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Original Article

Old age is associated with increased surgical drain output after lumbar surgery for degenerative disease

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Abstract: Employing a drain or not always put surgeons in a dilemma. Few studies have evaluated the associated factors of surgical drains after lumbar posterior decompression and instrumented fusion. The aim of this study was to record the characteristics of postoperative drain output, and tried to identify possible risk factors that are independently associated with it. From January 2014 to March 2017, patients undergoing posterior lumbar interbody fusion were included in our study. All patients underwent single- or multiple-level transforaminal lumbar interbody fusion (TLIF) or posterior lumbar interbody fusion (PLIF). The volume of drain output was measured. Variable were collected from demographic data, lab test and surgical information. Both univariate and multivariate analysis were used to detect factors associated with greater drain output. Besides, correlations between the potential variables and volume of drain output were also analyzed. A total of 429 patients were included in this study. Patients with drain output greater than 240 ml drain output were ascribed to case group, and other patients were in control group. The operative time was not correlated with volume of drain output (r = 0.471; $P = 0.29$), but age was positively correlated with postoperative drain output (r = 0.269; $P < 0.001$). Multivariate logistic analysis showed that age ≥ 55 years (odds ratio [OR], 2.860; 95% confidence interval [CI], 1.164-6.847) and multiple levels fused (OR, 1.359; 95% CI, 1.680-6.432) were two significant independent factors that are associated with greater drain output after lumbar spine surgery ($P < 0.05$). The present analysis demonstrated that age and number of levels are two factors that are associated with volume of postoperative drain output. Patients with these factors should be informed of the possibility of increased drain output, and routine blood test should be performed after surgery in case of the incidence of low hemoglobin.

Keywords: Old age, drain output, lumbar surgery, degenerative disease

Introduction

The number of cases with lumbar degenerative disease is increasing among the aging population worldwide [1]. Posterior decompression and instrumented fusion, including posterior lumbar interbody fusion (PLIF) and transforaminal lumbar interbody fusion (TLIF), is supposed to be the most commonly used surgical strategy for lumbar degenerative disease [2, 3]. Lumbar surgery entails prolonged operative time, use of instrumentation and considerable muscle dissection, all of which may contribute to great postoperative bleeding in wound. The usage of a closed suction drain after lumbar surgery has become a routine procedure [4].

The drawbacks of using a drain include pain, discomfort, anxiety and inconvenience of mobilization, which decrease the value of suction drain [5, 6]. Although there are reports challenging drain use in many other surgical procedures [7, 8], we consider that prophylactic placement of closed suction drain serves several important roles in lumbar surgery. Most commonly, drains are utilized to decrease the incidence of hematoma, which may result in a severe neurologic deficit [9]. Besides, drain use after lumbar surgery has been shown to decrease the amount of blood in wound and, as a result, decrease infection rates [10, 11]. Further more, it helps surgeons to detect the existence of potential cerebrospinal fluid leak after surgery. What's more, there is also evidence that usage of drains may decrease the incidence of postoperative fevers after lumbar spine surgery [12, 13].

A review of the literature revealed that only a few studies investigating the drain output after spinal surgery. Several years ago, Basques et al. performed a retrospective study and identified several factors that are independently associated with greater surgical drain output in patients after anterior cervical discectomy and fusion (ACDF) procedure [14]. However, as we know, few prior studies have directly evaluated the associated factors of surgical drains after lumbar posterior decompression and instrumented fusion. We conducted this study to record the characteristics of postoperative drain, and tried to identify possible risk factors that may be associated with the increased drain output.

Materials and methods

Ethics statement

The research protocol was approved by Ethics Committee of the Third Hospital of Hebei Medical University. As this was a retrospective study and all of the data were collected and analyzed anonymously, there was no need to obtain informed consent from patients.

Patient population

This retrospective study included 429 patients who underwent posterior lumbar interbody fusion for degenerative disease in our institution between January 2014 and March 2017. The inclusion criteria were adult patients with degenerative disease, including lumbar disc herniation (LDH) and lumbar spinal stenosis (LSS). Diagnoses were confirmed by neurological examinations and imaging tests. Patients were excluded if they had previous histories of lumbar spine surgery, vertebral fractures, or bleeding disorders like platelet disorder or factor deficiency. Patients with tear of dural sac and cerebrospinal fluid leak because of surgery were also excluded.

Surgical procedures

The location and number of levels to be treated surgically were based on objective clinical findings and imaging test, such as computed tomography (CT) or magnetic resonance imaging (MRI). In this study, all patients underwent single- or multiple-level transforaminal lumbar interbody fusion (TLIF) or posterior lumbar interbody fusion (PLIF) according to the scope of the lesions. Pedicle screws were inserted in both sides of vertebrae. In the PLIF procedure, spinous process, lamina, hyperplasia of yellow ligament, and interior zygapophysis were removed. In the TLIF procedure, unilateral pars interarticularis and interior zygapophysis were removed. The suction drain was placed before wound was closured in layers. Surgeries were performed by a senior doctor with more than 10 years of experience. All patients received intravenously administered 10 mg/kg tranexamic acid intraoperatively. The sustained negative pressure drains were removed at 2 days after surgery if the amount of drain output was less than 50 ml within 12 hours. Drains were not maintained for more than 3 days.

Data collection

Demographic data of each patient were collected from the medical record, including age, gender, body mass index (BMI), history of smoking, medical comorbidities (like diabetes mellitus, hypertension, heart disease and taking aspirin currently), and types of lesions. History of smoking was considered as positive if tobacco was used within one year before surgery. Diabetes and hypertension were defined as previous treatment for these conditions or by findings during the preoperative test. Heart disease was determined as previous or current arrhythmia, valvular abnormalities, myocardial infarction, congestive heart failure or coronary artery disease. From lab test, we retrieved the following variables, such as hemoglobin (HGB), platelet (PLT), fibrinogen (FIB), prothrombin time (PT), thrombin time (TT) and D-dimer. Surgical procedures included variables such as numbers of level fused, operative time, blood loss, blood transfusion, length of incision, and surgical strategy. Operative time was determined by the time from the start of incision to the end of wound closure.

Drain output was the primary outcome of our study, and it was measured as the total volume of output from the time of ending surgery until time of drain removal. This variable was measured in milliliters. Patients with drain output greater than 240 ml drain output were ascribed to case group, and other patients were in control group.

Table 1. Comparison of patient characteristics between case and control groups

Variable	Case group (n = 112)	Control group (n = 317)	*t* or chi-square value	*P* value
Age (years)	59.2±11.8	54.3±10.2	4.189	< 0.001
Gender				
Male	50 (44.6)	131 (41.3)	0.374	0.578
Female	62 (55.4)	186 (58.7)		
BMI (Kg/m^2)	24.8±5.7	25.2±5.2	-0.682	0.495
History of smoking				
Yes	37 (33.0)	91 (28.7)	0.741	0.402
No	75 (67.0)	226 (71.3)		
Diabetes mellitus				
Yes	25 (22.3)	75 (23.7)	0.083	0.897
No	87 (77.7)	242 (76.3)		
Hypertension				
Yes	36 (32.1)	97 (30.6)	0.092	0.812
No	76 (67.9)	220 (69.4)		
Heart disease				
Yes	14 (12.5)	50 (15.8)	0.698	0.444
No	98 (87.5)	267 (84.2)		
Taking aspirin currently				
Yes	7 (6.3)	17 (5.4)	0.123	0.811
No	105 (93.7)	300 (94.6)		
Types of lesions				
LDH	43 (38.4)	131 (41.3)	0.295	0.655
LSS	69 (61.6)	186 (58.7)		

BMI, body mass index; LDH, lumbar disc herniation; LSS, lumbar spinal stenosis.

Table 2. Comparison of lab tests between case and control groups

Variable	Case group (n = 112)	Control group (n = 317)	*t* or chi-square value	*P* value
HGB (g/L)	142.96±6.61	142.64±6.18	0.463	0.644
PLT (10^9/L)	195±58	201±49	-1.060	0.290
FIB (g/L)	2.95±0.83	2.84±0.81	1.228	0.220
PT (s)	10.91±0.82	10.93±0.76	-0.235	0.815
TT (s)	14.63±1.85	14.51±1.70	0.627	0.531
D-dimer (mg/L)	0.18±0.10	0.17±0.11	0.846	0.398

HGB, hemoglobin; PLT, platelet; FIB, fibrinogen; PT, prothrombin time; TT, thrombin time.

Statistical analysis

Variables were presented as a mean with standard deviation for continuous variables and with frequencies for categorical variables. The independent sample *t* test was used for numerical data and Fisher's exact probability test was used to identify differences in frequency of nominal variables. After univariate analyses, variables found to be potentially predictive of the outcome variable from the univariate analyses ($P < 0.10$) were included in the multivariate logistic regression models. Pearson's correlation coefficient was also used to check the correlation between potential factors and drain output. Statistical analysis was performed with the Statistical Package for Social Sciences software (version 17.0; SPSS Inc., Chicago, IL, USA), and *P* value less than 0.05 was considered statistically significant.

Results

General data of patients

A total of 429 patients undergoing posterior lumbar interbody fusion were included in this study. Among these patients, 181 were male and 248 were female. The mean age at the time of surgery was 55.6±10.7 years. One hundred and seventy-four patients were diagnosed as LDH, and the other 255 were LSS. One hundred and forty-nine patients underwent TLIF procedure, and the other 280 patients underwent PLIF procedure. Two hundred and thirty-six patients underwent single level surgery, and the other 193 patients underwent multiple levels surgery. The mean drain output was 193.2±83.1 ml. According to the amount of drain output, there were 112 patients in case group and 317 in control group. Three hundred and ninety-eight drains were removed within 48 hours, and 31 drains were removed within 72 hours.

Table 3. Comparison of surgical variables between case and control groups

Variable	Case group (n = 112)	Control group (n = 317)	*t* or chi-square value	*P* value
No. of level fused				
Single level	50 (44.6)	186 (58.7)	6.584	0.011
Multiple levels	62 (55.4)	131 (41.3)		
Operative time (min)	147.1±17.4	139.3±19.8	3.695	< 0.001
Blood loss (ml)	571.8±101.2	559.2±94.6	1.190	0.235
Blood transfusion				
Yes	42 (37.5)	109 (34.4)	0.352	0.566
No	70 (62.5)	208 (65.6)		
Length of incision (cm)	16.2±4.6	15.5±4.2	1.478	0.140
Surgical strategy				
TLIF	31 (27.7)	118 (37.2)	3.326	0.083
PLIF	81 (72.3)	199 (62.8)		

TLIF, transforaminal lumbar interbody fusion; PLIF, posterior lumbar interbody fusion.

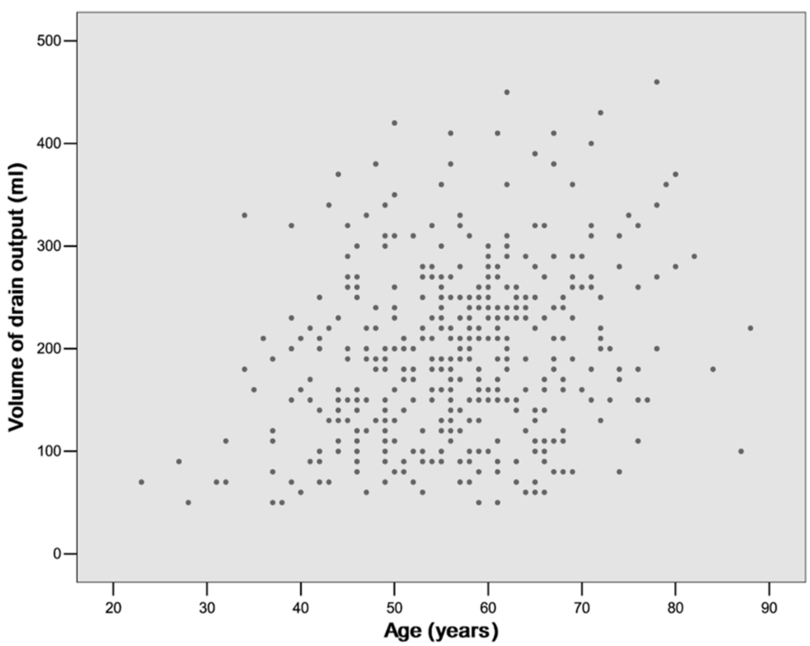

Figure 1. Scatter diagram showing correlation between age and postoperative drain output (r = 0.269; *P* < 0.001).

Comparison between groups

Patient characteristics, lab tests and surgical variables were summarized and compared. The details were listed in **Tables 1-3**. The mean age in case group was significantly higher than that in control group (59.2±11.8 vs. 54.3±10.2, *P* < 0.001), and the operative time was also significantly longer than that in control group (147.1±17.4 vs. 139.3±19.8, *P* < 0.001). Of the 112 patients in case group, 62 (55.4%) underwent multiple levels surgery, while 131 (41.3%) of the 317 patients in control group were performed multiple levels surgery, and the difference between the two groups were statistically significant (*P* = 0.011). Besides, the percentage of PLIF in case group (72.3%) was higher than that in control group (62.8%) though we cannot demonstrate a statistically significant difference (*P* = 0.083). However, there was no significant difference in gender, BMI, history of smoking, diabetes mellitus, hypertension, heart disease, taking aspirin currently, types of lesions, HGB, PLT, FIB, TT, D-dimer, TC, blood loss, blood transfusion and length of incision between the two groups in univariate analysis (*P* > 0.10).

Pearson's correlation analysis

Pearson's correlation analysis was also used to check the correlation between age as well as operative time and drain output. The result showed that the operative time was not correlated with volume of drain output (r = 0.471; *P* = 0.29), but age was positively correlated with postoperative drain output (r = 0.269; *P* < 0.001, **Figure 1**).

Multivariate analysis

To investigate the impact of independent variables on the amount of drain output, the multivariate analysis was also performed. The final results of multivariate logistic analysis showed

Table 4. Results of multiple logistic regression analysis

	OR	95% CI	*P* value
Age (years)			
< 55	Reference	Reference	
≥ 55	2.860	1.164-6.847	0.021
Level fused			
Single level	Reference	Reference	
Multiple levels	1.359	1.680-6.432	0.002
Operative time (min)			
< 120	Reference	Reference	
≥ 120	1.421	0.886-2.294	0.269
Surgical procedure			
TLIF	Reference	Reference	
PLIF	1.016	0.677-1.120	0.158

PLIF, posterior lumbar interbody fusion; OR, odds ratio; CI, confidence interval.

that age ≥ 55 years (odds ratio [OR], 2.860; 95% confidence interval [CI], 1.164-6.847) and multiple levels fused (OR, 1.359; 95% CI, 1.680-6.432) were two significant independent factors that are associated with greater drain output after lumbar spine surgery ($P < 0.05$, **Table 4**).

Discussion

Both TLIF and PLIF are common procedures in the treatment of lumbar degenerative disease [2, 3]. This study was performed to identify factors that may increase volume of drain output after lumbar interbody fusion to help surgeons have a good knowledge of postoperative drain output. Based on the data presented in this study, old age and multiple levels surgery were two independent factors that may increase the volume of drain output, while gender, BMI, history of smoking, diabetes mellitus, hypertension, heart disease, taking aspirin currently, types of lesions, HGB, PLT, FIB, TT, D-dimer, TC, blood loss, blood transfusion and length of incision were not.

Although no prior studies have investigated the risk factors of greater amount of drain output, there are some studies reporting the factors correlating with formation of postoperative epidural hematoma after lumbar spine surgery [15-17]. In our study, patients 55 years older were more likely to have high volume of drain output after lumbar interbody fusion. In consistent with our result, Sokolowski et al. found that old age is associated with the volume of postoperative epidural hematoma after lumbar surgery [16]. Basques et al. supposed that this effect may be due to delayed wound healing which is associated with advanced age [14]. We assumed that there may be another explanation that old patients usually have severe osteoarthritis, the resection of osteophytes during surgery can lead to sustained bleeding. Besides, osteoporosis often occurred in old patients. Bleeding from porous cancellous bone was not easy to stop, which may also contribute to the increased volume of drain output.

Multiple-level surgery is another factor that increases the volume of drain output. The current study showed that patients undergoing multiple-level surgery was 1.36-fold higher to have increased drain output in comparison with single-level surgery. Kou et al. have reported similar results, in which patients with multiple levels lumbar procedures are at a significantly higher risk for developing a postoperative epidural hematoma [15]. As we know, multiple levels procedure is generally associated with long length of incision, increased dissection of tissue and large exposed bony surfaces, thus it is reasonable to consider that this factor could lead to increased postoperative drain output.

Long operative time is a significant factor associated with greater drain output after lumbar interbody fusion in bivariate analysis, however, a significant association was failed to show in multivariable model. This may due to covariance with other predictor factors. Procedures with long operative time are usually multilevel procedures, so the effect of number of levels could have trumped the effect of operative time in the final multivariate result. Similarly, multiple levels procedure is associated with PLIF procedure, so the effect of PLIF procedure in the final multivariate logistic model could have also been overcome by the effect of multiple levels on drain output.

Smoking history has been regarded as an independent factor associated with greater drain output after ACDF in the study by Basques et al. [14]. However, this conclusion was not confirmed in our study. Though we cannot demonstrate that smoking can increase the risk of greater drain output, preoperative smoking cessation prior to lumbar interbody fusion is still encouraged to decrease the possibility of postoperative wound-related and other complications [18-20].

This study has several limitations. One apparent limitation is the retrospective nature of this analysis. The current study is susceptible to a selection bias as well as an information bias. Thus, future prospective studies are still required to validate our findings. Besides, only limited number of factors was analyzed, the analysis of other factors may provide more valuable information to us.

In spite of the limitations mentioned above, this study is clinically valuable to some extent. In summary, it appears that old age and multiple levels surgery were two independent factors that are associated with greater drain output. Patients with these factors should be informed of the possibility of increased drain output, and routine blood test should be performed after surgery in case of the incidence of low hemoglobin.

Disclosure of conflict of interest

None.

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