest in the TDC patients (93.5%) significantly better than for either BHC (86.4%, p<0.0001) or craniotomy (74.4%, p<0.0001) [10].

In another meta-analysis on the other hand, Weigel and co-workers showed that all three techniques have about the same mortality (2.4%) [4].

Regarding radiological outcome, in our study; craniotomy patients had worse radiological outcome according to recurrence and incidence of postoperative clinically insignificant acute subdural hemorrhagic, but brain recoil was better and in craniotomy group. These radiological findings had no clinical correlation that affects the overall outcome.

Most of the studies comparing both approaches reported non-significant difference in any of the main comparative parameters like recurrence rate [11-13], hospitalization [13,14], clinical course [15,16], neurological improvement [13], or hospital mortality [8,17,18].

Craniotomy technique may be useful in removing large bold clot, coagulation of any active bleed, and opening of membranes that can lead to recurrence specially in those old people with atrophic brain, however, in spite of all previous advantages of craniotomy technique in evacuation of chronic and subacute bleeding in old people, still burr hole technique still has the superiority for craniotomy in those cases for the better clinical and radiological outcome and less complications of the less invasive technique. Furthermore in our study; because of the frequent closure of the burr-holes by blood clots, matching with that done by Santarius et al. [8] we favour inserting subdural drain for few days postoperative in cases of burr hole evacuation to reduce recurrence and accumulation of washing fluids.

**Conclusions:**
The less invasive burr-hole craniostomy still has superiority over craniotomy even in cases of old people with chronic-subacute hematomas. Craniotomy can be preserved for those patients with significant membranes or when subdural haemorrhage fails to resolve by burr hole surgery.

**Ethical consideration:**
Before surgery, written informed consent was obtained from the conscious patient or from the most close 1st degree relative of comatose patients or those otherwise unable to give consent. Each procedure was discussed thoroughly with the relatives regarding benefits and hazards of each one.

**References**


