Original Article

# The correlation between intraoperative saline irrigation volume and postoperative drainage volume and short-term efficacy in single-level posterior lumbar interbody fusion

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**Background:** This study aimed to explore: (I) the effect of different intraoperative saline irrigation volumes on postoperative drainage volume, drainage tube removal time, and short-term efficacy in single-level posterior lumbar interbody fusion (PLIF); and (II) the recommended intraoperative saline irrigation volume.

**Methods:** A total of 120 patients with lumbar degenerative diseases who underwent single-level PLIF between January 2013 and December 2019 were enrolled. Based on the average total postoperative drainage volume, the patients were divided into 2 groups: group A (total postoperative drainage ≤103.86 mL) and group B (total postoperative drainage >103.86 mL). The recommended intraoperative saline irrigation volume (825 mL) was calculated from the receiver operating characteristic (ROC) curve and critical value. Using the recommended intraoperative saline irrigation volume (825 mL), patients were divided into 2 groups: group C (greater group, intraoperative irrigation volume >825 mL) and group D (lower group, intraoperative irrigation volume ≤825 mL) to evaluate the effect of different intraoperative saline irrigation volumes on postoperative drainage volume, extubation time, and short-term efficacy.

**Results:** A greater intraoperative saline irrigation volume was associated with lower postoperative drainage volume, shorter indwelling drainage tube time, shorter hospitalization time, lower hospital charges, and better recovery from postoperative pain (P<0.05). According to the ROC curve and critical value calculation, we found that when the intraoperative saline irrigation volume was greater than 825 mL, the total postoperative drainage volume was more likely to decrease [P<0.001, area under the curve (AUC) =0.852, sensitivity =88.1%, specificity =73.8%]. Patients with more than 825 mL intraoperative saline irrigation had lower postoperative drainage volume, shorter indwelling drainage tube time, shorter hospitalization time, lower hospital charges, and better postoperative pain recovery.

**Conclusions:** There was a significant correlation between the intraoperative saline irrigation volume and patient outcomes. At least 825 mL intraoperative saline irrigation is recommended during single-level PLIF.

**Keywords:** Saline irrigation; single-level posterior lumbar interbody fusion (single-level PLIF); post-operative complications

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## Introduction

Posterior lumbar interbody fusion (PLIF) is a routine operation in the treatment of lumbar degenerative diseases (1). The placement of a drainage tube in the incision can help to fully drain the operation area and promote healing (2). However, an indwelling drainage tube that is left in too long can also lead to a series of problems. For example, patients need to take the tube with them when they begin early ambulation, which causes inconvenience. The drainage tube and fixed line can pull on the local tissue and cause pain. A long indwelling drainage tube time may also cause an infection. Moreover, most patients choose to leave the hospital after extubation, and an indwelling drainage tube time that is too long also increases the hospitalization time and hospital charges.

At present, based on the enhanced recovery after surgery (ERAS) rapid rehabilitation concept, the early removal of drainage tubes can reduce patient discomfort and promote early rehabilitation. However, drainage tube removal timing depends on the situation of individual patients. It is generally believed that the drainage tube can be removed when the postoperative drainage volume is less than 50 mL (3).

Studies have shown that intraoperative saline irrigation can help remove the inflammatory factors released from intraoperative tissue, wash away the impurities and necrotic tissue that may be left during the operation, reduce the risk of postoperative infection, and promote wound healing (4). However, there are few reports about the recommended intraoperative saline irrigation volume. Therefore, the purpose of this study was to explore: (I) the effect of different intraoperative saline irrigation volumes on postoperative drainage volume, drainage tube removal time and short-term efficacy in single-level PLIF; and (II) the recommended intraoperative saline irrigation volume for patients undergoing single-level PLIF. We present the following article in accordance with the STARD reporting checklist (available at https://dx.doi.org/10.21037/apm-21-3459).

## Methods

### *Study participants*

This study employed a retrospective design. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional ethics board of Fujian Medical University Union Hospital (No. 2021KY068). Individual consent for this retrospective analysis was waived. A total of 120 patients with lumbar degenerative diseases who underwent single-level PLIF between January 2013 and December 2019 were enrolled. The following inclusion criteria were used: (I) patients with lumbar degenerative disease who underwent single-level PLIF; and (II) the preoperative, intraoperative, and postoperative follow-up data were complete. The exclusion criteria were as follows: (I) patients with concomitant abnormal albumin (serum albumin below 35 g/L); (II) patients with concomitant abnormal coagulation function [prothrombin time (PT) greater than 15 seconds, thrombin time (TT) greater than 21 seconds, or activated partial thromboplastin time (aPTT) greater than 42 s]; (III) previous lumbar trauma and lumbar surgery history; and (IV) lumbar deformity, infection, tuberculosis, tumor, or other diseases.

Sex, age, body mass index (BMI), hypertension, diabetes, preoperative hemoglobin, preoperative albumin, hospitalization time, and hospital charges were recorded in detail.

### *Intraoperative saline irrigation*

All patients underwent posterior lumbar discectomy, spinal canal decompression, cage fusion, and internal fixation. The surgical field was flushed from the inside out before suturing. A 20-mL disposable syringe with the needle tip removed was used for flushing with normal saline (15 ℃). After flushing, a rubber drainage tube (rubber material, diameter of 4.7 mm) was placed in the incision. After checking the surgical instruments and gauze, the incision was sutured layer by layer with a simple intermittent suture method and covered with a dressing. All surgeries were performed by 2 surgeons.

### *Postoperative evaluation*

(I) Total postoperative drainage volume before extubation: daily drainage volume of all days before the drainage tube was removed after the operation were added to obtain the total. The drainage tube was removed when the daily drainage volume was less than 5 mL.
(II) Drainage tube removal time: the number of days from the day of the operation to the day of removal of the drainage tube.
(III) Hospitalization time and hospital charges: the length of hospital stay from admission to discharge and all expenses involved in examinations, treatment, and

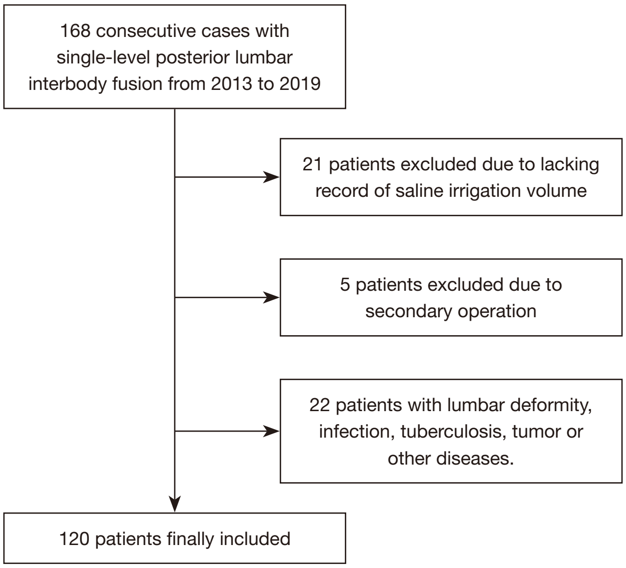



**Figure 1** Flowchart of patient selection.

nursing throughout the entire hospitalization process.

(IV) The visual analog score (VAS) was reported on an 11-point numeric rating scale from 0 (no pain) to 10 (worst pain imaginable). Scores were evaluated before the operation and 7 days after the operation.

(V) The Japanese Orthopaedic Association (JOA) scale was used to evaluate the severity and improvement of the patients. By evaluating subjective symptoms, objective signs, daily activity restriction, and bladder function, the full score was 29 points. JOA improvement rate = [(postoperative JOA score − preoperative JOA score)/(29 − preoperative JOA score)] ×100%. All scores were evaluated before the operation and 7 days after the operation.

(VI) Surgical site infection (SSI): patients with purulent secretion in the incision underwent culture analysis, and the culture results were used to confirm an incision infection.

### *Statistical analysis*

SPSS 24.0 was used for statistical analyses, and statistically significant differences were identified when the P value was <0.05. Pearson correlation coefficients were calculated to analyze the correlations between functional scores, age, sex, BMI, and other parameters and the trends of change among them. Independent-samples *t*-tests and paired sample *t*-tests were used to compare data between groups, Pearson's chi-squared test was used for count data, and receiver operating characteristic (ROC) curves were used to determine independent risk factors and critical values.

## Results

### *Basic data*

A total of 120 patients were enrolled, including 62 males (51.7%) and 58 females (48.3%). The patient selection process was summarized in *Figure 1*. The average age was 55.83±10.42 years, and the mean BMI was 22.98±1.49 kg/m$^2$. There were 34 patients with hypertension (28.3%) and 19 patients with diabetes (15.8%). The details are provided in *Table 1*.

Through paired sample *t*-tests, we found that the postoperative VAS and JOA scores of patients with lumbar degenerative disease were significantly improved after the operation (P<0.001). The details are provided in *Table 2*.

### *Correlations between basic data and functional scores*

Pearson correlation coefficients were calculated to analyze the correlations between each parameter. We found that intraoperative saline irrigation volume was negatively correlated with total postoperative drainage volume, drainage tube removal time, hospitalization time, hospital charges, and postoperative VAS score (P<0.05), indicating that greater intraoperative saline irrigation volume was related to lower total postoperative drainage volume, shorter indwelling drainage tube time, shorter hospitalization time, lower hospital charges, and better recovery from postoperative pain. Postoperative VAS score was positively correlated with total postoperative drainage volume and drainage tube removal time (P<0.05), indicating that better postoperative pain recovery was related to lower total postoperative drainage volume and shorter indwelling drainage tube time. Meanwhile, we found that patients with lower total postoperative drainage volume and shorter indwelling drainage tube time had shorter hospitalization time and lower hospital charges (P<0.05). The details are provided in *Table 3*.

### *ROC curves and critical values were calculated to determine the recommended intraoperative saline irrigation volume*

To further research the relationship between intraoperative saline irrigation volume and total postoperative drainage

**Table 1** Demographic characteristics of the population (n=120), preoperative and postoperative functional scores

| Characteristics | Mean | SD |
|---|---|---|
| Age (years) | 55.83 | 10.42 |
| BMI (kg/m$^2$) | 22.98 | 1.49 |
| Hospitalization time (days) | 11.73 | 2.10 |
| Hospital charges (CNY) | 43,490.35 | 5,686.52 |
| Preoperative hemoglobin (g/L) | 139.11 | 15.07 |
| Preoperative albumin (g/L) | 41.91 | 3.70 |
| Intraoperative saline irrigation volume (mL) | 850.50 | 362.73 |
| Total postoperative drainage volume (mL) | 103.86 | 16.94 |
| Drainage tube removal time (days) | 3.25 | 1.02 |
| Preoperative VAS | 5.92 | 1.92 |
| Preoperative JOA | 19.11 | 4.46 |
| Postoperative VAS | 2.42 | 1.29 |
| Postoperative JOA | 24.30 | 2.04 |
| JOA improvement rate (%) | 48.72 | 18.57 |

SD, standard deviation; CNY, China Yuan; BMI, body mass index; VAS, visual analogue score; JOA, Japanese Orthopaedic Association.

**Table 2** Pre- to post-operative changes in VAS score and JOA score

| Score | Preoperative | Postoperative | P value |
|---|---|---|---|
| VAS score | 5.92±1.92 | 2.42±1.29 | <0.001** (paired sample *t*-tests) |
| JOA score | 19.11±4.46 | 24.30±2.04 | <0.001** (paired sample *t*-tests) |

**, the significant differences at the 0.01 level. VAS, visual analogue score; JOA, Japanese Orthopaedic Association.

volume, we divided the patients into 2 groups according to the average total postoperative drainage volume: group A (lower drainage volume group, total postoperative drainage volume ≤103.86 mL) and group B (greater drainage volume group, total postoperative drainage volume >103.86 mL). Based on the ROC curve and critical value calculation, we found that when the intraoperative saline irrigation volume was greater than 825 mL, the total postoperative drainage volume was more likely to decrease (P<0.001, AUC =0.852, sensitivity =88.1%, specificity =73.8%; *Figure 2*).

### *Comparison of the greater intraoperative saline irrigation volume group and lower intraoperative saline irrigation volume group*

To further research whether the intraoperative saline irrigation volume affected patient outcomes, we divided the patients into 2 groups: group C (greater saline irrigation volume group, intraoperative irrigation volume >825 mL) and group D (lower saline irrigation volume group, intraoperative irrigation volume ≤825 mL). We found that compared with the patients in the lower saline irrigation volume group, patients in the greater saline irrigation volume group had lower total postoperative drainage volume, shorter indwelling drainage tube time, shorter hospitalization time, lower hospital charges, and better postoperative pain recovery. Meanwhile, we found that the number of patients with postoperative SSI in the greater saline irrigation volume group was significantly lower than that in the lower saline irrigation volume group (P<0.05). The details are provided in *Table 4*.

## Discussion

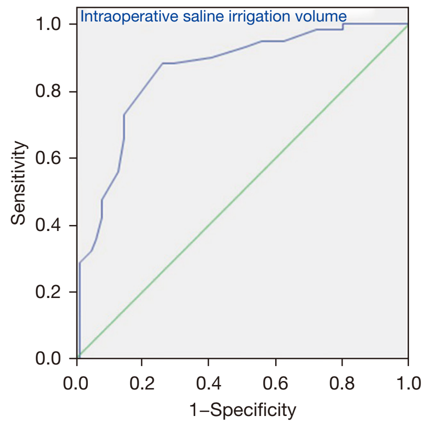
There are abundant inflammatory factors in the nucleus

**Table 3** Correlation between basic data and functional scores (Pearson correlation coefficients and P values)

| | Intraoperative saline irrigation volume (mL) | Age (years) | Hospitalization time (days) | Hospital charges (CNY) | BMI (kg/m$^2$) | Preoperative hemoglobin (g/L) | Preoperative albumin (g/L) | Total postoperative drainage volume (mL) | Drainage tube removal time (days) | Preoperative VAS score | Postoperative VAS score | Preoperative JOA score | Postoperative JOA score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intraoperative saline irrigation volume (mL) | 1.000 | –0.010 | –0.315** | –0.257** | –0.081 | 0.014 | –0.123 | –0.585** | –0.627** | –0.055 | –0.353** | 0.120 | 0.043 |
| Age (years) | | 1.000 | –0.120 | 0.047 | –0.120 | –0.113 | 0.123 | 0.046 | –0.118 | 0.054 | –0.034 | –0.114 | –0.121 |
| Hospitalization time (days) | | | 1.000 | –0.002 | 0.090 | 0.056 | –0.090 | 0.200* | 0.278** | 0.082 | 0.060 | –0.006 | –0.052 |
| Hospital charges (CNY) | | | | 1.000 | –0.098 | 0.020 | –0.009 | 0.265** | 0.208* | –0.165 | 0.150 | –0.017 | –0.122 |
| BMI (kg/m$^2$) | | | | | 1.000 | 0.004 | 0.065 | –0.018 | 0.141 | 0.055 | 0.043 | –0.014 | 0.002 |
| Preoperative hemoglobin (g/L) | | | | | | 1.000 | 0.003 | –0.027 | 0.000 | –0.047 | –0.130 | –0.073 | –0.097 |
| Preoperative albumin (g/L) | | | | | | | 1.000 | –0.030 | 0.088 | 0.042 | 0.043 | –0.202* | –0.063 |
| Total postoperative drainage volume (mL) | | | | | | | | 1.000 | 0.451** | 0.047 | 0.387** | 0.096 | 0.165 |
| Drainage tube removal time (days) | | | | | | | | | 1.000 | –0.114 | 0.333** | 0.014 | 0.093 |
| Preoperative VAS score | | | | | | | | | | 1.000 | 0.024 | –0.160 | –0.177 |
| Postoperative VAS score | | | | | | | | | | | 1.000 | 0.189* | 0.083 |
| Preoperative JOA score | | | | | | | | | | | | 1.000 | 0.631** |
| Postoperative JOA score | | | | | | | | | | | | | 1.000 |

*, the correlation is significant at the 0.05 level (two-tailed); **, the correlation is significant at the 0.01 level (two-tailed). CNY, China Yuan; BMI, body mass index; VAS, visual analogue score; JOA, Japanese Orthopaedic Association.




Area under the curve

| Parameter | Area | Standard deviation | P value | Asymptoic 95% lower bound | Confidence interval upper bound |
|---|---|---|---|---|---|
| Intraoperative saline irrigation volume (mL) | 0.852 | 0.036 | <0.001 | 0.782 | 0.921 |

**Figure 2** ROC curve of intraoperative saline irrigation volume. ROC, receiver operating characteristic.

pulposus of intervertebral discs, including interleukin-1β (IL-1β), interleukin-6 (IL-6), and tumor necrosis factor α (TNF-α) (5). IL-6, an important inflammatory enhancer in the IL family, is naturally produced in the intervertebral disc. IL-1β can stimulate an increase in IL-6, stimulate the aggregation of inflammatory cells, and activate the release of inflammatory mediators (6). High concentrations of TNF-α in degenerative intervertebral discs have chemotactic effects on neutrophils and monocytes.

During an operation, the destruction of the microenvironment can promote the infiltration of inflammatory cells and stimulate an increase in inflammatory factors. TNF-α acts on vascular endothelial cells, induces vascular endothelial cells to produce other inflammatory mediators, and causes a local inflammatory response together with IL-1β (7). The normal intervertebral disc is a closed tissue structure, and inflammatory factors in the nucleus pulposus will not be released to contact the neural structure, but when the annulus fibrosus is removed during the operation, internal inflammatory factors can be released (8). Intraoperative saline irrigation can remove the inflammatory factors released from the sectioned tissue along with the impurities and necrotic tissue that may be left during the operation, which is conducive to the reduction of postoperative exudation and the acceleration of tissue healing. These may have been the reasons for the difference between greater and lower saline irrigation volume groups in total postoperative drainage volume and drainage tube removal time. In our study, we found that compared with the patients in the lower saline irrigation volume group, the patients in the greater saline irrigation volume group had lower total postoperative drainage volumes, a shorter indwelling drainage tube time. This is consistent with the research results of the above scholars. TNF-α can cause edema of the nerve fiber intima and increase sensitivity to nerve pain (9). IL-1β is a powerful pain-inducing inflammatory factor that, together with IL-6, can induce pain by stimulating the release of prostaglandin E2 (PGE2) (10). Intraoperative saline irrigation can remove these released inflammatory factors, which may have been the reason for the better postoperative pain recovery of patients in the greater saline irrigation volume group.

The effect of intraoperative saline irrigation on postoperative pain may also come from the protection of irrigation against local tissue damage. To stop bleeding or resect tissue, surgeons often use electric scalpels, which inevitably produce heat and damage nearby tissues. Heat damage can lead to changes in cell membrane function and disturbances of water electrolytes and the acid-base balance in tissues. The corresponding consequences include liquefaction of adipose tissue, delayed wound healing, and even SSI (11). The best protective measure against scald injury is cooling,

**Table 4** Basic data of group C and group D: comparison of patient profile, total drainage before extubation, outcome scores, and SSI by degree of saline irrigation amounts

| Variables | Group C (n=52) | Group D (n=68) | P value |
|---|---|---|---|
| Intraoperative saline irrigation volume (mL) | 524.23±209.53 | 1,100.00±233.40 | <0.001** (independent-samples *t*-tests) |
| Male:female (female, %) | 24:28 (53.85) | 38:30 (44.12) | 0.291 (Pearson's chi-squared test) |
| Age at surgery (years) | 55.15±9.22 | 56.34±11.29 | 0.540 (independent-samples *t*-tests) |
| BMI (kg/m$^2$) | 23.10±1.54 | 22.90±1.46 | 0.470 (independent-samples *t*-tests) |
| Concomitant hypertension, n (%) | 15 (28.85) | 19 (27.94) | 0.913 (Pearson's chi-squared test) |
| Concomitant diabetes, n (%) | 7 (13.46) | 12 (17.65) | 0.534 (Pearson's chi-squared test) |
| Hospitalization time (days) | 12.35±2.33 | 11.26±1.78 | 0.006** (independent-samples *t*-tests) |
| Hospital charges (CNY) | 44,945.98±6,012.48 | 42,377.22±5,197.54 | 0.014* (independent-samples *t*-tests) |
| Preoperative hemoglobin (g/L) | 138.58±13.72 | 139.51±16.12 | 0.737 (independent-samples *t*-tests) |
| Preoperative albumin (g/L) | 42.23±3.72 | 41.66±3.68 | 0.405 (independent-samples *t*-tests) |
| Total postoperative drainage volume (mL) | 115.29±12.93 | 95.12±14.27 | <0.001** (independent-samples *t*-tests) |
| Drainage tube removal time (days) | 4.04±0.84 | 2.65±0.69 | <0.001** (independent-samples *t*-tests) |
| Preoperative VAS score | 6.02±1.82 | 5.84±2.00 | 0.610 (independent-samples *t*-tests) |
| Postoperative VAS score | 2.96±0.91 | 2.00±1.93 | <0.001** (independent-samples *t*-tests) |
| Preoperative JOA score | 19.13±4.70 | 19.09±4.32 | 0.955 (independent-samples *t*-tests) |
| Postoperative JOA score | 24.42±1.92 | 24.21±2.13 | 0.565 (independent-samples *t*-tests) |
| SSI, n (%) | 8 (15.38) | 3 (4.41) | 0.039* (Pearson's chi-squared test) |

Data are shown as mean ± standard deviation if not otherwise specified. *, the significant differences at the 0.05 level; **, the significant differences at the 0.01 level. SSI, surgical site infection; CNY, China Yuan; BMI, body mass index; VAS, visual analogue score; JOA, Japanese Orthopaedic Association.

and most surgeons recommend local cooling treatment to prevent scald injury (12). Baldwin *et al.* (13) found that in a variety of different cooling strategies, the effect of flowing water flushing away the heat was best, followed by liquid immersion. In addition, some studies have shown that cooling after scald injury has an obvious analgesic effect (13-15), which provides the basis for intraoperative saline irrigation reducing postoperative pain in this study. In our research, the theoretical basis for using 15 ℃ normal saline as the flushing fluid temperature during an operation comes from the research of Baldwin *et al.* and Cuttle *et al.* (13,16). They believe that flushing and cooling treatment at 15 ℃ can maintain epithelial function and minimize thermal damage. The difference in drainage volume and pain recovery between the 2 groups in our study showed the effectiveness of low-temperature flushing at 15 ℃ for protection against thermal damage in local tissues. In our study, we found that compared with the patients in the lower saline irrigation volume group, the patients in the greater saline irrigation volume group had better postoperative pain recovery. We think that intraoperative saline irrigation can remove these released inflammatory factors, which may be the reason for the better postoperative pain recovery of patients in the greater saline irrigation volume group.

The JOA scores of the greater and lower saline irrigation volume groups were significantly improved compared with those before the operation, but there was no significant difference between the 2 groups. Some scholars believe that adequate drainage can reduce the formation of hematoma to minimize the risk of spinal cord compression and postoperative neurological damage (17). We believe that adequate saline irrigation can reduce hematoma formation; however, a difference in the risk of neurological damage was not observed in this study. Due to the short follow-up time, further follow-up studies are needed to evaluate the difference in long-term neurological functional improvement.

In this study, there were differences in hospitalization time and hospital charges between the greater and lower saline irrigation volume groups, which may have been due to the shorter indwelling drainage tube time and faster wound healing. Drainage tube removal is more conducive to early activity of patients, and early activity is also conducive to postoperative rehabilitation and early discharge.

Compared with other orthopedic surgical sites, the infection rate of spinal surgery is high (18). The use of internal fixation will further increase the risk of infection, which has been reported in the literature to be approximately 2.4% to 8.5% (19). An incision infection that occurs after spinal fusion can lead to consequences such as the need for long-term intravenous antibiotics, sepsis, reoperation, implant loosening and displacement, prolonged hospitalization time, and increased hospital charges, which will introduce unnecessary complications to treatment and also place significant economic and psychological burden on patients. Intraoperative saline irrigation is helpful for flushing out blood clots in the operation field, exposing active bleeding points, facilitating complete hemostasis, and reducing postoperative wound bleeding and the formation of hematoma in the incision. Ho *et al.* (20) found that after an operation, clots and necrotic fat were not easily absorbed, which could lead to the formation of hematoma in the incision, providing a medium for bacteria growth and leading to delayed infection. Intraoperative saline irrigation also has a direct positive effect on maintaining the aseptic state of the operation field. Watanabe *et al.* (4) reported that adequate saline irrigation (at least 500 mL) during surgery effectively reduced the infection rate. In this study, we obtained similar results, with the number of patients experiencing postoperative SSI in the greater saline irrigation volume group significantly lower than that in the lower saline irrigation volume group.

However, this study was limited by its retrospective nature, and had following limitations: First, the number of patients in this study was limited, and a large number of patients was not available to confirm our results. Second, the surgical segment in our study was limited to a single segment. The volume of saline irrigation necessary during a multi-segment surgery needs further study. Third, Makino *et al.* (21) found that for patients who underwent posterior lumbar interbody fusion, adjacent segment degeneration had a negative effect on the improvement of lumbar spine dysfunction and gait disturbance. Thus, when discussing the intraoperative saline irrigation volume and the postoperative efficacy, patients' diseases should be also included. Finally, as the follow-up time of the study was short, it was not possible to judge the effect of different volumes of saline irrigation on the long-term functional score.

## Conclusions

In single-level PLIF, there was a significant correlation between intraoperative saline irrigation volume and the postoperative efficacy. Compared with patients with less than 825 mL of intraoperative saline irrigation, patients with more than 825 mL of intraoperative saline irrigation had lower postoperative drainage volume, shorter indwelling drainage tube time, shorter hospitalization time, lower hospital charges, and better postoperative pain recovery. At least 825 mL of intraoperative saline irrigation is recommended during single-level PLIF.

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## Footnote

*Reporting Checklist:* The authors have completed the STARD reporting checklist. Available at https://dx.doi.org/10.21037/apm-21-3459

*Data Sharing Statement:* Available at https://dx.doi.org/10.21037/apm-21-3459

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at https://dx.doi.org/10.21037/apm-21-3459). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by institutional ethics board of Fujian Medical University Union Hospital (No. 2021KY068). Individual consent for this retrospective analysis was waived.



 

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