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Chronic subdural hematoma: Wide dural window and incision of inner membrane

[*1]Nnadi Mathias O. N., [2]Bankole Olufemi B. and [3]Olatosi John O.

[1]Division of Neurosurgery, Department of Surgery, University of Calabar Teaching Hospital, Calabar, Cross River State, Nigeria
[2]Neurosurgical Unit, Department of Surgery, Lagos University Teaching Hospital, Lagos, Nigeria
[3]Department of Anesthesia, Lagos University Teaching Hospital, Lagos, Nigeria
Corresponding E-mail: nnadimon@yahoo.com

ABSTRACT

Surgical treatment of chronic subdural hematoma can give dramatic recovery and the patient and his relatives see the surgeon as a 'miracle' worker. This euphoria can suddenly give way to anguish whenever recurrence occurs. Many methods of surgical care have arisen in the bid to avoid the despair of recurrence. The objectives of the study were to evaluate the Glasgow outcome scores and recurrence in wide dural window and incision of inner membrane in chronic subdural hematoma surgeries. It was a prospective study on patients with chronic subdural hematoma managed in our centers from 2009 to 2015. Patients were resuscitated with Advance Trauma Life Support protocols in accident and emergency. Brain Computerized tomography scan was used to make diagnosis. The hematoma was evacuated using large burr hole for liquefied types and craniotomy for those with solid components. The dural/outer membrane incision was widened and the inner membrane incised. On discharge, patients were followed up for three months. Data were collected using proforma and analyzed using Environmental Performance Index info 7 software. There were 55 patients. Males were forty six. The mean age was 56.6 years. The most common etiology was road traffic accident. The favorable outcome was 94.54%. The Glasgow Coma Scores (GCS) prior to surgery affected the outcome. There was no recurrence. The use of wide dural opening and incision of the inner membrane was not associated with any recurrence and complications were few. It is recommended as a suitable treatment option for patients with chronic subdural hematoma.

Keywords: chronic subdural hematoma, dura, membrane, window

INTRODUCTION

"Doctor, this is miracle; where is your church?" "Doctor, I brought this child for the same miracle you performed in me." These were from an elderly man who was brought to our clinic on wheelchair due to paraplegia from bilateral chronic subdural hematoma. The first sentence was made first day post-op when power in lower limbs improved to 4^{+} and we instructed him to come down from the bed and walk, which he did. The second sentence was made on his first follow up day in surgical out-patient clinic when he brought a three year old child with cerebral palsy to us to perform similar 'miracle' on the child. The dramatic postoperative improvement of symptoms in chronic subdural hematoma had been documented by other authors.[1] The 'miraculous' feeling by patients and their relatives could turn to despair by recurrence of the hematoma. The disappointment felt by neurosurgeons from recurrence had led them to try various surgical techniques such as burr hole craniostomy, twist drill craniostomy, craniotomy, and with other associations like irrigation, subdural drain, subgaleal drain, to mention but three.[2, 3] Trans-marrow puncture had also been introduced into the 'ring'. [4]

We studied wide dural window with incision of inner membrane from April 2009 to September 2015. The first author learnt the procedure from Dr Shani Kumar Sogani when he did clinical attachment under Dr Rejendra Prasad of Neurosurgical Department, Indraprastha Apollo Hospital, Sarita Vihar, New Delhi, India. Dr Sogani said he performed the procedure on many patients with chronic subdural hematoma and none had recurrence.

MATERIALS AND METHODS

Study design
It was a prospective, observational and cross-sectional study.

Sample size
Sample size was calculated using Fisher's formula: $n = N^2pq/d^2$ and $n_f = n/1+n/N$. With incidence rate of 13.1 [5] and average of 10 cases a year, the calculated sample size was 50.

Setting/approval
The study was carried out in tandem in two tertiary hospitals in Nigeria. It was a component of compound study that was approved by the ethics committee of the first hospital, and a component of prospective data bank that was approved by ethics committee of the second hospital. Consents for the surgery were obtained from the patients and/or their legal representatives after being informed of the details of the surgery, the probable outcome, the complications, and the possibility of recurrence and re-operation.

Inclusion criteria
All patients who had burr holes or craniotomies for chronic subdural hematoma (CSDH) with wide dural window and incision of inner membranes from 1st April 2009 to 30th September 2015 were included.

Exclusion criteria
All patients we could not incise the inner membranes. Patients who had simple burr hole evacuation with subdural drainage. Recurrence from hematoma removed in other centers who presented in emergency conditions to us. Though they had the procedure but the primary surgery was not done in our center. Patients we could not get the three months post-op status due to failure to attend the clinic, and we could not reach them on phone.

Principles of the technique
1 With the two openings on the outer membrane/dura and inner membrane, it becomes difficult for fluid to re-accumulate in the cavity as outer opening channels fluid to subgaleal space and the inner opening channels fluid to uninflamed subdural space and the fluid will be absorbed in both sites.
2 Pulsation of the brain empties any remaining fluid in the cavity leading to apposition and adhesion of the membranes.
3 The wide windows take longer time to close, thus giving enough time for patients with slow re-expansion of the brain.

Protocol
The patients were resuscitated in accident and emergency using Advanced Trauma Life Support protocols. Cranial computerized tomography (CT) scan (plain and contrast), full blood count, urinalysis and clotting profile were done. After optimizing the patients we took them to theater for surgery. Burr hole was used for patients with hypodense and isodense (liquefied) lesions. Small craniotomy was used for those with solid components (hyperdense). Under general anesthesia, the patient was positioned 15 degree head up. The operation site was shaved and the incision line marked and infiltrated with 1% Xylocaine with Adrenaline (1 in 200,000). The site was cleaned with 7.5% Povidone Iodine and painted with 10% Povidone Iodine. Patient was draped. Burr-hole was drilled using automatic perforator and widened with burr. Cruciate incision was done on dura and external membrane, and the hematoma gently aspirated using size 8 feeding tube for left side (dominant hemisphere) and size 8 or 10 for the right side. After aspiration of the blood, the cavity was irrigated with Normal Saline/Genticin (500ml/80mg) until the effluent was clear. The edges of dura and outer membrane were coagulated together as wide as possible. Under magnification using loupes, the inner membrane was incised as far as possible and the edges coagulated. Sometimes to avoid injury to cortical vessels we had to lift the inner membrane with cannula needle between two vessels before incising it. To avoid possible injuries to cortical vessels in some patients we could not incise the inner membranes, and they were not included in the study. In those with solid components, small craniotomy bone flap centered at the junction

of solid and liquid components was raised. Cruciate incision was done on the dura/outer membrane in one burr hole site over the liquid part and the liquid hematoma aspirated. Over the solid component dura fenestrations were done and the clot irrigated out. The whole cavity was irrigated until effluent was clear. The incised dura/outer membrane was widened by coagulation. The inner membrane was incised as far as possible and the edges coagulated. The feeding tube was left in the cavity (not used by Dr Sogani). Meticulous hemostasis was done and wound closed in layers. The drain was brought out through the wound in a position that would cause less kinking, and for easy removal without causing dragging of the tip to avoid vascular injury. The wound edge was covered with 10% Povidone Iodine gel. The drain was removed 2-3 days post op. Post-op, the patients were nursed in 30 degree head up position. We used prophylactic Ceftriaxone 1gm at induction of anesthesia and subsequently 1gm daily for two days. We discontinued intravenous fluids on second day post-op and commenced oral feeding and oral medications. For unconscious patients, we commenced nasogastric feeding on third day post-op using high energy/high protein mixture constituted thus: 500ml pap, two tablespoonful soya bean powder, two tablespoonful powdered milk, one tablespoonful red oil, and one tablespoonful cray fish powder. The daily fluid requirements of the patients were factored into the diet. It was given five to six times daily. The infusions were discontinued once nasogastric feeding was enough for daily requirement. Oral drugs were given via the nasogastric tube.We commenced mobilization from first day post-op if power in lower limbs were 4 and above. On discharge, the patients were followed up in surgical out-patients clinic. Their functional outcomes were determined three months post-op using Glasgow Outcome Scale. Data were collected using structured proforma which was component of compound research that was approved by ethics committee of the first institution. Data were collected from 1st April 2009 to 31st July 2010 in the first institution. In the second institution the proforma was component of prospective data bank that was approved by the ethics committee. Data collection was from 1st August 2010 to 30th September 2015. Data collected included biodata, history/physical findings, CT findings, Glasgow Coma Scores (GCS) prior to surgery, progress of the patients on admission, complications of the surgery, length of hospital stay, Glasgow Outcome Scores (GOS) three months after surgery, and recurrence. Data were analyzed using Environmental Performance Index (EPI) info software (Center for Disease Prevention and Control, Atlanta, Georgia, USA). We used 'Add analysis gadget' of the visual dashboard component. We used mean component for continuous variables such as age and length of hospital stay. We used frequency/chart components to determine frequency of some variables such as etiology. We used MXN/2X2 components for univariate analysis and its advanced component for multivariate analysis. At 95% confidence interval, P <0.05 was considered significant.

RESULTS

Fifty five patients qualified for the study. There were 46 males (83.64%) and 9 females (16.36%). The ages ranged from 24 to 82 years with mean age of 56.96 years. Sixty to sixty nine years patients had highest frequency, 15 (27.27%). Patients aged 50 years and above constituted 74.54%, table 1. The most common etiology was road traffic accident (RTA), with frequency of 23 (41.82%) fig 1. Twelve patients did not have specific etiology. Ten of them were ≥50 years. The most common comorbidity was hypertension, table 2. Forty three patients (78.18%) had GCS 13-15 prior to surgery, table 3. Twenty patients had headache, seven had features of frontal lobe syndrome (two brought from psychiatry hospital with CT showing chronic subdural hematoma), four patients had dysphasia, 35 patients had long motor deficits ranging from monoparesis to quadriparesis, eight patients had facial nerve palsy (upper motor), and three patients had seizure prior to surgery. The hematoma was on the left in 29 patients, on the right in 19 patients, and bilateral in 7 patients. Fifty patients had burr hole craniostomy, while five patients had craniotomy. The outcome was favorable (≥4) in 94.54%, table 4. The outcome was significantly affected by GCS prior to surgery P = 0.0005, table 5. Comorbidity also significantly affected the outcome P = 0.0258, table 6. Age group did not have significant effect on outcome P = 0.9061. Etiology did not have significant effect on the outcome P = 0.4721. Location of the hematoma did not have effect on the outcome P = 0.5251. Two patients had motor dysphasia post-surgery which resolved within 10 days. Three patients had seizure onset after surgery. All patients with seizure were treated with antiepileptic drugs. One patient had aspiration pneumonitis and he succumbed to it, while another patient, a diabetic, died from sepsis from gluteal pressure sores and chest infections he developed in private hospital prior to his referral to us. In all, two patients (3.64%) died. There was no recurrence of the hematoma in any of the patients three months after the surgery. The mean hospital stay was 14.02 days, with a range of 6-34 days.

DISCUSSION

In the study there were more males (83.64%) than females. Rovlias et al. [6] in Greece found 650 males (65.92%) and 336 females (30.08%) in their study. In Brazil, Silva et al. [7] found 102 males (81.6%) and 23 females (18.4%)

in their own study. Ahmed et al. [8] in India found 88.24% males. The higher number of males had been attributed to males being more active than females. The mean age in the patients was 56.96 years with age range of 24–82 years. Ishfaq et al. [9] in Pakistan found mean age of 59.98 years with range of 30–97 years. In Bangladesh, Asaduzzaman et al. [10] found mean age of 52.8 years with age range of 50-70 years. In Kosovo, Mekaj et al. [11] found mean age of 62.85 years with age range of 1-89 years. In Turkey, Ak et al. [12] found mean age of 62.06 years with a range of 42-87 years. The difference in mean age in these studies was due to longevity seen more in European (developed) countries above than the developing ones where we belong. That 74.54% of our patient was 50 years and above led credence to the report of other authors that the incidence of chronic subdural hematoma (CSDH) in developing countries is rising due to increasing rise in life expectancy. [13, 14] In Brazil, Sousa et al. [15] found mean age of 64.3 years with age range of 14-93. In the study, they found that 56.8% of their patents were ≥65 years which was almost similar to the European countries above. [11, 12]

The most common etiology was road traffic accident (41.82%), with traumatic brain injury (TBI) forming 78.18%. Huang et al. [16] in Taiwan found traumatic brain injury in 73 (74.49%) of 98 patients they studied. Rovlias et al. [6] in Brazil found TBI in 503 (51.01%) of 986 patients they studied. These were almost similar to ours. Ten of the twelve patients with unknown etiologies in our study were ≥50 years. It had been noted that in the elders the brain weighs approximately 200mg less due to brain atrophy and that leads to about 11% increase in extra-cerebral space volume, causing increase in brain movement. [17] The atrophy leads to increase in tension on the bridging veins moving from brain surface to dural sinuses. Trivial forces rupture the vessels. It had been noted that CSDH was a delayed complication of trivial trauma which went unnoticed. [18] The patients with unknown etiology were probably from trivial trauma as none was on anticoagulant, antiplatelet aggregation or had coagulopathy. Patients with unknown etiology had been documented by other authors. [11, 19]

The comorbidity in our patients were not common predisposing factors such as anticoagulant use, antiplatelet use, coagulopathy or chronic alcoholism seen in other studies.[6, 20] These might be due to higher number of elderly in these studies (age range 37-98, 29-96) compared to ours (age range 24-82) or a reflection of lower level of medical care compared to theirs. Many of our patients had high GCS scores (87.27% for GCS 9-15), but comatose patients formed 12.73%. Ahmed et al. [7] had relatively higher GCS scores (93% for GCS 9-15) and 7% for comatose patients. Mekaj et al. [11] in their study found that 89% of their patients had GCS 9-15, while 10.9% were comatose. The high percentage of comatose patients, in a condition that symptoms start gradually most of the time as the hematoma increases in size, may be attributed to delays due to missed clinical diagnosis, late presentation or delayed intervention. Some patients with frontal lobe syndromes were admitted in psychiatry hospitals, only to be referred to us after CT scan diagnosis. Some patients with hemiparesis were admitted by physicians with clinical diagnosis of cerebrovascular disease and invited us to take over the patients after CT diagnosis. Delayed presentation or intervention can cause catastrophic drop in level of consciousness. The patient with severe disability in our study was diagnosed in private hospital with CT scan. He was referred to us for surgery. Because he was conscious, he kept delaying to come. His colleagues in office were urging him to go for surgery but he kept delaying. He eventually can to us three days after the diagnosis. He had sudden drop in GCS from 14 to 6 few hours after presentation. By the time the theater was ready; his GCS score had dropped to 3. The GCS remained 3 for five days after the surgery before he turned around. That goes to show that delay in treatment of these patients could be disastrous.

The favorable outcome in our study was 94.54%. It was significantly affected by GCS prior to surgery. Silva et al [7] in Brazil had favorable outcome of 82.4% and their outcome was also affected by GCS. Kazmi et al. [19] in Pakistan found good recovery in 97.2% The significant effect of GCS scores on outcome had been documented also by other authors. [21 – 27] The fact that outcome was significantly affected by GCS prior to surgery should be a clear warning that there should not be delay in operating these patients The outcome was also significantly affected by comorbidity. The diabetic patients had worst outcome among them. Using multivariate analysis (not included in the result) we found that four of the five diabetic patients were from TBI while the etiology in the fifth was unknown. Metabolic response to trauma such as surgery causes production of hormones that causes gluconeogenesis and also inhibit glucose uptake by cells. [28]Gluconeogenesis worsens the hyperglycemia in diabetics. Attempts to control hyperglycemia in traumatic diabetic patients may lead to depletion of glucose in the extracellular fluid of the brain, compromising cerebral metabolism which can worsen outcome. [29 – 31] The mortality in our study was 3.64%. Silva et al. [7] in Brazil found mortality of 11.2%. The mortality was within the range of 0 -15.6% reported by many authors. [15, 16, 19, 32 – 35]

There was no recurrence in our patients after three months of follow up and complications were few. Regan et al [20] compared burr hole and craniotomy and found recurrence of 6.6% in burr hole and 24.1% in craniotomy patients. Silva et al[7] did burr hole with closed system drainage and recorded 8.8% recurrence. Kazmi et al [19] used double burr hole and recorded recurrence of 5.6%.Many techniques had been used for CSDH with varying degrees of recurrence and complications. [6, 11, 15, 36] The length of hospital stay in our study was within the range seen in other series. [8, 11, 15]

Table 1: Age group frequency

Age group	Number	Percent (%)
20 - <30	3	5.45
30 - <40	2	3.64
40 - <50	9	16.36
50 - <60	14	25.45
60 - <70	15	27.27
70 - <80	11	20.00
80 - <90	1	1.82
Total	55	100

Table 2: Comorbidity frequency

Comorbidity	Number	Percent (%)
Asthma	2	3.64
Diabetes	5	9.09
Hypertension	11	20.00
Hypertension & Diabetes	1	1.82
None	35	63.64
Sickle cell anemia	1	1.82
Total	55	100

Table 3: Glasgow Coma Scores prior to surgery frequency

GCS prior to surgery	Number	Percent (%)
13 - 15	43	78.18
9 - 12	5	9.09
3 - 8	7	12.73
Total	55	100

Table 4: Glasgow Outcome Scores (GOS) 3 moths post-op

Glasgow Outcome score	*Number*	*Percent (%)*
1	*2*	*3.64*
3	*1*	*1.82*
4	*3*	*5.45*
5	*49*	*89.09*
Total	*55*	*100*
4 + 5	*52*	*94.54*

Table 5: GCS VS GOS

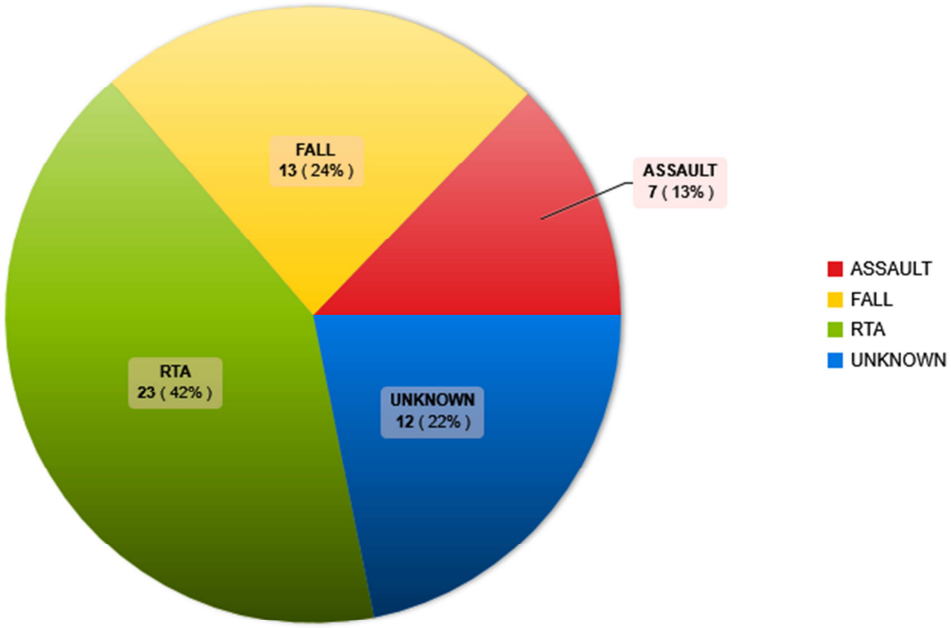
GCS prior to surgery	Glasgow Outcome Scores					
	1 (%)	3 (%)	4 (%)	5 (%)	4 + 5 (%)	Total (%)
13 - 15	0 (0.00)	0 (0.00)	2 (4.65)	41 (95.35)	43 (100)	43 (100)
9 – 12	0 (0.00)	0 (0.00)	1 (20.00)	4 (80.00)	5 (100)	5 (100)
3 – 8	2 (28.57)	1 (14.29)	0 (0.00)	4 (57.14)	4 (57.14)	7 (100)
Total	2 (3.64)	1 (1.82)	3 (5.45)	49 (89.09)	52 (94.54)	55 (100)
$P = 0.0005$						

Table 6: Comorbidity vs GOS

comorbidity	Glasgow Outcome Scores					
	1 (%)	3 (%)	4 (%)	5 (%)	4 + 5 (%)	Total (%)
Asthma	0 (0.00)	0 (0.00)	0 (0.00)	2 (100)	2 (100)	2 (100)
Diabetes	1 (20.00)	1 (20.00)	0 (0.00)	3 (60.00)	3 (60.00)	5 (100)
Hypertension	0 (0.00)	0 (0.00)	3 (27.27)	8 (72.73)	11 (100)	11 (100)
HTN & D	0 (0.00)	0 (0.00)	0 (0.00)	1 (100)	1 (100)	1 (100)
None	1 (2.86)	0 (0.00)	0 (0.00)	34 (97.14)	34 (97.14)	35
SCD	0 (0.00)	0 (0.00)	0 (0.00)	1 (100)	1 (100)	1 (100)
Total	2 (3.64)	1 (1.82)	3 (5.45)	49 (89.09)	52 (94.54)	55 (100)
P = 0.0258						

HTN & D (Hypertension and Diabetes), SCD (Sickle cell disease).

Fig 1: Etiology frequency



CONCLUSION

The use of wide dural opening and incision of the inner membrane was not associated with any recurrence and was relatively complication free in this series. It is recommended as a suitable treatment option for patients with chronic subdural hematoma. Further studies with bigger sample size are needed to validate this technique.

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