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Clinical commentary

Duration of indwelling drain following instrumented posterolateral fusion of the lumbar spine does not predict surgical site infection requiring reoperation

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ABSTRACT

The objective of this study was to determine the incidence and predictors of reoperation for surgical site infections (SSI) among patients whose lumbar, closed wound suction drains were removed in the inpatient setting prior to hospital discharge (pre-discharge cohort) versus after inpatient discharge during the first follow up visit (post-discharge cohort). All patients who were admitted for first-time, posterolateral decompression and fusion for degenerative lumbar spine disease were retrospectively reviewed at a single institution. In order to eliminate biases, neither the pre-discharge nor post-discharge cohorts experienced any intra-/postoperative sentinel events other than the primary outcome measure: reoperation for SSI. Of 209 patients in the pre-discharge ($n = 130$) and post-discharge ($n = 79$) cohorts, 15 patients required reoperation for SSI. Although time to drain discontinuation was significantly longer in the post-discharge (8.28 days) than the pre-discharge (4.65 days) cohorts ($p < 0.001$), the incidences of reoperation for SSI did not significantly differ (6.33 vs 7.69%, respectively, $p = 0.711$). In a multivariable regression, only smoking (OR = 5.75, $p = 0.007$) and depression (OR = 4.11, $p = 0.040$) predicted reoperation for SSI. Neither time to drain removal nor setting of drain removal was a predictor of reoperation for SSI. Although time to drain discontinuation was expectedly longer in the post-discharge versus pre-discharge cohorts, the incidences of reoperation for SSI did not significantly differ. Neither time to drain removal nor setting of drain removal predicted reoperation for SSI. These results suggest that patients may be safely discharged from the hospital with the surgical drain in place.

1. Introduction

Prophylactic placement of closed wound suction drainage in spine surgery serves dual roles in both the detection and the prevention of a seroma from interstitial fluid collection, a hematoma from excess bleeding, and/or pseudomeningocele from a cerebrospinal fluid leak [1]. In a randomized controlled trial of 83 patients undergoing extensive lumbar surgery, Brown et al concluded that the closed wound suction drains do not significantly increase the risk of surgical site infections (SSI) [2]. However, the controversy on closed wound suction drainage hinges on whether the risk of infection from prolonged retention of a foreign body outweighs the utility the drain itself [3,4]. One important consideration often overlooked in this long standing debate is that time to drain discontinuation may require examination in conjunction with the setting of drain discontinuation. The objective of this study was to determine the incidence and predictors of reoperation for SSI among patients whose lumbar, closed wound suction drains were removed in the inpatient setting versus the outpatient setting.

2. Methods

Following Institutional Review Board approval, patient records were retrospectively reviewed for hospital admissions for all first-time lumbar laminectomy plus instrumented posterolateral

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fusions performed at a single institution from 2007 to 2014. All lumbar surgeries were indicated for degenerative spinal diseases. Operations for congenital spinal conditions, metabolic diseases, and neoplastic spinal processes were excluded. Similarly, the exclusion criteria also pertained to pediatric patients (age <18 - years), previous lumbar fusion, and history of HIV/AIDS infection or hepatitis. During the index spinal surgery, a closed wound suction drain was placed in all patients in the study population. All patients were admitted onto the inpatient neurosurgical service following lumbar operation. In the postoperative course, the surgical wound was maintained with closed-suction drainage. The drain was removed either in the inpatient setting prior to hospital discharge (pre-discharge cohort) or in the outpatient clinic at first follow up appointment after hospital discharge (post-discharge cohort).

Preoperative demographic data, patient comorbidity, intraoperative surgical parameters, postoperative outcomes, and follow up encounters were collected from the electronic medical records. Drain output [milliliters (mL)] 24 h prior to drain discontinuation was collected for all patients in the pre-discharge cohort. The primary endpoint of this study was reoperation for SSI, which was defined as a surgical site infection that occurred after the index operation and required surgical debridement plus aggressive antibiotic therapy. Cultures from all reoperations returned positive for infectious microbes. In order to eliminate biases, neither the pre-discharge nor the post-discharge cohorts experienced any intra-/postoperative sentinel events other than the primary outcome measure: reoperation for surgical site infection.

2.1. Statistical analyses

The study population was elaborated using general summary statistics. The pre-discharge cohort was compared with the post-discharge cohort. Continuous outcomes were compared with a variance ratio test followed by the appropriate t-test, based on the population variances. Nominal variables were compared with Pearson's chi-squared (χ^2) test. Median numbers were compared with a Wilcoxon rank-sum test. Number of days until drain discontinuation was divided into 5 quantiles (quintiles) in order to (1) eliminate the skewed effect of outliers; and (2) identify a time frame, at which the incidence and/or odds of reoperation for SSI statistically significantly increases. Excluding cases with missing data may comprise the statistical power and bias the results [5]. Thus, absent values for drain output (mL) in the pre-discharge cohort were populated with multiple imputations, using chained equations implemented by the Stata v12.1 (Stata Corporation, College Station, Texas) mi command [6]. The imputation model included the outcome, reoperation for SSI, as well as the covariables age, gender, diabetes mellitus, obesity, smoking, depression, antibiotics, number of spinal levels decompressed, and time to drain discontinuation. The model was limited to the pre-discharge cohort (from which drain output was missing) and generated 100 datasets. Imputed values for drain output are included in Table 1.

After an initial simple logistical regression, predictors of reoperation were calculated with multiple logistical regression with a forward stepwise modeling, reporting adjusted odds ratios ($OR_{\_adjusted}$). Each regression model tested in the forward stepwise approach was analyzed with a sensitivity analysis based on three criteria: (1) Akaike's Information Criterion (AIC), (2) model discrimination: C-statistic corresponding to the area under the receiver-operating characteristic (ROC) curve; and (3) model calibration: p-value of the Hosmer-Lemeshow Goodness-of-Fit Test. The AIC enables the analysis of the tradeoff between the log-likelihood function and the number of parameters, such that lower AIC values indicate a more robust model fit [7]. The C-statistic was used for model discrimination. By approximating the area under the receiver-operating characteristic (ROC) curve, a C-statistic was used to measure how well the regression model can discriminate among different observations between the dichotomous outcome measure: reoperation for SSI [8]. According to the Hosmer and Lemeshow principles on the C-statistic, discrimination is deemed acceptable (0.7–0.8), excellent (0.8–0.9), or outstanding ($\geqslant$0.9) [9]. Lastly, goodness-of-fit of the model, or model calibration, was tested with the Hosmer-Lemeshow approach, a statistic which resembles a chi-square test modified with the degrees of freedom [10]. A Hosmer-Lemeshow goodness-of-fit test approaching a p-value of zero reflects a poor fit of the data. Statistical significance was set at $p < 0.05$. All statistical analyses were performed using STATA (version 13.0, College Station, TX, USA) and Microsoft Excel.

Table 1
Perioperative characteristics are compared in patients whose drains were removed in the hospital (pre-discharge cohort) versus in the clinics (post-discharge cohort).

	Pre-discharge drain removal n (%)	Post-discharge drain removal n (%)	P^*
Number of cases	130	79	
Age ± standard error (years)	57.27 ± 1.13	59.87 ± 1.28	0.141
Sex, males	57 (43.85)	41 (51.90)	0.258
Comorbidities			
Coronary Artery Disease	14 (10.77)	12 (15.19)	0.348
Chronic Obstructive Pulmonary Disease	6 (4.62)	5 (6.33)	0.591
Diabetes Mellitus	25 (19.23)	5 (6.33)	**0.010**
Current Smoker	21 (16.15)	13 (16.46)	0.954
Hypertension	62 (47.69)	51 (64.56)	**0.018**
Obesity	44 (33.85)	25 (31.65)	0.743
Depression	25 (19.23)	13 (16.46)	0.614
Hyperlipidemia	30 (23.08)	27 (34.18)	0.081
Postoperative outcomes			
Inpatient hospital stay ± standard error (days)	4.82 ± 0.15	3.91 ± 0.14	< **0.001**
Drain retention ± standard error (days)	4.65 ± 0.17	8.28 ± 0.36	< **0.001**
Days on perioperative antibiotics ± standard error	3.62 ± 0.17	3.15 ± 0.17	0.066
24-h drain fluid collection prior to drain removal ± standard error (mL)	91.44 ± 6.36		
Reoperation for surgical site infection	10 (7.69)	5 (6.33)	0.711
Months of follow up ± standard error	21.07 ± 1.91	30.94 ± 2.71	**0.003**

* Statistically significant values are in bold.

3. Results

3.1. Demographic and comorbidity data

The study population consisted of 209 patients who were admitted for first-time lumbar laminectomy plus instrumented posterolateral fusion. Over a mean follow up time of over 2 years (24.80 months), the setting of drain discontinuation was either in the inpatient setting prior to hospital discharge (pre-discharge cohort: $n = 130$, 62.20%) or in the outpatient clinic at first follow up appointment after hospital discharge (post-discharge cohort: $n = 79$, 37.80%) (Table 1). Between the pre-discharge and post-discharge cohorts, preoperative prognostic factors did not statistically significantly differ with age ($p = 0.258$) and gender ($p = 0.258$). Of the comorbidities, diabetes mellitus was statistically significantly higher in the pre-discharge group (19.23%) versus the