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Clinical Studies

Is a wound drain needed routinely after anterior cervical discectomy and fusion?

Jude Geldart, BSc (Hons), MBChB[a], Katie Mathieson, MBChB (c)[b], Sayan Biswas, MBChB (Hons), MRes (Dist)[c], Ella Snowdon, BSc (Hons), MBChB[c], Ved Sarkar, BSc (c)[d], Callum Tetlow, BSc[e], K. Joshi George, MBBS, MD, FRCS (Neurosurgery), FEBNS, FISS[b,f,*]

[a] Specialised Foundation Doctor Training Programme, University of Glasgow, University Avenue, G128QQ, Glasgow, Scotland, United Kingdom
[b] Faculty of Biology, Medicine and Health, University of Manchester, M139PL, Manchester, England, United Kingdom
[c] Specialized Foundation Doctor Training Programme, Edge Hill University, L394QP, Omskirk, England, United Kingdom
[d] College of Letters and Sciences, University of California, Berkeley, California, 94720, United States
[e] Division of Data Science, The Northern Care Alliance NHS group, M68HD, Manchester, England, United Kingdom
[f] Department of Neurosurgery, Manchester Centre for Clinical Neurosciences, Salford Royal Hospital, M68HD, Manchester, England, United Kingdom

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ABSTRACT

Background: Postoperative subfascial wound drains are commonly used in anterior cervical discectomy and fusion (ACDF) surgeries to help lower the risk of complications from postoperative haematomas (POHs) and surgical site infections (SSIs). However, controversy surrounding their efficacy remains, due to limited guidelines and a lack of conclusive evidence. The primary aim of this study is to determine whether placing a drain routinely offers any therapeutic benefit for postsurgical outcomes in ACDF intervention, hence re-evaluating their routine use in clinical practice.

Methods: This retrospective study analyzed on patients who underwent ACDF procedures between January 2013 and December 2023 at a tertiary neurosurgical centre in the UK. Patients were categorized into drain and nondrain cohorts and stratified according to several predictor variables including baseline demographics, and clinico-social characteristics. The primary outcome measure investigated in this study was the incidence of postoperative complications and length of stay (LOS) between those who received a drain and those who did not.

Results: A total of 1,938 patients met the inclusion criteria and were included in our analysis. Of these patients, 1,614 (83.3%) had subfascial drains placed during surgery. Baseline demographics differed slightly between both cohorts, with patients in the drain group having a higher median age (p=.02), and a significantly higher proportion were male (p=.02), hypertensive (p<.01), drank alcohol (p<.01) and smoked (p=.04). Between the 2 groups, we observed no significant difference in rates of reoperation for POHs (p=.43), SSIs (p=.85) or LOS (p=.18).

Conclusions: Our study found no significant differences in the incidence of POHs or SSIs between post-ACDF patients with drains and those without, nor was there any difference in postoperative length of stay between the groups. Therefore, our results do not support the routine use of subfascial drains in clinical practice.

Introduction

ACDF surgery is 1 of the most frequently performed procedures in the cervical spine [1]. The volume of ACDF operations has grown rapidly, with an almost eightfold increase in the United States between 1990 and 2004 [2]. Additionally, projections suggest a further 13.3% rise in ACDF procedures between 2020 and 2040 [3]. Considering the high prevalence of this surgery, it is essential to re-evaluate the techniques

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* Corresponding author. K. Joshi George, Consultant Neurosurgeon, University of Manchester, Manchester Centre for Clinical Neurosciences, Salford Royal Hospital, Stott Ln, Salford M68HD, Manchester, England, United Kingdom.

E-mail address: joshi.george@nca.nhs.uk (K.J. George).

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used as well as different aspects of each technique, as improvements could benefit a significant and growing number of patients. This goal serves as the focus of our study.

Navigating the complicated anatomy of the anterior cervical region can bring about a variety of complications [4]. The reported incidence of dysphagia following ACDF ranges from 1.7% to 9.5%, and surgical site infections (SSI) rates are estimated between 0.1 and 1.6% [5,6]. In addition, postoperative hematoma (POH) formation is associated with 0.4% to 5.6% of cases [5]. Although small haematomas are common in most surgeries, when confined to the cervical spine, POH can lead to airway compromise, proving fatal if not evacuated promptly [7,8]. Additionally, POH can also compress neurological structures and the oesophagus, as well as impairing wound closure and thus promoting surgical site infection (SSI) [7].

In an attempt to combat this, many surgeons routinely employ the use of postoperative subfascial drains when carrying out this procedure. However, this decision is primarily based on surgeon preference rather than prior evidence. The intended outcomes for drain placement involves removing blood and debris, primarily to reduce the risk of POHs and SSIs, whilst promoting wound healing [9]. A few studies have reported postoperative benefits with use of subfascial drains across different spinal surgeries [10,11]. However, research specifically examining their effectiveness in ACDF procedures remains limited.

Many studies have questioned whether routine drain use is necessary to prevent such rare complications, given the lack of research supporting their efficacy [7,12]. Several studies have shown no difference in clinical outcomes and complication profiles between patients undergoing ACDF with drains and those without [4]. While others have suggested that drain placement adversely impacts outcomes by infact increasing total blood loss and posthaemorrhagic anaemia, resulting in a greater requirement for allogenic blood transfusions [13]. Theoretically, drain usage could help reduce the risk of SSIs by removing blood and debris from the wound site. Nonetheless, some studies indicate that drains may act as a pathway for retrograde infection by becoming contaminated [4,13]. As such, the impact of drains usage on SSI rates postsurgery remains unclear.

The use of subfascial drains also carries an economic burden. In the local NHS hospital, 1 drain and bag is valued at a cost of £11.40 (data given by procurement department). Additionally, there is a cost associated with the time it takes to insert the drain, monitor its drainage and remove it. Drain placement has been associated with increasing both mean operating time and post operative LOS, which inevitably has a significant secondary cost for healthcare providers [4,6]. Additionally, the removal of drains can heighten patient anxiety and has been associated with increased rates of surgical site pain, dysphagia and hematoma formation [4,14].

Given these findings, postoperative drains remain a point of controversy amongst many spinal surgeons [4]. On the other hand, many surgeons believe that placing a drain even when there is no bleeding or risk factors for bleeding should be done routinely and in fact would see this as a standard of care.

As such, our study aims to investigate whether drain usage is associated with a decreased incidence of haematomas and surgical site infections, as well as observing any difference in LOS between drain and nondrain patients. The overall goal of this is to re-evaluate the routine use of drains during ACDF procedures, in order to improve patient outcomes, guide hospital resource allocation and streamline surgical protocol.

Methods

Data source

This study was a single tertiary centre retrospective analysis of all patients who had undergone ACDF surgery at a tertiary neurosurgery centre in the United Kingdom from 2013 to 2023. Both single and multilevel ACDFs were included. A PEEK cage was used in all cases and there was no plate fixation used.

Data for the study was obtained from the theatre coding system and operations were checked using the electronic patient record for accuracy. A retrospective case note review was performed, including data obtained from clinic letters, operation notes, discharge summaries, nursing notes and clinical notes. Patients with missing data and those undergoing nonelective surgeries were excluded.

Patient data was then anonymized and blinded prior to analysis. This retrospective study was approved by the institutional research and innovation team with the requirement for informed consent being waived due to the blinded and anonymized nature of the study (Reference number: 24HIP22).

Feature selection and cohort characteristics

6 predictor variables were identified and extracted from the database: age in years (continuous), sex (binary), ethnicity (white British, other white, Asian, black/African, other background and mixed background), co-morbidities (multiclass), neuropathy status (binary), and index of multiple deprivation (IMD) (yes or no)/IMD decile binarized (≤5 and >5). The primary outcome measure investigated in this study was the incidence of postoperative complications between those who received a drain and those who did not.

All patients receiving a sub-fascial wound drain intra-operatively were included in the drain group and the remaining patients were in the nondrain group. The placement of a wound drain was determined by analyzing the operation note for each patient.

The placement of a drain routinely was purely due to surgeon preference. The drain group included both single and multilevel fusions, while the no-drain group included only 1 and 2 level fusions.

Postoperative complications included POHs and SSIs within 30 days of the procedure. SSI was defined as starting on antibiotics with or without return to the operating room. POH was defined as a significant neck swelling thought to be from a haematoma or a haematoma which required return to the operating room.

Both haematoma and nonhaematoma groups had patients with some form of anticoagulation, but they were all stopped at an appropriate time point before surgery. Postoperatively, most patients went home the next day and did not require chemo-prophylaxis. Those who stayed in and had their drains removed were treated with prophylactic low molecular weight heparin.

Lastly, the differences in LOS between the drain and nondrain groups were compared. Postoperative LOS was divided into short (<48 hours), long (48 and 72 hours) and extended (>72 hours) groups.

Statistical analysis

All statistical analysis was conducted using the IBM SPSS software (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) Version 28 and trends were explored using Microsoft Excel (Microsoft Corporation, 2018). Categorical variables are presented as counts and percentages, with continuous variables presented as medians and ranges. Chi-square test and Fisher's Exact test were used to compare nominal variables. Independent sample t-test and Mann-Whitney U tests were used to assess difference in means and medians of continuous variables between 2 groups. The Kruskal-Wallis test was used to investigate difference in the medians between 3 groups. Values of $P < 0.05$ were considered statistically significant. P-values have been rounded to 2 decimal places.

Results

Baseline patient characteristics

1938 patients underwent ACDF surgeries between January 1st 2013 and December 31st 2023. Of the 1938 patients analyzed, 1,614 patients

Table 1
Cohort demographics with descriptive statistical analysis using t-tests for continuous variables (mean (± standard deviation)) and chi-square tests for categorical variables (n (%)).

Variable	Drain (n=1614)	No drain (n=324)	p-value
Sex n (%)			
Male	871 (54.0)	151 (46.6)	.02*
Female	743 (46.0)	173 (53.4)	
Age n (%)			
Median age	49	48	.02*
Comorbidities n (%)			
Alcohol	1054 (65.3)	186 (57.4)	<.01*
Smokers	546 (33.8)	91 (28.0)	.04*
Diabetes	160 (9.91)	21 (6.48)	>.05
Hypertension	294 (18.2)	35 (10.8)	<.01*
Neuropathy Status n (%)			
Radiculopathy	439 (27.2)	86 (26.5)	.81
Myelopathy	192 (11.9)	41 (12.7)	.70
n/a	983 (60.9)	197 (60.8)	.97
Index of multiple deprivation n (%)			
1-5	1048 (64.9)	224 (69.1)	.15
6-10	566 (35.1)	100 (30.9)	
Median	4	3	.16
Ethnicity n (%)			
White British	1472 (91.2)	294 (90.7)	.93
Asian	48 (2.97)	11 (3.40)	.69
Afro-Caribbean	16 (0.99)	1 (0.31)	.34
Any other ethnic group	78 (4.83)	18 (5.56)	.58

had a drain fitted (83.3%) whilst 324 patients did not have a drain fitted (16.7%). A significantly higher proportion of patients in the drain group were male compared to the no drain group (p=.02, Table 1). Median age was 49 years in the drain group, which was significantly higher than that of the no drain group (p=.02).

A significantly higher proportion were hypertensive (p<.01), drank alcohol (p<.01) and smoked (p=.04) in the drain group, compared to the no drain group. There were no differences between the 2 groups regarding the remaining variables (IMD, ethnicity, neuropathy status and diabetes); importantly, there were no significant differences with respect to previous extended LOS in the past year.

Additionally, there was no statistically significant association between number of fusion levels and whether a drain was fitted (p=.29). In the drain group, 63.8% had 1 level fusion, 33.7% had 2 level fusion and 2.4% had 3 level fusion. In the nondrain group, 75.7% had 1 level fusion and 24.3% had 2 level fusion.

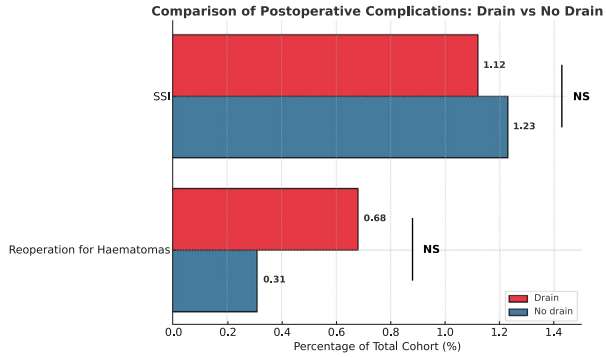

Fig. 1. Bar chart comparing rates of surgical site infections and reoperation for hematomas between the drain and the nondrain groups.

Haematomas, infections and length of stay

Out of a total of 1,938 patients included in our study, 12 received reoperations for POHs within 30 days of their initial procedure, accounting for 0.62% of the cohort. 5 additional patients had haematomas that were managed conservatively, all of whom were from the drain group. As such, a combined total of 17 (0.88%) patients suffered a postoperative haematoma, treated either conservatively or surgically.

Of those 12 receiving reoperations, 11 were performed in the drain group (n=1614) (0.68%, Fig. 1) and 1 was performed in the nondrain group (n=324) (0.31%). There was no significant difference in incidence of reoperations for POH between the 2 groups (p=.43). Half of the haematomas occurred in the first few hours after intra-operative drain placement and the other half occurred in a delayed fashion subsequent to drain removal.

The total number of patients who experienced an SSI within 30 days of their operation was 22 (1.14% of overall sample). 18 of these were from the drain group (1.12%) and 4 of these were from the nondrain group (1.23%). There was no significant difference in SSI incidence (p=.85, Fig. 1) between the 2 groups.

LOS was on average 48.8 hours (range 33–129 hours) in the group who had a drain fitted, versus 51.4 hours (range 33–130.5 hours) in the group who did not have a drain fitted. There was no significant difference (p=.18) in average LOS between the 2 groups, nor were there any differences in the proportion of each group who had short, long or extended LOS.

Symptomatology of haematomas needing reoperation

Haematomas were evacuated a median time of 48 hours following the original operation, with a range of reoperation occurring 0-144 hours postsurgery. Symptoms indicative of haematomas occurred on average 36.9 hours following the start of the original procedure, with a range of 0–193.5 hours (Table 2). Most frequently observed were neck swelling (28%, Fig. 2), dysphagia (24%) and focal neurological impairment (16%). There was insufficient data to be able to comment on the symptoms and the timing when they presented for 3 patients.

Discussion

To the best of our knowledge, Lim et al. (2022) and Lerch and Chau (2024) are the only available meta-analyses investigating the impact of subfascial drains on rates of reoperation for haematomas, SSIs and LOS for ACDF surgery [4,6]. A similar analysis was performed by Liu et al.

Table 2
Symptomatology and outcomes of all 12 patients reoperated on for hematomas.

Timing of reoperation/ days	Symptom	Time till symptom/hours for each symptom	Outcome
1	Neck swelling, dysphonia, bleeding	0 (neck swelling)	resolved
2	Neck swelling, dysphagia, focal neurological impairment	46 (dysphagia), 30 (focal neurological impairment)	n/a
0	Neck swelling, dysphagia, focal neurological impairment, bleeding	7 (focal neurological impairment)	residual motor impairment
2	Neck swelling, dysphagia	10.5 (dysphagia)	residual dysphagia
0	Neck swelling, dysphagia and stridor	4 (all)	residual dysphagia
0	Neck swelling, dysphagia, dysphonia and stridor	0 (all)	resolved
1	Focal neurological Impairment	1.33	resolved
4	Neck swelling, dysphagia and dysphonia	77 (all)	residual dysphagia
9	Unsteadiness, focal neurological deficit	193.5 (all)	residual motor impairment
9	n/a	n/a	n/a
3	n/a	n/a	n/a
9	n/a	n/a	n/a

n/a refers to cases where insufficient data was present.

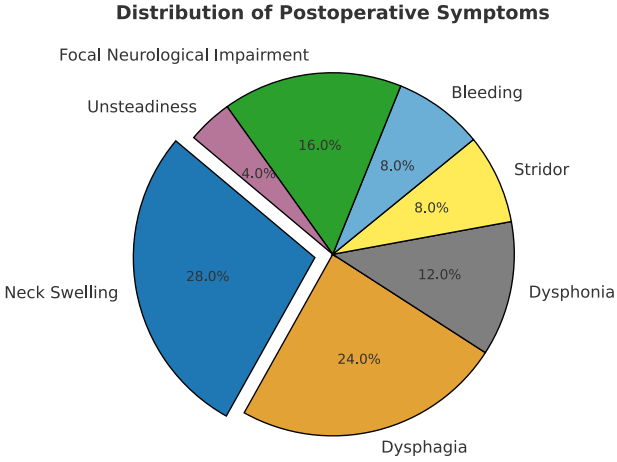

Fig. 2. Pie chart demonstrating the frequency distribution of clinical signs and symptoms seen in patients with postoperative hematomas.

[15] with a focus on posterior spinal surgery, as well as Muthu et al. [16] looking at various types of spinal surgery. Both Lim et al. [6] and Lerch and Chau. found no significant protective benefit of drain usage in ACDF surgery. Lim et al. [6] reported no increase in POH incidence among patients with drains, but observed a higher risk of extended LOS in these patients (p<.001). Similarly, Lerch and Chau found no significant difference in the incidence of POH, SSI, or reoperation rate in those receiving a drain, as well as no change in average LOS [4].

However, as acknowledged by the authors, the poor quality of data included in these studies was insufficient to draw conclusions on the effect of postoperative drains for ACDF procedures. Because of this, more studies with greater patient samples and experimental designs were required to address this clinical question.

Haematomas

Out of a total of 1938 patients included in our study, 12 received reoperations for POHs within 30 days of their initial procedure, accounting for 0.62% of the cohort. This rate of reoperation is in line with the range from previous studies: 0.4%–2.4% [5,7]. In our study, 5 additional patients had haematomas that were managed conservatively, as such, a combined total of 17 (0.88%) patients suffered a postoperative haematoma, treated either conservatively or surgically. This is also in line with rates from previous studies, who generally observe the rate of haematoma formation to be <1% [5–7,17].

Our results displayed no significant difference in incidence of reoperations for POH between the drain and nondrain groups (p=.43), which is consistent with existing literature [4,6,18]. In the meta-analyses produced by Lim et al, which analyzed 7943 ACDF patients, drain usage showed no significant impact on the rate of postoperative hematoma requiring either return to theatre or readmission [6]. Lerch and Chau et al also conducted a meta-analysis of 7 trials, with 1 of the primary outcomes to be observing any change in haematoma formation between drain and nondrain groups. However, 5 of these 7 trials documented no haematomas and so were not included in the results [8,13,18–20]. This is due to a small sample size, and given the small rate of haematomas, its not surprising that several studies documented no haematomas, limiting research in this area. Despite this, the analyses still concluded that drain usage had no measurable effect on the incidence of POH following ACDF surgery [4].

Regarding different surgeries within the same cervical region, Youssef et al. similarly found no significant difference in the risk for wound hematomas during both thyroidectomies and carotid endarterectomy procedures [21]. Likewise, in a meta-analysis evaluating closed suction wound drainage following lumbar spine surgery, Liu et al. demonstrated no significant reductions in rate of haematoma formation or reoperations associated with drain use [15,18].

Overall, the present study demonstrates that drain use does not reduce the need for hematoma evacuation within 30 days of ACDF surgery, which supports findings from previous studies.

Surgical site infections

The incidence of surgical site infections (SSI) serves as a key indicator of operation care quality, representing an unavoidable risk in surgical practice [22,23]. The present study's total SSI rate (1.14%) was in line with that reported in previous studies: 0.1%–1.6% [5,6,22].

There is a considerable lack of data surrounding the impact of drains on ACDF infections [5]. Several studies across various spinal surgeries have concluded that drain use increases the rate of SSIs by acting as a harbour for infection [15,16,24,25,26]. Some authors have also suggested that the duration a drain remains in place may influence the likelihood of SSI development [26]. This study did not include drain duration as a predictor variable, which is an area for future exploration.

Our results show no significant difference in SSI incidence between the drain and nondrain groups (p=.85), indicating that drain usage did

not affect SSI rates. This finding aligns with conclusions from multiple authors across various spinal surgeries [6,16,26,27]. In particular, meta-analyses on ACDF surgery have consistently found that drain use does not impact SSI rates [4,6].

In contrast, some authors have linked drain usage with a reduced incidence of SSIs. One large-scale study reported no significant difference in reoperation rates for SSIs between the drain and nondrain groups (1.61% vs 2.58%, p=.16). However, after adjusting for diabetes history and the number of operative levels, patients with drains showed significantly lower odds of returning to surgery for an SSI (OR 0.48, p=.04) [26]. Notably, this finding was specific to posterior spinal surgery.

Overall, the relationship between drain usage and SSI rates in ACDF procedures remains uncertain. However, our findings align with existing literature suggesting no correlation between the 2.

Length of stay

Few studies comment on LOS following ACDF surgery; average Figs. have ranged between 31.7 and 47.5 hours [13,28]. In our study, average LOS ranged from 48.8 hours and 51.4 hours in the drain and nondrain groups, respectively. There was no significant difference (p=.18) in average LOS between the 2 groups, nor were there any differences in the proportion of each group who had short, long or extended LOS. These findings are supported by consecutive meta-analyses focusing on ACDF surgery [4,6].

In contrast, several other studies have shown that drain use does increase LOS, showing a lack of consensus regarding this outcome [4,6,13,18,26].

Limitations

One limitation of the study was its retrospective design, which is inherently more susceptible to selection and recall biases and poses significant challenges in accounting for confounding variables. Statistically significant differences were observed in the number of patients with hypertension (p<.01), alcohol consumption (p<.01), and smoking (p=.04) between the drain and nondrain groups. These factors may have predisposed patients to higher rates of bleeding and infection postprocedure, potentially impacting the reliability of our results.

\Additionally, the drain group had a higher proportion of male patients (p=.02) and older individuals (p=.02). A recent study by Bovonrawet et al. [7] identified male sex as a risk factor for postoperative hematomas requiring reoperation in ACDF procedures. Age is also a well-established risk factor associated with prolonged recovery times and a higher likelihood of complications. These demographic differences could have further influenced our results.

Additionally, given the retrospective nature of this study, the reliance on pre-existing data means that missing data points or poor documentation may have compromised the reliability of our findings. Other recognized demographic risk factors, including ASA status, body mass index (BMI), preoperative anemia and coagulopathies, were not collected as part of this study, all of which could have influenced our results.

In addition, the present study did not consider the duration for which the drain remained in place as a predictor variable, a factor that has been linked to postoperative complications in several spinal surgeries. Additionally, selection bias and inherent differences between the drain and nondrain cohorts may have influenced our findings. One such difference that remains to be analyzed is whether pre-existing coagulopathies would have an impact on rates of SSI and POH.

Thus, there is a need for future larger prospective studies with more homogenous cohorts and propensity matching to strengthen our conclusions. Lastly, the single centre nature of this study also highlights the need for future prospective, external validation of these results in more diverse patient cohorts, in geographically different healthcare settings.

Conclusions

In conclusion, our study found no significant reduction in the incidence of postoperative haematomas or surgical site infections in postoperative ACDF patients receiving a wound drain, nor was there any difference in postoperative LOS between the drain and nondrain groups. Therefore, the use of subfascial drains in clinical practice should be evaluated on a patient by patient basis rather than being considered as a routine intervention or standard of care for patients undergoing ACDF surgery. One circumstance where we do recommend using a drain is if the surgical field looks oozy intra-operatively. Further studies are however needed to identify other patient groups that may benefit from drain placement, along with comprehensive research into their overall utility. Thus, re-evaluating the routine use of drains could help to reduce procedure costs, shorten surgery time and enhance patient recovery following ACDF intervention.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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