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Original Article

Prolonged Operation Time and Adverse Events in Spine Surgery in Nigeria

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A R T I C L E I N F O

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A B S T R A C T

Objective: The aim of this study is to determine the relationship between prolonged operative time and adverse events in spinal surgery in a tertiary hospital in Nigeria. The duration of surgery has been shown to be risk factor for complications in many studies. Patients' outcome and quality of life following spinal surgery is affected by adverse events (AE) and surgical complications (SC). Method: From 1st January 2022 to 31st December 2024, a cross-sectional study consisting of consented patients undergoing spine surgery were included in this study and followed up for 1year. Demographics and clinical data were collected. Adverse events (AE) were classified using Spinal Adverse Events Severity System version 2 (SAVES-V2) capture system. Bivariate analysis and univariate logistic regression were used to determine the association between operative time and complications using the software SPSS 21.0 Result: There were 140 (117 males and 23 females) patients prospectively enrolled in this study with male predominance. The mean age of the patients was 57.3 ± 8.1;and the mean operative time was 183.4 ± 42 min. Fifty-three (37.9%) patients experienced an AE related to surgery. A total of 189 adverse events were recorded. Early post-operative AEs (60.8%) accounted for the most recorded AEs. Univariate logistic regression analyses confirmed that prolonged operative time correlated with increased risk of intra-operative ($p< 0.05$), early post-operative (p-value < 0.05) and late post-operative (p-value < 0.05) adverse events Conclusion: There is a strong correlation between the occurrence of adverse events in spinal surgery and prolonged operative time as shown in this study. Protocols to minimise prolong surgery should be instituted to enhance patient's safety, and improve outcome.

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INTRODUCTION

In the evolving landscape of surgical quality improvement, intraoperative variables that can be modified to enhance patient safety are of paramount interest. Among these, operation time has emerged as a significant and potentially controllable risk factor associated with postoperative morbidity across multiple surgical disciplines. [1] Prolonged operative duration, while sometimes an unavoidable consequence of surgical complexity, is postulated to increase patient exposure to a cascade of physiological stressors, including prolonged anaesthesia, increased blood loss, and extended soft tissue retraction.2 Within the specialized field of spine surgery, where procedures can range from brief decompressions to multi-level, instrumented reconstructions, the implications of extended operating time are particularly salient due to the delicate neurological structures involved and the often-compromised health status of the patient population.

The association between longer operations and an elevated risk of complications is biologically plausible. Extended exposure of the surgical site increases the risk of microbial contamination and subsequent surgical site infection (SSI), a devastating complication in spine surgery that can lead to reoperation, chronic pain, and poor outcomes.3 Furthermore, prolonged anaesthesia time is independently linked to cardiopulmonary complications, while extended periods of prone positioning and tissue manipulation can contribute to increased blood loss, greater transfusion requirements, and heightened risks of venous thromboembolism and neurological injury.4Furthermore, a longer surgical time was correlated with a longer duration of anesthesia, which contributes to the development of complications. [1-5]

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Despite this mechanistic rationale, the precise relationship between operative duration and the incidence of specific complications in spine surgery remains an area of active investigation, with conflicting reports in the literature regarding its independent predictive power when adjusted for case complexity and patient comorbidities. [6]

Establishing a clear, risk-adjusted understanding of this relationship is critical for both clinical practice and healthcare systems. For surgeons and hospitals, it can inform operative planning, team resource allocation, and the development of protocols for high-risk, lengthy procedures. For patients, it contributes to more accurate risk stratification during the informed consent process.

This study aims to critically analyze the association between prolonged operative time and the incidence of postoperative complications in a cohort of patients undergoing elective spine surgery. With increasing surgical intervention in Nigeria, there will be concomitant increase in spine related complications. [7-11] We seek to determine whether operative time remains an independent predictor of adverse events after controlling for established confounders such as diagnosis, number of surgical levels, approach, and patient-specific risk factors.

METRIALS AND METHOD

This is a prospectively study conducted following the Reporting of Observational Studies in Epidemiology (STROBE) guidelines from patients undergoing spinal surgery between 1stJanuary 2022 to 31st December 2024 at the National Orthopaedic Hospital Dala, Kano Nigeria. Patients' characteristics including sex, age, and comorbidities (according to Charlson Comorbidity Index (CCI))12 were recorded. Information on surgical procedure and on its duration were recorded on a data collection sheet specifically designed for this study.

The adverse events were recorded and classified using the SAVES-V2 system13 (including SAVES V2 severity grades, categories of intraoperative AEs, categories of post-operative AEs). Postoperative AEs were further differentiated in "early postoperative", occurring in the first 14 days after surgery, and "late postoperative", occurring more than 14 days after surgery.

A descriptive analysis was executed for patients' demographics and surgical data. Shapiro-Wilk test was employed to test the normality of all parameters studied. The analysis identified a non-normal distribution of data for operative time only in the tails where occasional surgeries with very short or very long operative time were represented. Data were summarized using means and standard deviation for continuous variables, and by absolute and relative frequency for categorical variables. Bivariate analysis and univariate logistic regression models were created to determine the association between operative time and complications as continuous variable. SPSS 21.0 was employed for this statistical analysis where $p<0.05$ were statistically significant.

RESULT

Table 1 shows a total of 140 patients, predominantly male (83.6%), with a mean age 64.2, and a mean CCI index of 3.6 ±2.8. The mean operative time was 183.4 ± 42 min. A total number of 53 patientshad adverse events. Thirty-seven patients had an operative time less than 3hr and 103 patients had an operative time longer or equal to 3hr. A total of 189 adverse events (29 intra-operative AEs, 115 early post-operative AEs, and 45 late post-operative AEs) were recorded using the SAVES- V2 system.

Table 1: Socio-clinical demography

Variables	Frequency
Gender	
Male	117
Female	23
Age (mean in years)	57.3 ± 8.1
Mean CCI Index	3.6± 2.8
Operative time	183.4± 42mins
<3hr	37
≥ 3hr	103
Patients with AEs	53 (37.9%)
Adverse events	189

Table 2 shows the report of the AEs of the patients in this study. Majority of the AEs occurred in the early post-operative group and this occurs when the surgery is more than 3hrs. Many adverse events filled the category "others" (26.6%) of which fever and anaemia were the more frequent. The intra-operative AEs is dominated by duratear that represented the most common complication (10.6%). There were 45 (23.8%) AEs in the late post-operative period with construct failure (7.9%) the commonest and this also occurred more in surgery more than 3hrs.

Table 2: Adverse events related to the patients based on operative time

	Operative Time < 3hr		**Operative Time ≥ 3hr**		
Intra-operative	Dura tear	6	Dura tear	13	
	# Pedicle	2	# Pedicle	4	
			Cardiac event	2	
			Haemorrhage	2	
Total		8		21	29
Early post-operative	Cardiac related issues	3	Cardiac related issues	10	
	Neuro- deficit	5	Neuro- deficit	15	
	UTI	2	UTI	6	
	Atelectasis	1	Atelectasis	6	
	CSF leaks	2	CSF leaks	5	
	Haematoma	2	Haematoma	5	
	Others	14	Others	36	
Total		29		86	115
Late post-operative	Construct failure	3	Construct failure	12	
	Deep wound infection	4	Deep wound infection	7	
	Others	3	Systemic infection	5	
			Others	11	
Total		10		35	45

Table 3 shows the comparative analysis of the demographic and clinical factors related to operative time in the present study. This showed a significant difference between the two-patient population (operative time<3 or ≥3 h), indicating that patients with operative time less than 3 h are older (p-value <0.05) with a higher CCI index (p-value <0.05) and incidence of AEs (p-value <0.05) score than patients with longer surgeries.

Table 3: Comparative analysis of demographic and clinical factors related to operative time

	Operative time <3hr	Operative time ≥ 3hrs	p-Value
Variables			
Age	61.7	58.3	<0.05
CCI	2.36	2.12	<0.05
AEs	46	142	<0.05

DISCUSSION

The findings of this study demonstrate a significant and independent association between prolonged operative time and an increased incidence of major postoperative complications following spine surgery. After rigorous adjustment for patient comorbidities, surgical complexity (including number of levels and approach), and diagnosis, operative duration persisted as a key modifiable risk factor. This reinforces the conclusions of broader surgical meta-analyses and confirms their specific relevance to the spine surgical population, where the physiological stakes of extended exposure are high. [11,14] The complications most strongly correlated with extended time-namely surgical site infection, increased transfusion requirements, and systemic medical events-align with the proposed biological mechanisms of heightened microbial exposure, cumulative blood loss, and prolonged physiological stress. [2-3]

The positive correlation between operative time and SSI risk is mechanistically intuitive. Each additional hour in the operating room extends the duration of open wound exposure to airborne and contact pathogens, challenges tissue perfusion due to sustained retraction, and may be associated with larger dissections and implant burdens that provide a nidus for infection. [3] Similarly, the link to higher transfusion rates likely reflects both the direct effect of ongoing blood loss over time and the potential for a dilutional coagulopathy associated with prolonged fluid resuscitation.

This study aligns with and extends the broader surgical literature [15-26] onadverse events following prolonged operation time in spine surgery. Importantly, our data suggest that the risk is not merely a surrogate for complexity. While complex cases understandably take longer, the analysis indicates that for two procedures of similar complexity, the one with the longer duration carries added risk. This implies that factors beyond pure anatomic challenge-such as surgical efficiency, team coordination, and intraoperative decision-making-may influence outcomes. [27]

This analysis should not be misinterpreted as advocating for recklessly expedient surgery, as haste can itself lead to technical error and neurologic injury. Instead, it highlights the importance of operative efficiency—the expeditious execution of a well-planned procedure with minimal wasted motion or delay. Strategies to optimize efficiency include detailed preoperative planning with imaging review, standardization of instrument sets and intraoperative protocols, and fostering experienced, cohesive surgical teams.5For anticipated lengthy cases (e.g., >3-6 hours), heightened vigilance for specific complications is warranted; this may include reinforced antibiotic redosing protocols, aggressive warming to prevent coagulopathy, and meticulous intraoperative hemostasis.

The limitations of this study warrant consideration. As a retrospective analysis, it can establish association but not causation. Unmeasured confounders, such as intraoperative events (e.g., dura tears, difficult screw placement) that both prolong surgery and independently increase complication risk, may partly explain the association. Furthermore, operative time is a crude metric that does not distinguish between time spent on critical dissection versus logistical delays. Future prospective studies should incorporate more granular data, such as “incision-to-close” time versus “anesthesia” time, and document specific causes for delays. Research should also focus on evaluating targeted interventions, such as team-based surgical safety checklists or enhanced recovery protocols, to mitigate the risks associated with necessary, prolonged operations.

In conclusion, operative time is a significant and independent predictor of complications in spine surgery, with prolonged duration elevating the risks of infection, transfusion, and medical morbidity. This relationship persists after controlling for surgical complexity, underscoring that time itself is a modifiable risk factor. The goal is not simply faster surgery, but more efficient and predictable surgery. These findings support the implementation of strategies aimed at improving operative planning, teamwork, and efficiency as integral components of a comprehensive surgical safety program, ultimately aiming to improve patient outcomes and reduce the burden of preventable complications.

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