Significant Blood Loss in Lumbar Fusion Surgery for Degenerative Spine

Yu-Hua Huang[1,2] and Chien-Yu Ou[1,3]

OBJECTIVE: **Lumbar fusion is a widely used procedure for degenerative spine diseases but frequently is accompanied with substantial surgical blood loss. We aimed to investigate the risk factors for significant intraoperative blood loss and the influence of excessive bleeding on postoperative complications in patients undergoing fusion for degenerative lumbar spines.**

METHODS: **For this retrospective study, we enrolled 199 patients who had undergone lumbar fusion surgery for degeneration. The definition of significant blood loss at operation was 500 mL or more in blood volume. The patients were subdivided into 2 groups on the basis of whether significant blood loss was present (n = 107) or not (n = 92).**

RESULTS: **The incidence of significant blood loss during lumbar fusion was 53.8%. In the multivariate logistic regression model, the independent risk factors for significant blood loss included body mass index ($P = 0.027$), extreme spinal canal narrowing ($P = 0.023$), spine fusion segments >1 level ($P = 0.008$), and transforaminal lumbar interbody fusion ($P = 0.006$). Significant blood loss in lumbar fusion was associated with a greater incidence of postoperative complications ($P = 0.002$). The length of hospital stay for patents with excessive bleeding was prolonged significantly ($P = 0.045$).**

CONCLUSIONS: **Because substantial bleeding in lumbar fusion is associated with a greater incidence of morbidities and prolonged length of hospital stay, attention to the risk factors for significant blood loss is important in the preoperative assessment and postoperative guidance for the level of care.**

INTRODUCTION

As early as 1911, Hibbs and Albee described fusion surgery of the spine that aimed to stabilize diseased vertebrae by using bone grafts (2). Since then, fusion surgery has become a widely used therapy for various spinal conditions, and one of the common indications is degenerative lumbar spine diseases (17). Although this procedure is technically familiar to surgeons, it is not without morbidities. Spinal fusion is accompanied frequently by substantial blood loss and is among the top surgical procedures associated with blood transfusion (20). Significant intraoperative blood loss of 500 mL or greater, which increases postoperative morbidity and mortality in patients undergoing major noncardiac surgery, has been reported (3, 22, 23). In addition, fusion of degenerative lumbar spines usually is carried out among geriatric patients. Older patients are especially vulnerable to the detrimental effects of blood loss and anemia because of the limited physiological reserve (6, 12). Blood loss during surgery also leads to the need of red cell, platelets, or factor transfusions, and the potential for immunological reaction and infection transmission must be considered. As a result, the ability to identify the risk of significant blood loss in patients undergoing lumbar fusion procedures is quite important and may guide the level of care and offer modifiable targets to alleviate the effect of morbidities.

In this study, we retrospectively collected clinical data and assessed risk factors for significant blood loss during lumbar fusion surgery for degenerative spine diseases. We also investigated the impact of significant intraoperative blood loss on postoperative complications.

MATERIALS AND METHODS

Data Collection

This retrospective cohort study was carried out at Kaohsiung Chang Gung Memorial Hospital, a 2715-bed medical center in

Key words
- Blood loss
- Complication
- Degenerative spine disease
- Lumbar fusion

Abbreviations and Acronyms
ASA: American Society of Anesthesiologists
BMI: Body mass index
CSF: Cerebrospinal fluid
PLF: Posterolateral lumbar fusion
PLIF: Posterior lumbar interbody fusion
TLIF: Transforaminal lumbar interbody fusion

From the [1]Department of Neurosurgery, Kaohsiung Chang Gung Memorial Hospital and Chang Gung University College of Medicine, Kaohsiung, Taiwan; [2]Department of Neurosurgery, Kaohsiung Municipal Min-Sheng Hospital, Kaohsiung, Taiwan; and [3]Department of Surgery, Kaohsiung Armed Forces General Hospital, Kaohsiung City, Taiwan

To whom correspondence should be addressed: Chien-Yu Ou, M.D. [E-mail: oucu2003@yahoo.com.tw]

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Taiwan. After obtaining consent from the institutional review board, we reviewed the records of patients who had undergone lumbar fusion surgery for degenerative spine diseases in the neurosurgical department from September 2012 through June 2013. We excluded patients who had had previous spine surgeries. A total of 199 patients were enrolled for analysis. Trained research staff collected clinical data, consisting of the patients' baseline information, body mass index (BMI), findings of laboratory examinations, and American Society of Anesthesiologists (ASA) Physical Status Classification (1). Details of the operations were recorded, and total intraoperative blood loss was calculated as the sum of blood in suction containers and soaked sponges. The definition of significant operative blood loss was 500 mL or more of blood volume (3, 22, 23).

Preoperative Evaluation

Diagnosis of degenerative lumbar spine disease was established on the basis of the history and physical examination in conjunction with magnetic resonance imaging scans. In addition, anteroposterior translation or intervertebral rotation was examined on lateral flexion/extension and anteroposterior radiographs. All patients experienced low back pain, lower extremity pain, or other neurologic deficits resulting from spinal stenosis or localized lumbar/lumbosacral segmental instability at the L1–S1 levels. The levels of the affected vertebrae with a compressed dura sac or nerve roots were determined. The degree of spinal canal narrowing was evaluated on the basis of the cerebrospinal fluid (CSF)/rootlet ratio as seen in axial T2 images, and was graded as A, B, C, and D (Grade A stenosis, i.e., there is clearly CSF visible inside the dural sac, but its distribution is inhomogeneous; Grade B stenosis, i.e., the rootlets occupy the whole of the dural sac, but they can still be individualized; Grade C stenosis, i.e., no rootlets can be recognized, the dural sac demonstrating a homogeneous gray signal with no CSF signal visible; Grade D stenosis, i.e., in addition to no rootlets being recognizable, there is no epidural fat posteriorly) (18). Grade D was defined as extreme spinal canal narrowing in this study.

Surgical Strategy and Techniques

Lumbar spine fusion was indicated when the patients had clinical and/or radiographic signs of instability or were at risk of iatrogenic instability after decompression. The patients underwent one of the following 3 fusion procedures: posterior lumbar interbody fusion (PLIF), transforaminal lumbar interbody fusion (TLIF), or posterolateral lumbar fusion (PLF). In brief, neural decompression was carried out by removing the degenerated ligamenta flava, lamina of vertebrae, or protruded disc. In cases involving PLIF or TLIF, the cage was placed after cleaning the disc space. For PLF, removed lamina with or without iliac bone was used as autologous bone graft and placed on the transverse process of the vertebra. Pedicle screw instrumentation was performed on the basis of the stability of the fused spines, as determined by the surgeon. There was no artificial disc replacement, corpectomy, osteotomy, kyphectomy, or insertion of spinal spacers or dynamic stabilizing devices in our patient group.

Postoperative Complications

The outcome for this study was postoperative complications during hospitalization. The following events were defined as complications: acute renal failure, myocardial infarction, stroke, delirium, deep venous thrombosis, pulmonary embolism, wound disruption, deep surgical-site infection, pneumonia, urinary tract infection, sepsis, systemic inflammatory response syndrome, and >4 U red blood cell transfusion within 72 hours after operation. All deaths also were considered postoperative complications.

Statistical Analysis

Data were analyzed using SPSS version 20.0 (IBM SPSS Statistics, Armonk, New York, USA). Descriptive statistics are presented as frequencies (percentages) or as mean and SD. Categorical variables were compared using the χ^2 test or Fisher exact test. Continuous variables were assessed using the Student's t test or Mann–Whitney U test. All parameters with a $P < 0.05$ were entered into multivariable logistic regression to adjust for independent risk factors of significant blood loss during lumbar fusion surgery. The results were expressed as odds ratios with 95% confidence intervals. A $P < 0.05$ was considered to be statistically significant.

RESULTS

Patient Characteristics

The 199 patients who underwent lumbar fusion surgery for degenerative spine diseases included 90 men and 109 women. The mean age was 61.8 (SD, 12.3; range, 20–83) years. Underlying medical conditions included 40 cases of diabetes mellitus, 110 of hypertension, 6 of coronary artery disease, 1 patient receiving anticoagulant therapy, and 9 patients undergoing antiplatelet therapy. The anticoagulant and antiplatelet treatments were halted before surgery. Average BMI was 26.8 (SD, 3.6; range, 18–40) kg/m^2. The mean hemoglobin level before operation was 13.2 (SD, 1.7; range, 9–19) g/dL. The number of patients with ASA classification I, II, and III was 7, 101, and 91, respectively. There were 56 patients with extreme spinal canal narrowing on the basis of findings on magnetic resonance imaging.

Lumbar Fusion Surgery

The mean blood loss during operation was 554.3 (SD, 346.3; range 50–1850) mL. Figure 1 shows the distribution of the volume of

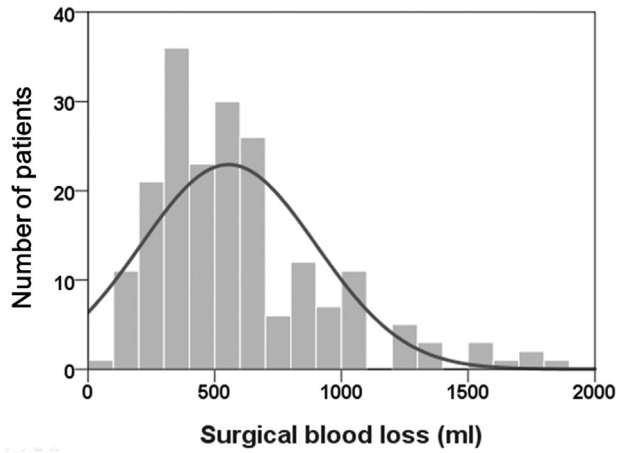

Figure 1. Distribution of volume of surgical blood loss in lumbar fusion.