



A comparison of narcotic usage and length of post-operative hospital stay in open versus minimally invasive lumbar interbody fusion with percutaneous pedicle screws

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Background: Instrumented lumbar fusion can be accomplished through open or minimally invasive techniques. The focus of this study was to compare perioperative narcotic usage and length of hospital stay between patients undergoing open versus minimally invasive spinal surgery (MISS).

Methods: A retrospective chart review was performed on 110 patients who underwent instrumented lumbar fusion over 2 years at our institution. These patients were divided into two groups: those that received open transforaminal interbody fusion (n=69), and those whose surgeries were performed minimally invasively with lateral lumbar transpoas interbody fusion (LLIF) and percutaneous pedicle screws (n=41). Narcotic usage was recorded for both groups intra-operatively and post-operatively throughout their hospital stay. These values were standardized using an equianalgesia chart.

Results: Average narcotic usage post-operatively was significantly lower for the LLIF group relative to those who underwent open lumbar fusion (278.48 vs. 442.06 mg, P=0.03). The average length of post-operative hospital stay was significantly shorter for patients who underwent LLIF compared to those who had an open procedure (4.10 vs. 6.19 days, P=0.02).

Conclusions: Patients who underwent minimally invasive surgery (MIS) LLIF had decreased overall use of opioids in the perioperative period and shorter hospital stays when compared to patients who underwent the open transforaminal interbody fusion approach. These findings support pre-existing literature in favor of LLIF MISS with regards to the above stated outcome measures. The long-term benefits of MISS with regards to narcotic usage in spine patients are not yet known.

Keywords: Minimally invasive surgery; lumbar fusion; narcotics; spine; pain

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Introduction

Instrumented lumbar fusion is a widely accepted surgical treatment for symptomatic degenerative spine disease (1). With an aging population, this procedure remains in high

demand (2). Lumbar fusion can be accomplished through open or minimally invasive techniques. The open interbody fusions require more extensive tissue take down, while minimally invasive spinal surgery (MISS) utilizes multiple small incisions and minimizes muscle dissection (3).

Multiple studies have reported detrimental effects of extensive muscle dissection and retraction often employed in open transforaminal lumbar interbody fusion (TLIF) procedures (4,5).

Despite these disadvantages, open instrumented spinal fusions reliably result in high fusion rates, increased foraminal height, and improved post-operative patient satisfaction (6,7). The goal of MISS is to minimize soft tissue trauma, thereby decreasing pain levels and improving post-operative rehabilitation, while maintaining the clinical and radiographic outcomes seen with an open approach (3,4,7). In the hands of an experienced surgeon, MISS has also been shown to be cost effective, result in a shorter length of stay, and decrease the need for perioperative blood transfusions (4,8,9). The disadvantages of MISS include longer operating times, higher intraoperative radiation exposure, a learning curve for the surgeon, and increased risk of cage and pedicle screw misplacements, in addition to cage migrations (10).

Both MISS and open techniques necessitate the use of narcotics for post-operative pain management. Options for perioperative analgesia include opioid and non-opioid medications as well as patient-controlled analgesia (PCA) (either epidural or intravenous), spinal analgesia, and oral medications (11,12). Post-operative nausea and vomiting is a concern when using opioids; lower doses and alternative routes of administration can provide relief from these symptoms (12). Options for non-opioid analgesia such as gabapentin, pregabalin, acetaminophen, dexamethasone, ketamine, and nonsteroidal anti-inflammatory drugs (NSAIDs) can be considered and have been shown to be efficacious. Recent research suggests that a multimodal approach to pain control involving opioids, NSAIDs, neuromodulatory agents, acetaminophen, and extended-action local anesthesia can reduce patient exposure to narcotics while adequately controlling pain (13,14).

To compare opioid dosage through multiple modalities across MISS and open spinal surgery, we standardized the dosage using the equianalgesic conversion chart. The equianalgesic dose ratio (EDR) is an evidence-based method of correlating doses of different strength opioids when administering for pain control (15). Using conversion tables to equate differing opioid modalities is controversial. While there is literature to support its accuracy, physicians are encouraged to use clinical judgement in addition to direct conversions (16). Additionally, research suggests that MISS is associated with a shorter hospital stay when compared to

open surgery (17).

Methods

This study was approved by the Institutional Review Board for a retrospective review of medical records for patients age 18 to 65 years who underwent lumbar fusion by 1 of 2 spinal surgeons over 2 years. Patients treated with minimally invasive surgery were treated with lateral lumbar interbody fusion surgery with percutaneous pedicle screws while open surgeries were open transforaminal interbody fusion cases. Exclusion criteria included patients with revision surgeries and those concurrently hospitalized for co-existing morbidities. The study group included 41 patients that underwent LLIF and 69 that had open surgery. Two surgeons performed these procedures. Surgeon A performed 60 open procedures and 13 LLIF procedures. Surgeon B performed 9 open and 28 LLIF procedures.

A retrospective analysis of 110 patients meeting the inclusion criteria was performed. Data including patient's demographics, clinical presentation, indications for surgery, surgery performed, number of levels fused and medication administration was collected through Cerner EMR for each case. Length of hospital stay was defined as the number of days between the date of surgery to the date of discharge.

Inpatient narcotic usage was defined as narcotics used intra-operatively and narcotics used during the post-operative recovery period, including scheduled medications, PCA and pain score as recorded in the Medication Administration Record (MAR) in Cerner EMR. Peri-operative period was defined as the time from anesthesia administration on date of surgery until return to the general floor post-operatively. Opioid use was standardized using an equianalgesia chart and total dose was calculated for each patient as morphine equivalents and adjusted to patient dosage weight.

Statistics

Mean and standard deviation were used to describe total opioid dose as a continuous variable. Data was separated into two independent populations, minimally invasive *vs.* open surgery. Univariate analysis using a one-tailed pooled *t*-test was used to compare the interventions. A P value <0.05 was considered statistically significant. Other outcomes included length of hospital stay and number of spinal levels fused.

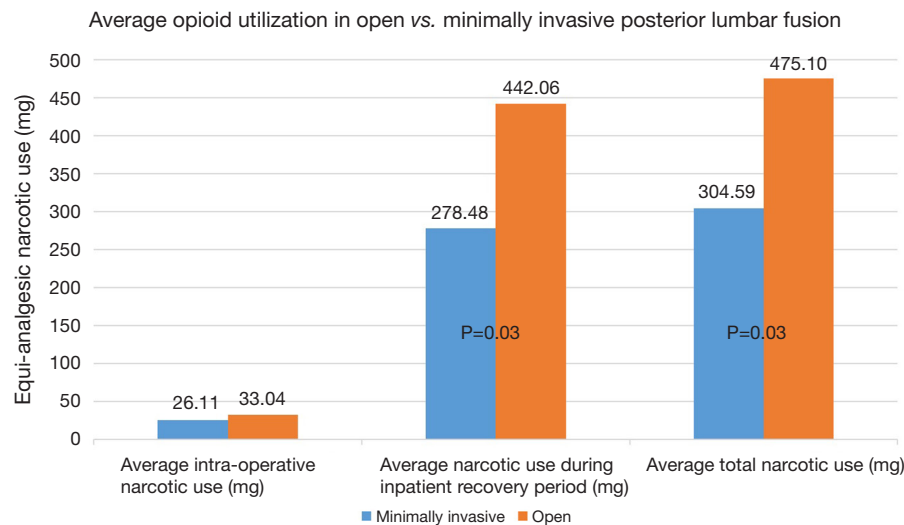


Figure 1 Average opioid utilization in open versus minimally invasive lateral lumbar interbody fusion. MISS is plotted against open procedure for intra-operative, inpatient recovery, and total narcotic use. MISS, minimally invasive spinal surgery.

Analysis was performed using Statistical Product and Service Solutions software (version 13; SPSS, Chicago, IL).

Results

A total of 110 patients presenting for lumbar spinal fusion were included in this study. There were 41 patients included in the MISS group and 69 included in the open surgery group. The average post-operative equianalgesic dose was 278.48 mg for the MISS group. The average post-operative equianalgesic dose for the open group was 442.06 mg. Average narcotic usage post-operatively was significantly lower for the MISS group relative to those who underwent open lumbar fusion ($P=0.03$) (Figure 1).

Average total narcotic use during the patient's hospital stay was also recorded with 304.59 mg for the MISS group and 475.10 mg for the open group. A comparison of intra-operative narcotic use did not reveal a statistically significant difference (26.11 vs. 33.04 mg, $P=0.06$).

Additionally, we measured length of hospital stay for MISS patients compared to open surgery patients and found that MISS patients had an average stay of 4.10 days (STD DEV 2.4) and open surgery patients had an average stay of 6.19 days (STD DEV 6.1). The average length of post-operative hospital stay was significantly shorter for patients who underwent MISS compared to those who had an open procedure ($P=0.02$) (Figure 2).

Data was also collected on opioid usage based on number

of vertebrae fused. We measured average intraoperative narcotic usage as well as during the inpatient recovery period. No significant trend was found in the equianalgesic narcotic use when comparing number of vertebrae fused. This data was also stratified by MISS vs. open surgery groups and no significant difference was found (Figure 3).

Discussion

The minimally invasive technique for spinal fusion attempts to reduce iatrogenic injury to soft tissue associated with open spinal fusion (3-5). The literature supports that MISS with LLIF is associated with a decrease in soft tissue injury, blood loss, hospital length of stay, as compared to open procedure (4,8,9). In addition to recording additional data on hospital length of stay, this study examines how narcotics are used in LIF MISS when compared to open surgery. Clarke *et al.* reported that approximately 3% of patients who previously did not use opioids continued use for more than 90 days after major elective surgery (18). Opioid use following orthopedic surgery can be correlated to how opioids are administered in perioperative period. According to Nora et al, in a survey 2 weeks after discharge, patients who expressed satisfaction with pain management in the hospital used significantly less opioids compared with patients who were not always satisfied (19).

The current literature has not adequately explored the amount of opioid use in the perioperative period in

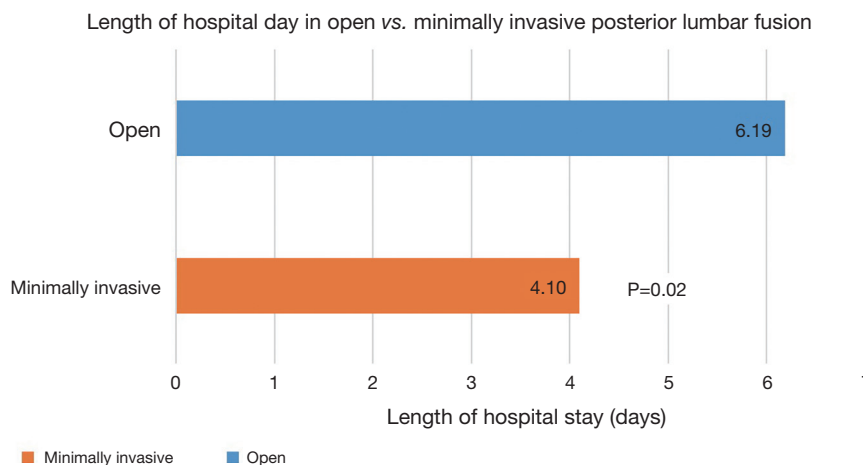


Figure 2 Length of hospital stay in open versus minimally invasive lateral lumbar interbody fusion.

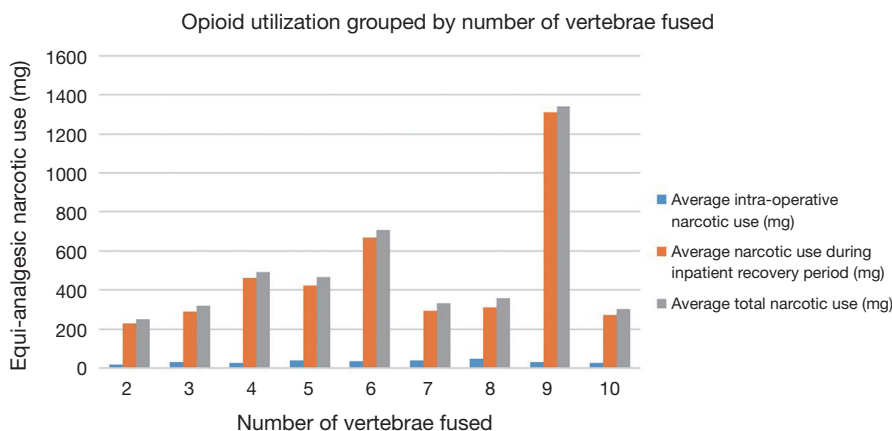


Figure 3 Opioid utilization in equianalgesic dose is plotted against number of vertebrae fused. Both open and MISS cases are included and narcotic used is categorized into intraoperative and post-operative. MISS, minimally invasive spinal surgery.

LLIF minimally invasive fusion techniques compared to open techniques. Previous studies have shown that high preoperative opioid use is associated with high perioperative opioid demand and continued opioid use 12 months postoperatively (20). However, these patients do not have increased intraoperative opioid use. This study demonstrated that patients who received minimally invasive lumbar fusion via LLIF had decreased overall use of opioids in the perioperative period and shorter hospital stays relative to the open procedure. Of the 41 minimally invasive surgeries included in this study, the average perioperative opioid use was significantly less than the 69 open cases. Total opioid use during the hospital course was also higher in the open surgery population. This greater exposure to opioids could correlate to a higher risk of long term opioid

use. According to Clarke *et al.*, the risk of long-term opioid use following major surgery is 3.1% (18). If perioperative opioid exposure can be reduced than perhaps long-term opioid use can be reduced.

Intraoperative narcotic usage was not statistically different between the two groups. This may be because of differences in physician preference, length of surgery, and type of anesthetics administered by anesthesia. Ketamine can decrease opioid use in the perioperative setting, which may influence our results because intraoperative anesthesia was not standardized (21). Previous literature has indicated that increased procedural invasiveness has led to increased intraoperative opioid demand, possibly secondary to more extensive soft-tissue dissection and additional instrumentation (20).

This study supports evidence from the literature that have shown MISS to have better short-term outcomes in terms of pain control and length of hospital stay relative to open surgery. In 2016, Kulkarni *et al.* (22) found that MISS results in significantly shorter hospital stays 4.11 days when compared to open surgery 5.84 days. This was similar to our results where we found that MISS has an average stay of 4.1 days *vs.* open surgery with an average stay of 6.2 days. As longer hospital stay is associated with increasing risk of morbidity to the patient, providers may consider MISS over open procedure when weighing this fact (23).

Limitations of this study include a small patient population. Patients were not matched based on demographics and were grouped only based on type of surgery. Patients were not monitored after discharge to determine opioid use after leaving the hospital. Limitations may also exist in the equianalgesic dosage chart used for conversions in this study. This may lead to opioid doses being misconstrued as higher or lower in efficacy.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: This study was approved by the Institutional Review Board of The George Washington University (No. 031558).

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