



# ADVERSE EVENTS FOLLOWING LUMBAR SPINE FUSION: THE IMPACT OF DIABETES MELLITUS

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## ABSTRACT

**Objective:** Spinal surgery is becoming increasingly popular, but its complications cause substantial morbidity and mortality. Diabetes mellitus is prevalent in patients undergoing lumbar fusion surgery, yet the literature is divided on whether they are prone to a higher complication rate and worse outcomes. The aim of this study is to investigate the complication rates in patients undergoing elective lumbar fusion surgery and its relationship to diabetes mellitus and other potential risk factors.

**Materials and Methods:** A retrospective review of all adult patients undergoing instrumented lumbar fusion surgery in the past two years was performed. Demographic and clinical data were collected, and diabetic patients were compared with non-diabetic controls. Statistical analysis was performed to test for the significance of any difference, and multiple regression analysis was then done to assess the strength of this significance.

**Results:** Eighty patients were included in the study, 24 (30%) of whom were diabetic. Diabetic patients were older, had more comorbidities, shorter fusions, less blood loss, more complications but similar pain control and length of stay compared to non-diabetic patients. Diabetes was found as an independent significant predictor of adverse events, yet the other factors were not found.

**Conclusion:** Patients with diabetes mellitus have a higher risk of infection and other complications following instrumented lumbar fusion. Although maintaining good glycemic control is paramount, the higher risk necessitates close postoperative observation and extra care in the long term.

**Keywords:** Spine surgery, diabetes mellitus, complications

## INTRODUCTION

The last two decades have brought about a substantial increase in lumbar spine fusion surgery globally<sup>(1-3)</sup>. Improved understanding of lumbar pathology and biomechanics led to improved outcomes when compared to nonoperative treatment<sup>(4,5)</sup>. An aging population and increasingly more complex procedures lead to concerns of higher complication rates in some instances<sup>(6,7)</sup>.

A significant percentage of spine surgery patients suffer from diabetes mellitus (DM), up to 25%<sup>(8)</sup>. Numerous studies have looked into the association of DM with clinical outcomes following lumbar fusion surgery, and a clear association was found in most<sup>(9,10)</sup>. Patients with DM had worse clinical outcomes and were burdened with a higher rate of adverse events<sup>(8,11)</sup>.

This realization caused an increased emphasis on tight control of DM prior to spine surgery, with clinical pathways incorporating a normal HgA1C as a precondition for considering elective lumbar spine surgery<sup>(12)</sup>. The assumption was that euglycemic patients should have similar outcomes to non-diabetic patients, as was stipulated in some published results<sup>(13,14)</sup>. The author noticed

that complication rates were still more prevalent in diabetic patients, regardless of how controlled the serum glucose is. The goal of this study was to investigate the complication rates in patients undergoing elective lumbar fusion surgery and to investigate the modifiable risk factors associated with its incidence.

## MATERIALS AND METHODS

The institutional research ethics board approval (21/0034/IRB) was obtained prior to the collection of the data. A retrospective chart review of all patients undergoing elective thoracolumbar fusion surgery in our institution from January 2019 to the end of December 2020 was performed. All these patients went through a pre-anesthesia evaluation that included confirmation of normal serum glucose (4.4-7.8 mmol/L) and hemoglobin A1c levels (<7.5%) for all patients suffering from DM. All patients that did not fulfill this condition had their procedure delayed until their blood sugar was well controlled. Data collected included demographics and numerous clinical data. That included the American Society of Anesthesiologists physical Status Classification System, the number of levels fused, the estimated



blood loss intraoperatively, the length of anesthesia, the first day of mobilization out of bed, the length of inpatient stay, the numeric pain score on the day of discharge, the presence of any complications, the serum glucose level on the day of discharge (for diabetic patients) and patient's status when it comes to DM. Short-term follow-up was available for all patients (up to one year). All data was anonymized, coded, and tabulated electronically on a password-secured computer. The t-test and the Mann-Whitney test were used for the analysis of continuous data, while the chi-square test was used for the analysis of categorical data. Regression analysis was performed for the relevant variables to assess the strength of their association with the primary outcome of postoperative complications. All analysis was performed on SPSS version 27 software (IBM Corp, Armonk, NY, USA). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

## RESULTS

Eighty patients were included in the study cohort, twenty-four out of which (30%) had DM. The demographic and clinical data are presented in Table 1.

The incidence of patients who had complications was 8.8% (n=7 patients). The complications were as follows: six wound infections requiring reoperation, one deep vein thrombosis, and one urinary tract infection (one patient had two complications). Univariate analysis showed that DM was significantly associated (p=0.026) with the incidence of complications (odds ratio=7,105, 95% confidence interval: 1.271-39,725). Multiple regression analysis revealed that DM alone was significantly associated with the development of complications (Table 2). There were no deaths, and all patients left the hospital to their residence, mobilizing independently with minimal need for assistance.

## DISCUSSION

DM is a global epidemic, causing substantial morbidity and mortality<sup>(15,16)</sup>. The continued rise of the incidence of DM is unequal, affecting developing countries at a higher rate and posing a significant challenge to the healthcare systems<sup>(17,18)</sup>. The pathophysiology is complex, but it has been proposed that glycosylation of tissue leads to irreversible fibrosis and angiogenesis resulting in end-organ damage<sup>(19)</sup>. The link between DM and surgical complications- infection particularly- has been repeatedly reported on<sup>(20,21)</sup>. The first series reporting

**Table 1.** Demographic and clinical information of the study sample

|                           | Diabetic (n=24) | Non-diabetic (n=56) | p-value |
|---------------------------|-----------------|---------------------|---------|
| Age (SD)                  | 62.9 (13.3)     | 38.7 (18.1)         | 0.001   |
| Female sex, n (%)         | 18 (75)         | 36 (64)             | 0.225   |
| ASA class, n (%)          |                 |                     | 0.018   |
| I                         | 3               | 23                  |         |
| II                        | 14              | 27                  |         |
| III                       | 7               | 6                   |         |
| Number of levels (SD)     | 1.54 (1)        | 4.34 (4.44)         | 0.003   |
| EBL in ml (SD)            | 302 (128)       | 417 (267)           | 0.048   |
| LOA in minutes (SD)       | 246 (74.9)      | 275 (96.7)          | 0.196   |
| Days to mobilize (SD)     | 1.58 (1)        | 1.79 (1)            | 0.246   |
| NPS on DOD (SD)           | 1.87 (1.74)     | 1.86 (1.29)         | 0.972   |
| RSG on DOD in mmol/L (SD) | 7.8 (1.8)       | N/A                 | N/A     |
| LOS in days (SD)          | 5.54 (4.3)      | 4.77 (1.7)          | 0.252   |
| Complications, n (%)      | 5 (21)          | 2 (3.6)             | 0.012   |

SD: Standard deviation, EBL: Estimated blood loss, LOA: Length of anesthesia, NPS: Numeric pain score, DOD: Day of discharge, RSG: Random serum glucose, LOS: Length of admission

**Table 2.** Multiple regression analysis of factors associated with complications

|                  | Odds ratio | 95% confidence interval | p-value |
|------------------|------------|-------------------------|---------|
| DM               | 13.21      | 1.175-148,452           | 0.037   |
| ASA              | 1.166      | 0.316-4,299             | 0.818   |
| EBL              | 1.003      | 0.999-1.007             | 0.146   |
| Number of levels | 0.997      | 0.714-1.393             | 0.987   |

DM: Diabetes mellitus, ASA: American Society of Anesthesiologists, EBL: Estimated blood loss

on this issue was by Simpson et al.<sup>(22)</sup> in 1997. Reporting on 62 lumbar fusion cases performed in the 1980s, longer hospital stay, delayed wound healing, and poor clinical results were noted in the DM group. Of note is that the mean serum glucose in that series was 10 mmol/L (6-14), which shows that there was no strong control on DM for that cohort. The second study was published by Glassman et al.<sup>(23)</sup>. It involved a retrospective review of 94 cases against a matched control group. Again, complication rates were higher in the DM group (53% vs. 21%). Subgroup analysis for multi-level fusions showed a higher complication rate, a finding that was not confirmed in our series. In fact, the diabetic group had less blood loss and shorter fusion in our study yet still had more complications. That may be attributed to the employment of less invasive approaches in the diabetic patients to reduce complication rates. Cho et al.<sup>(24)</sup> reported on the impact of DM on outcomes in spinal deformity cases. They reported on a cohort of 23 adult deformity cases with DM utilizing a matched case-control design. They did not find any difference between the two groups and attribute that to the matching by age, sex, body mass index (BMI), and operative details. This was possible as they selected the control group from over 5000 such cases in their database. Our study did not match for age or comorbidity, but regression analysis confirmed that DM alone has the strongest association with complication occurrence. Shortly after, Takahashi et al.<sup>(25)</sup> published their series of 41 patients with DM who underwent lumbar fusion. They compared their cohort with 124 non-diabetic patients and were the first to link a higher hemoglobin A1c (HgA1C) level with poor outcomes. They also found that patients who have had diabetes for more than 20 years had worse outcomes. Sharma et al.<sup>(26)</sup> published their series in the same year and contradicted Takahashi et al.<sup>(25)</sup> by confirming a higher complication rate in DM patients (29% vs. 13%). The rest of their clinical data was not different between the groups except for the length of stay, which was higher in the DM group<sup>(26)</sup>. Their results are very close to the findings from this current study, especially noting that they reported relatively good glycemic control -measured by HgA1C- for their DM cohort. Golinvaux et al.<sup>(27)</sup> made a distinction between non-insulin-dependent DM (NIDDM) and insulin-dependent DM (IDDM). They reported that an increase in complication rates was found in the IDDM group, and that the complications themselves were more severe. The NIDDM group did differ in some clinical data-such as BMI-and in none of the groups was there any mention of glycemic control. We did not make any distinction based on insulin dependence, as the literature supports the notion that good glycemic control is paramount regardless of the type of DM<sup>(28)</sup>. Guzman et al.<sup>(29)</sup> addressed the issue of glycemic control in their study. A direct comparison of controlled DM and uncontrolled DM patients undergoing lumbar spine surgery showed that diabetic patients had a higher complication rate in general, and uncontrolled DM led to a longer hospital stay and higher mortality.

### Study Limitations

This study had some limitations, such as a retrospective design, short-term follow-up, and a relatively small sample size. Nevertheless, the data comparison and analysis clearly showed that -regardless of glycemic control and despite smaller operations and less blood loss-diabetic patients are more prone to adverse events, and as such extra care needs to be taken in their postoperative clinical follow-up.

### CONCLUSION

Patients with DM have a higher risk of infection and other complications following instrumented lumbar fusion. Although maintaining good glycemic control is paramount, the higher risk is present regardless.

### Ethics

**Ethics Committee Approval:** The institutional research ethics board approval (21/0034/IRB) was obtained prior to the collection of the data.

**Informed Consent:** Retrospective study.

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