ORIGINAL ARTICLE

Subgaleal Drain Placement Following Intracranial Surgeries: A Prospective Observational Study on Outcomes and Complications

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ABSTRACT

Introduction: Subgaleal drains are commonly used following intracranial surgeries to prevent hematoma accumulation and enhance wound healing. However, there is limited evidence regarding the outcomes and complications associated with drain placement. There is also a lack of standardized protocols regarding the use of drain following craniotomies. **Aims:** To evaluate the postoperative outcomes, including complication rates, duration of ICU and hospital stay following subgaleal drain placement in patients undergoing intracranial surgeries. Additionally, the aim was to correlate the patient characteristics with the duration of drain placement. **Methods:** A prospective observational study was conducted among 40 patients at Nepalgunj Medical College. Demographic, clinical and postoperative data were collected, including drain duration, ICU and hospital stay and complications such as cerebrospinal fluid leak, wound infection, and periorbital swelling. All data were analyzed using SPSS version 26. **Results:** Among 40 patients with subgaleal drains, the mean duration of drain placement was 4.55 days, with 55% of drains removed within 5 days with the threshold being <30ml/24 hrs. The most frequent complication was periorbital swelling (72%), followed by surgical site infection (30%) and wound dehiscence (27.5%). CSF leaks occurred in 10% of cases, while meningitis and pneumocephalus were rare (<5%). There was no statistically significant correlation between the patient characteristics (Age, sex, diagnosis and type of surgery) to the duration of drain placement. **Conclusion:** Subgaleal drain placement following intracranial surgery appears to be generally safe and effective owing to the removal of drain in less than 5 days without clinical untoward effects. There is no correlation of duration of drain placement to patient demographics and surgical parameters including postoperative complications. suggesting the need of standardized early drain removal protocols. The self-limiting and minor, manageable complications like periorbital swelling, surgical site infection and wound dehiscence are most frequent complications and are independent of the drain duration placement.

Keywords: Craniotomy, Complications, Hypertension, Intracranial surgery, Neurosurgery, Skin closure, Subgaleal Drain

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INTRODUCTION

Numerous surgical nuances have been highlighted in literature to reduce complications and accelerate recovery following intracranial surgeries. These include meticulous surgical techniques, proper dura and skin closure, and the strategic placement of surgical drains.[1] The use of drains has been shown to lower both recurrence and mortality rates.[2] However, postoperative complications such as intracranial bleeding, cerebrospinal fluid (CSF) leakage, surgical site infections and meningitis can still arise. These complications may lead to prolonged hospital stays, increased morbidity and mortality, and higher healthcare costs.[3–6] Surgical evacuation followed by placement of postoperative drain remain standard in many intracranial procedures. Subgaleal drain placement, specifically used to reduce fluid accumulation under the scalp (subgaleal collections), has its own advantages and risks.[6] While it can potentially facilitate surgical site infections, secondary wound break

down, and even meningitis in the presence of a CSF leak,[1 7] it is also associated with shorter hospital stays, a higher likelihood of being discharged home and improved functional outcomes. It is important to note that negative suction drainage may lead to severe complications such as brain swelling and even death, particularly after procedures like cranioplasty.[8,9] The recent TOSCAN trial, in a post hoc analysis, suggested that subgaleal drains may offer a safer risk profile and comparable efficacy to subdural drains.[10] Understanding the implications of subgaleal drain placement on patient outcomes including the incidence of complications, duration of hospitalization, morbidity, mortality, and overall treatment costs is vital for optimizing neurosurgical practices and improving patient care.

METHODS

A prospective observational study was conducted at Nepalgunj Medical College over a six-months period (May 2024 - October 2024) to evaluate the outcomes and potential complications of subgaleal drain placement following intracranial surgeries. The ethical approval for the study was obtained from the Institutional Review Committee of Nepalgunj Medical College.

Inclusion criteria:

1. Patients from the Department of Neurosurgery who underwent procedures for brain tumors, hemorrhages, traumatic injuries, aneurysms, or ischemic stroke and add Brain abscess also.

2. Willing to give consent for the study.

Exclusion criteria:

1. Patients with chronic liver or kidney disease,

2. Patients with coagulation disorders, prior radiation therapy, or those receiving immunosuppressive treatment.

Collected data included demographic and clinical information such as age, sex, diagnosis, and comorbidities, along with detailed surgical records covering craniotomy type, presence of dural defects, incision length, and closure methods. Postoperative metrics included drain duration, length of ICU and hospital stay, and complications such as CSF leaks, wound infections, meningitis, pneumocephalus and periorbital swelling. The subgaleal drain output was measured 24 hourly. Drain was intermittently clamped and was removed if the output dropped below 30 ml.

Statistical analysis

All data were analyzed using SPSS version 26. The continuous variables (age, incision size duration of hospital and ICU stay, duration of drain) were mentioned as means. Similarly, categorical variables (complications, comorbidities) were analyzed using chi-square test to determine the association with drain duration, hospital and ICU stay.

RESULTS

Variables	Frequency (F)	Percentage (%)
Age (in years)		
<=20	4	10
21-39	8	20
40-60	15	37.5
>60	13	32.5
Mean age (years) 47.6		
Sex		
Male	28	70
Female	12	30
Comorbidities		
Diabetes Mellitus	6	15
Hypertesion	12	30
Diagnosis		
Ischemic stroke	8	20
Intracerebral hematoma	11	27.5
Ruptured aneurysm	4	10
Brain tumor	2	5
Extradural Hematoma(EDH)	4	10
Subdural Hematoma(SDH)	10	25
Cerebral contusion	1	2.5
Surgery		
Decompressive craniectomy with lax duroplasty	8	20
Craniotomy with clipping of aneurysm	4	10
Craniotomy with tumor decompression	2	5
Craniotomy and evacuation of hematoma	18	45
Decompressive craniectomy with evacuation of Hematoma	7	17.5
Craniotomy with excision of brain tuberculoma	1	2.5

Table I (a): Demographic and clinical data of Patients: (n=40)

Among the 40 patients enrolled in the study, the mean age was 47.6 years. A male predominance was observed, with 70% of the participants being male and 30% female. Regarding comorbidities, 15% patients were diabetic, and 30% had history of hypertension. The common diagnosis were intracerebral hematoma and subdural hematoma, each comprising 27.5% and 25% of cases respectively. This was followed by ischemic stroke (20%) and extradural hematoma (10%). Less frequently observed conditions included brain tumors, ruptured aneurysms and cerebral contusion. Craniotomy and evacuation of hematoma was the most commonly performed surgery, undertaken in 45% of the patients.

Parameters	Frequency (F)	Percentage (%)
Incision length (cm)		
Mean	9.775 cm	
Incision breadth(cm)		
Mean	9.3 cm	
Size of craniotomy		
<=25 cm^2	16	40
>25 cm^2	24	60
Glasgow coma scale		
Mild (13-15)	10	25
Moderate (9-12)	22	55
Severe(<=8)	8	20
Type of skin closure		
Mattress	14	35
Continuous interlocking	26	65
Dural defect length		
None	26	65
1cm	7	17.5
2cm	7	17.5
Duration of drain (days)		
<5 days	22	55
>=5 days	18	45
Days of ICU stay		
<5 days	10	25
>=5 days	30	75
Complications		
None	7	17.5
Periorbital swelling	29	72
CSF leak	4	10
Surgical site infection	12	30
Wound dehiscence	11	27.5
Meningitis	2	5
Pneumocephalus	1	2.5

Table I (b): Clinical parameters, Perioperative data and surgical outcome of patients (n=40)

The mean incision length and breadth were 9.775 cm and 9.3 cm, respectively. Craniotomies measuring more than 25 cm^2 were more frequently observed, accounting for 60% of cases. A majority of patients (55%) presented with a moderate Glasgow Coma Scale (GCS) score at the time of admission. Regarding skin closure techniques, continuous interlocking suturing was the most commonly applied method (65%) while mattress suture was used in 35% of cases. The mean ICU stay was 8.6 days, and the average total hospital stay was 17.8 days. In terms of dural closure, 65% of patients had no dural defect. Sub-galeal drains were typically maintained for less than 5 days in the majority of patients (55%), with the mean drain duration being 4.55 days. The prevalence of complications (at least one complication) following drain placement in intracranial surgeries was 82.5%. Periorbital swelling was the most frequently reported complication (72%), followed by surgical site infection (30%) and wound dehiscence (27.5%). Less frequently observed complications included CSF leaks, meningitis, and pneumocephalus.

Parameters	Duration of drain less than 5 days	Duration of drain more than 5 days	P value (0.05)
Age			
<=20	4	0	0.23
21-39	3	5	
40-60	8	7	
>60	7	6	
Sex			
Male	17	11	0.26
Female	5	7	
Diabetes Mellitus (+)	33	3	0.534
Diabetes Mellitus (-)	189	15	
Hypertension (+)	74	8	0.122
Hypertension (-)	18	10	
Diagnosis			0.313
Ischemic stroke	4	4	
Intracerebral hematoma	4	7	
Ruptured aneurysm	2	2	
Brain tumor	1	1	
Extradural Hematoma(EDH)	4	0	
Subdural Hematoma(SDH)	7	3	
Cerebral contusion	0	1	
Type of Surgery			
Decompressive craniectomy with lax	4	4	
Duroplasty	3	1	
Craniotomy with clipping of aneurysm	2	0	
Craniotomy with tumor decompression	7	11	
Craniotomy and evacuation of hematoma	6	1	
Decompressive craniectomy with evacuation of Hematoma	0	1	
Glasgow coma scale			
Mild	7	3	

Moderate	12	10	0.159
Severe	3	5	
Dural defect			
None	14	12	0.514
1cm	3	4	
2cm	5	2	
Type of skin closure			
Mattress	8	6	0.87
Continuous interlocking	14	12	
Complications			
No complications	5	2	0.97
Complications+	17	16	

Table II: Association of patient characteristics and surgical factors with duration of drain: (n=40)

Drain duration was independent of patient characteristics like age, sex, diagnosis, type of surgery, comorbidities, neurological status, or surgical factors (dural defect and type of skin closure) in this cohort. There is also no significant association of complications with the duration of drain placement. Sub group descriptive frequency analysis showed that drain duration was independent of the individual complications like periorbital swelling and wound dehiscence, implying no added benefit of reducing wound dehiscence and periorbital swelling by keeping the drain for longer period of time.

DISCUSSION

The average drain time in this study is 4.55 days, supports current recommendations that early drain removal decreases the risk of an infected hematoma with little compromise to hematoma formation. The common complications observed were periorbital swelling (72%), surgical site infections (30%), and wound dehiscence (27.5%). The commonest complication being periorbital swelling may be due to tracking of fluid along the subcutaneous planes, exacerbated by subgaleal drainage dynamics as also mentioned by Gazzeri et al.[6] These complications are consistent with previously reported postoperative complications following craniotomies, including intracranial or extracranial hemorrhage, cerebrospinal fluid (CSF) leakage, delayed wound healing, and wound infections.[11, 12] While subgaleal drains are routinely employed to prevent subgaleal fluid collections and minimize wound tension, inappropriate management of these drains may contribute to postoperative complication. Our findings align with the study by Hani et al., which demonstrated that subgaleal drain placement is generally safe and effective, with no reported parenchymal injuries.[13] However there are some mentions in research studies done by Roth et al[7] and Van Roost et al[9] of very rare but serious complications such as intracranial hypotension, hematoma formation, and pseudo hypoxic brain swelling associated with suction drainage. The result of this research states that there is a change in opinion for subgaleal drains in comparison with subdural drains due to the fact that with the former the placement is quick and clean and the possibility of direct cortical injury is less.[2,8,13] Moreover, the infection rates post-surgery in our study were very low which is suggestive of a good sterile technique and a careful attempt at prophylactic antibiotics.[3,4] After all, proper adjustment of suction strength and continuous patient monitoring is to be ensured. The lack of correlation between drain duration and patient factors contrasts with Roth et al[7] who associated prolonged drainage with comorbidities like diabetes. This discrepancy may stem from our smaller sample size or stricter adherence to the 30 mL/24-hour output threshold for removal. Our findings align more closely with the TOSCAN trial's post hoc analysis by Hani et al[13] which favored subgaleal over subdural drains for safety and comparable efficacy. The is no significant association between the duration of drain and the presence of complications. This suggests that complication rates were similar whether drains were removed earlier (<5 days) or later (≥5 days).This supports the fact that we have removed drain not considering the presence of complications but only keeping up the criteria of 30ml/day. In contrast to the study done by Roth et al[7], which stated the higher infection rates with prolonged drain placement, our study does not state any association. This may indicate strict aseptic protocols in our institute as well as exclusion of immunocompromised patients. This unassociated assertion is in alignment to the study done by Gazzeri et al[6], where drain duration was independent of outcomes.

Further studies involving larger sample sizes and comparative analyses are warranted to validate these findings and optimize best practices in neurosurgical care.

LIMITATIONS

This study has limitations inherent to its single-center design and small sample size (n=40), which may limit generalizability. Larger, multi-center studies could validate our findings and explore subgroup analyses (e.g., tumor vs. trauma patients). Additionally, the lack of a control group (e.g., no-drain patients) precludes definitive conclusions about drain efficacy.

CONCLUSION

Subgaleal drain placement following intracranial surgery appears to be generally safe and effective, with the majority of patients undergoing drain removal within five days. There is no significant association observed between drain duration and other demographic and surgical parameters including complications. The complications after drain placement are minor and usually self-limiting. Early removal of subgaleal drain appears feasible across diverse populations.

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