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A comparison of subperiosteal vs subdural drainage in the treatment of chronic subdural haemorrhage

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Abstract

Introduction. Symptomatic chronic subdural haemorrhages (CSDH) continue to be one of the most common diagnoses in modern neurosurgery. The current standard procedure for symptomatic CSDH is a burr-hole craniostomy with irrigation and the installation of close-system drainage. The purpose of this study is to conduct a direct comparison of two surgical procedures for the treatment of symptomatic CSDH that are effective in prior studies. Our main goal was to compare the efficacy of placing a subperiosteal drain (SPD) and a subdural drain (SDD) after a single burr-hole craniostomy and irrigation and to show any significant differences in terms of overall surgical complications, functional outcome and mortality rate at three months, and complications at six months.

Materials and methods. From August 2022 to December 2023, the study was conducted in the Department of Neurosurgery at a tertiary care centre, with a total of 25 patients in both treatment groups.

Results. Overall, there was no statistically significant difference between the two groups in terms of patient general characteristics, pre-and post-operative symptoms, Markwalder grades, postoperative hematoma volume and recurrence, mortality, and functional outcome at discharge and at three months follow-up. Despite not reaching statistical significance, we found a decreased risk of surgical complications, particularly post-operative cerebral haemorrhage, with SPD system implementation.

Conclusions. According to our findings, both therapy modalities are extremely successful in the treatment of CSDH. therapy with a single burr-hole craniostomy, irrigation, and implantation of the SPD system, on the other hand, has a reduced overall surgical complication rate and can be regarded as a therapy of choice for the management of symptomatic CSDH.

Keywords
subperiosteal, subdural drainage, chronic subdural haemorrhage

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Introduction

The frequency of patients presenting with symptomatic chronic subdural haemorrhage (CSDH) has steadily increased in recent years, owing to increased life expectancy, particularly in developing nations (1, 6). There have only been a few class (II) evidence articles in the literature on the treatment of CSDH to yet. Burr-hole craniostomy coupled with irrigation and implantation of a closed-drainage system is the primary surgical treatment of choice for symptomatic CSDH (10, 12). Santarius et al. concluded in 2009 that placing a subdural drain (SDD) after burr-

hole evacuation of CSDH was linked with decreased recurrence and death. Recent investigations have reported on a significantly less invasive approach that involves the insertion of a subperiosteal drain (SPD) rather than the traditional SDD. (3, 5, 14). This was looked at since placing an SDD on the cortical brain surface might result in problems including haemorrhage, seizures, and surgical-site infections like empyema. SPD installation has been indicated as the therapy of choice for patients with a predicted high risk of problems, particularly those over 80 years old, with a clear trend towards lower mortality and complications (3). Kaliaperumal et al.'s single-center prospective randomised trial comparing the results of SDD and SPD in 2012 found statistically significant modified Rankin Score (mRS) measures, with improved outcomes in the SPD group at three and six months of follow-up The current study compared SDD and SPD implantation for the treatment of CSDH to examine recurrence rates and overall results in terms of surgical complications, functional outcomes, and death in both groups.

Materials and methods

The goal of this prospective interventional trial was to compare patients who received SDP versus SDD drain insertion for the treatment of symptomatic CSDH. The primary goal was to assess effectiveness and detect differences between the two groups in total surgical adverse events, functional outcomes, and death. We recruited 50 patients (25 each group) who met the inclusion and exclusion criteria between August 2022 and December 2023, and we performed the surgical operations using the standardised methodology specified below. Prior to surgery, general patient parameters such as age, gender, concomitant medical problems, medicines, and other risk factors were evaluated. Pre-operative symptoms, admission Glasgow Coma Scale (GCS) and Markwalder scores, as well as radiological data (hematoma volume) from pre-operative CT scans, were also examined. The XYZ/2 formula (7) was used to obtain haemorrhage size and volume estimates. The following variables were recorded: post-operative signs, neuroradiological abnormalities on post-operative CT at 24 hours, instances of surgical complications and repeat operations, Glasgow Outcome Score (GOS), Markwalder score, and mortality during hospitalization. GOS scores, repeat CT results, and death rates were examined after three months of follow-up. A favourable result was defined as a decrease in pre-operative symptoms, a Markwalder grade of 0 or 1, minimal surgical morbidity and mortality, and a GOS score of 4 or above. In a symptomatic patient, a recurrent hematoma was defined as a thickness of more than 10 mm. Any patient who came with a recurrence haemorrhage within three months of the scheduled follow-up session was documented and treated accordingly.

Study inclusion and exclusion criteria

This study's inclusion criteria were an age of 80 years, the presence of symptomatic CSDH on plain CT imaging, and an admission Glasgow Coma Scale (GCS) of 6 or higher (with a motor score of at least 4). Exclusion criteria included terminal disease, pregnancy, a history of prior CSDH surgery, or an entrance GCS of 6.

Outline of peri-, intra-, and post-operative management Each patient or their immediate family members or carers provided informed permission prior to surgery. Anticoagulants and antiplatelet medicines were stopped during surgery, and fresh frozen plasma with intravenous (IV) vitamin K was given to restore normal coagulation characteristics.

Patients who showed with seizures upon arrival were given antiepileptic medicines. At both research sites, these perioperative parameters were standardized for both patient groups. The patient was always positioned supine and given general anesthesia, with the head resting on a rubber horseshoe ring. The incision site was noted and cleansed with povidone iodine before being draped in sterile surgical drapes. Each patient received a single injection of antibiotic prophylaxis shortly before the skin incision. At the location of maximum blood thickness, a single burr hole was created, with the craniostomy measuring at least 10 mm× 10 mm in diameter. The dura mater was coagulated and expanded wide enough to accommodate the burr-hole. Intraoperative subdural irrigation with body temperature normal saline was performed until the effluent was reasonably clear but not completely eliminated. The closed drainage system was installed in accordance with normal procedure at each facility. A passive corrugated Redivac catheter was put across the burr-hole beneath the galea for SPD

systems. A Jacques catheter was navigated through the burr-hole and carefully positioned in the subdural area for SDD systems. Each drain was attached to a passive collection system by a minor skin incision posterolateral to the burr-hole, with no suction force used. To reduce intracranial air collection, the subdural space was filled with body-temperature saline before sealing the skin incision. The drainage system was installed beneath the head. After a repeat brain CT scan within 24 hours, the drain was removed.

Statistical evaluation

SPSS software for Windows version 21.0 was used to examine the data. Every variable was expressed as a mean standard deviation (X SD). The t-test and the chi-square test were used to assess the studied parameters. To establish statistical differences in total surgical complications, functional outcomes, and death, the determined sample size was 25 patients per group (power of 80%). The significance threshold was set at $P< 0.05$.

Results

General demographics and patient characteristics A total of 25 subjects per group were eligible for analysis. The SPD group included 18 males (72%) and 7 females (28%), while the SDD group contained 17 males (68%) and 8 females (32%). The mean age was 67 years in the SPD group and 71 years in the SDD group. As depicted in Table 1, there were no significant differences in mean age or gender between the groups ($P > 0.05$). In the SPD group, the CSDHs included 10 right-sided, 14 left-sided, and one bilateral. The SDD group included 12 right-sided and 13 left-sided CSDHs. ONE patients (4%) in the SPD group and TWO (8%) in the SDD group were on chronic oral antiplatelet therapy. Only two subject (8%) in the SPD group was on anticoagulation. The most frequent associated comorbid conditions in the SPD versus SDD groups, respectively, were hypertension (60% versus 72%), type II diabetes mellitus (24% versus 24%), ischemic heart disease (16% versus 20%), chronic kidney disease (4% versus 4%), chronic liver disease (4% versus 4%), and chronic alcoholism (0% versus 4%). There were no significant differences regarding these clinical parameters between the SPD and SDD groups ($P > 0.05$).

Table 1. General demographics and patient characteristics between both groups (chi-square test).

	Subperiosteal Drain	Subdural Drain	P-value
No. of Patients	25	25	
Age (mean)	67	71	NS
Sex Male	18 (72%)	17 (68%)	NS
Female	7 (28%)	8 (32%)	
Right SDH	10	12	NS
Left SDH	14	13	NS
Bilateral SDH	1	0	NS
on anti-platelet	1 (4%)	2(8%)	NS
on anti-coagulation	2 (8%)	0	NS
Co-morbidities			
HPT	15 (60%)	18(72%)	NS
IHD	4 (16%)	5 (20%)	NS
DM	6 (24%)	6 (24%)	NS
CKD	1 (4%)	1 (4%)	NS
CLD	1(4%)	1 (4%)	NS
Previous Stroke	1 (4%)	2 (8%)	NS
Chronic Alcoholic	0	1 (4%)	NS

Pre- and post-operative symptoms All patients in both study groups were assessed for presenting symptoms and signs on admission, and subsequently reassessed and documented to ascertain post-operative outcomes upon discharge. As shown in Table 2, a majority of patients presented with GCS scores of 13–15, including 22 patients (88%) in the SPD group and 23 (92%) in the SDD group. Two patients (8%) in the SDP group and one (4%) in the SDD group presented with a GCS of 9–12. One patient (4%) from each group presented with a GCS of 8. The most common symptoms at admission in the SPD versus SDD groups, respectively, included headache (88% versus 84%), altered sensorium (92% versus 88%), asymmetrical reflexes (96% versus 84%), hemiparesis (60% versus 64%), aphasia (32% versus 28%), hemiplegia (4% versus 0%), and seizures (4% versus 4%). Overall, there were no significant differences in pre-operative symptoms and signs between the two groups ($P > 0.05$). All patients were re-examined postoperatively with regard to presenting symptoms. As shown in Table 2, all patients in both groups fully recovered post-operatively from the initial symptoms and signs of aphasia, altered sensorium, and asymmetrical reflexes. Both groups showed significant improvements in headache (from 88% to 20% in the

SPD group and from 84% to 12% in the SDD group) and hemiparesis (from 60% to 12% in the SPD group and from 64% to 4% in the SDD group) ($P < 0.05$). No patients in the SPD group and SDD group developed persistent hemiplegia postoperatively. There were no detectable differences in seizure control post-operatively between the groups (0% versus 4%); all patients who presented with pre-operative seizures had residual focal seizures post-operatively, which were controlled by optimisation of antiepileptic drugs. Overall, no statistically significant differences were demonstrated in post-operative symptoms between the groups ($P > 0.05$).

Table 2. Pre-operative and post-operative symptoms and signs between both groups (chi-square test).

	Subperiosteal Drain	Subdural Drain	P-value (between groups)
Pre-op Symptoms			
GCS 13-15	22 (88%)	23 (92%)	
GCS 9-12	2 (8%)	1(4%)	
GCS 3-8	1 (4%)	1(4%)	
Symptoms & Signs on Admission			
Hemiparesis	15(60%)	16(64%)	NS
Hemiplegia	1(4%)	0	NS
Aphasia	8(32%)	7(28%)	NS
Headache	22(88%)	21(84%)	NS
Seizures	0	1(4%)	NS
Altered Sensorium	23(92%)	22(88%)	NS
Reflex Asymmetry	24(96%)	21(84%)	NS
Symptoms and Signs at Discharge			
Hemiparesis	3(12%)	1(4%)	NS
Hemiplegia	0	0	
Aphasia	0	0	
Headache	5(20%)	3(12%)	NS
Seizures	0	1	
Altered Sensorium	0	0	
Reflex Asymmetry	0	0	

Markwalder grade Markwalder grades at admission and upon discharge were used to assess the clinical courses of patients in both groups. As shown in Table 3, the majority of patients presented with Markwalder grade 2 on admission, including 19 patients in the SPD group and 14 in the SDD group. Five subjects in the SPD group and 10 in the SDD group had Markwalder grade 1 on admission. One patient (4%) in each group had Markwalder grade 3 on admission. Post-operatively, the patients in both groups were examined and reassigned post-operative Markwalder grades. All patients in each group with admission Markwalder grade 1 improved to Markwalder grade 0 by the time of discharge. Therefore, the majority of patients demonstrated good post-operative Markwalder scores (grade 0 or 1) at discharge, for a total of 23 patients (92%) in the SPD group and 24 (96%) in the SDD group. Table 5 shows that the calculated mean admission Markwalder score was 1.72 for the SPD group and 1.65 for the SDD group. Upon discharge, the mean Markwalder scores in both groups had improved significantly (from 1.72 to 0.49 in the SPD group and from 1.65 to 0.51 in the SDD group). These changes were statistically significant within each group, respectively ($P < 0.05$). However, there were no significant differences in mean Markwalder scores between the SPD and SDD groups upon admission and at discharge ($P > 0.05$).

Table 3. Markwalder grades on admission and upon discharge comparing mean grade within and between both groups (independent t-test).

Markwalder Grade	Subperiosteal Drain (SPD)	Subdural Drain (SDD)	P-value (between groups)
On admission			
MW 0/ MW 1 /MW 2/ MW 3 /MW 4	0/5/19/1/0	0/10/14/1/0	
Mean Markwalder Grade	1.72	1.65	NS
On discharge			
MW 0 /MW 1 /MW 2 /MW 3 /MW 4	20/3/2/0/0	21/3/1/0/0	
Mean Markwalder	0.49	0.51	NS

Hematoma volume The mean hematoma volume was estimated pre-operatively, within 24 hours post-operatively, and at three months of followup based on CT findings; Table 4 illustrates that there were no significant differences ($P > 0.05$). However, within the respective groups, hematoma volumes were significantly reduced compared to pre-operative imaging ($P < 0.05$). In the SPD group, the mean pre-operative hematoma volume decreased significantly from 118.92×10^3 mm³ to 9.10×10^3 mm³ during the

post-operative period ($P < 0.05$). Significant changes were also noted in mean hematoma volume from the post-operative CT (9.10×10^3 mm^3) to the three-month follow-up CT (3.87×10^3 mm^3) ($P < 0.05$). Similar results were found for the SDD group, in which the mean pre-operative hematoma volume significantly decreased from 118.81×10^3 mm^3 to 8.30×10^3 mm^3 in the post-operative period, with a further drop to 3.62×10^3 mm^3 on the three-month follow-up CT ($P < 0.05$).

Table 4. Mean hematoma volume in both groups pre-operatively, post-operatively and at 3 months follow-up (independent t-test).

Mean Hematoma volume (*10^3)	Subperiosteal Drain (SPD)	Subdural Drain (SDD)	P-value (between groups)
Pre-op	118.92	118.81	NS
Post-op (24 hours)	9.10	8.30	NS
Follow-up (3 months)	3.87	3.62	NS

Overall surgical complications The overall surgical complications were categorised into intracerebral hematoma (ICH), recurrent hematoma, surgical-site infection, and tension pneumocephalus. Table 5 shows that the overall complication rate in the SPD group was 8%, with two patients who developed recurrent hematoma during follow-up, requiring re-evacuation surgery via burr-hole craniostomy and SPD drainage. None of the patients developed ICH as a post-operative complication in this group. The two recurrent hematomas were a direct result of restarting anticoagulant treatment by the cardiology team within two weeks of surgery. In the SDD group, the overall complication rate was 8%, with two patients (8%) developing ICH while hospitalised, and one (3.3%). Both patients with ICH underwent craniotomy and clot evacuation while hospitalised, and a repeat burr-hole craniostomy was performed for the other patient with recurrent CSDH.However, as shown in Table 5, this did not translate into a significant statistical difference ($P > 0.05$). There was also no detectable difference between the groups in post-operative recurrent hematomas ($P > 0.05$). Additionally, in terms of the overall surgical complication rate, there was no significant difference between the SPD and SDD groups ($P > 0.05$). None of the patients in either group developed post-operative seizures, surgical-site infections, or tension pneumocephalus.

Table 5. Overall surgical complications and mortality between both groups (independent t-test).

	Subperiosteal Drain (SPD)	Subdural Drain (SDD	P-value (between groups)
Repeat surgeries while hospitalised			
Re-evacuation	0	0	
Craniotomies	0	2(8%)	NS
Repeat surgeries after discharge			
Re-evacuation	2(8%)	0	NS
Craniotomies–	0	0	
Intracerebral Hematoma	0	2(8%)	NS
Recurrent Hematoma	2(8%)	0	NS
Surgical Site Infection	0	0	
Tension Pneumocephalus	0	0	
Seizures	0	0	
Overall Surgical Complications	2 (8%)	2(8%)	NS

Functional outcomes and mortality Functional outcomes were measured with the Glasgow Outcome Score and compared between the two groups. A good functional outcome was defined as a GOS of 4 or higher (Table 6). In the SPD group at discharge, a total of 22 patients had a GOS of 5, and 3 patients had a GOS of 4. The mean GOS at discharge was 4.8 in the SPD group. In the SDD group, 22subjects had a GOS of 5, one had a GOS of 4, and two had a GOS of 3 at discharge. The mean GOS at discharge was calculated at 4.7 for the SDD group. There was no significant difference between the two groups in GOS scores at discharge ($P > 0.05$). At three months of follow-up in the SPD group, 24 (96%) patients had a GOS of 5, while one (4%) had a GOS of 4. In the SDD group, 24 . patients (96%) had a GOS of 5 and 1 (4%) had a GOS of 4. No significant difference was noted in mean GOS scores at three months. The mean GOS was 4.9 in the SPD group and 4.9 in the SDD group ($P > 0.05$). There was no

mortality throughout the entire study duration in either group.

Table 6. Functional outcome assessment between both groups.

Glasgow Outcome Score	Subperiosteal Drain (SPD	Subdural Drain (SDD)	P-value (between groups)
Outcome at discharge			
GOS 5 GOS 4 GOS 3 GOS 2 GOS 1	22/3/0/0/0	22/1/2/0/0	
Mean GOS (at discharge)	4.8	4.7	NS
Outcome at 3 months follow-up			
GOS 5 GOS 4 GOS 3 GOS 2 GOS 1	24/1/0/0/0	24/1/0/0/0	
Mean GOS (at 3 months follow-up)	4.9	4.9	NS
Mortality	0	0	

Discussion

There have been an increasing number of studies published in recent years on the efficacy of placing SPD devices following burr-hole craniostomy for the treatment of symptomatic CSDH. SPD insertion has been rated a technically simple solution that is both safer and more successful than traditional SDD insertion. The purpose of our study was to conduct a prospective direct comparison of these two surgical methods, with the realistic objective of evaluating their efficacy and discovering any variations in total surgical complications, functional outcomes, and death. There were no statistically significant changes in patient data, mean haemorrhage size, concomitant conditions, or pre-operative complaints. When compared to traditional SDD, we discovered that SPD implantation was similarly effective and resulted in a reduced risk of surgical complications. This was indicated by a considerable decrease in post-operative symptoms and an improvement in Markwalder grades within each group. We discovered a decreased risk of post-operative ICH, which can be induced by unintended insertion of the SDD into the brain, due to the small invasiveness of the SPD method, which includes no contact with the brain parenchyma. However, this difference did not achieve statistical significance. As previously reported (3, 14), we found no significant differences in the decrease of postoperative seizures or recurrent haemorrhages in the SPD team. The comparatively small sample size in our study hampered these conclusions somewhat. We also discovered that recurring hematomas were closely associated to the resumption of anticoagulant therapy throughout the postoperative period. The authors of three distinct trials that yielded class (III) recommendations discovered that restarting oral anticoagulants 72 hours after surgery was safe and did not increase the incidence of post-operative cerebral haemorrhage (4, 9, 13). As a result, further research is needed to provide better recommendations for beginning anticoagulant therapy during the post-operative period. A GOS score of 4 or above at three months of follow-up indicated favourable functional results. Other trials with identical follow-up periods revealed comparable satisfactory results three months after surgery (3, 14). In line with these findings, our study found that after three months, there was no discernible difference between the two groups. Yet, Kaliaperumal et al. (2012) discovered that patients treated with the SPD system had considerably superior modified Rankin scores after six months. As a result, a longer period of follow-up would be required to show any significant changes in the overall functional results of the patients in our research.

Conclusion

Our findings show that the SPD and SDD methods are both safe, technically simple, and very successful in the treatment of CSDH, with no statistically significant differences in terms of total surgical complications, functional results, or death. The SPD group had a lower risk of post-operative ICH due to unintentional subdural drain insertion in the brain parenchyma, but the difference was not statistically significant. Because our study had a limited sample size and a short follow-up time, we urge a future prospective, randomised, multicenter investigation with a bigger sample size and a longer follow-up period (at least six months) to further corroborate our findings .

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