



IMPACT OF SURGICAL DURATION ON POSTOPERATIVE OUTCOMES IN SICKLE CELL DISEASE-POSITIVE PATIENTS: A RETROSPECTIVE OBSERVATIONAL STUDY

General Surgery

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ABSTRACT

Background: Sickle Cell Disease (SCD) is a significant genetic disorder affecting millions worldwide, characterized by the presence of abnormal hemoglobin S leading to vaso-occlusive crises, chronic anemia, and multi-organ damage. Surgical interventions in SCD-positive patients carry heightened perioperative risks, including hypoxia, dehydration-triggered vaso-occlusive crises, infections, and delayed recovery. Surgical duration has been identified as a key modifiable risk factor in determining postoperative outcomes. **Aim and Objectives:** To evaluate the impact of surgical duration on postoperative complications, recovery times, and hospital stay in SCD-positive patients, and to identify evidence-based perioperative risk-mitigation strategies. **Methods:** A retrospective observational study was conducted at Zydus Medical College and Hospital, Dahod, Gujarat over a two-year period (2022–2023). A total of 620 SCD-positive patients who underwent surgical procedures were included and stratified by surgical duration: Short (<2 hours), Medium (2–4 hours), and Long (>4 hours). Postoperative outcomes including complication rates, recovery times, and length of hospital stay were analyzed. **Results:** Prolonged surgical duration (>4 hours) was significantly associated with higher complication rates, including vaso-occlusive crises (VOC) and infections ($p < 0.05$). Shorter surgeries (<2 hours) had quicker recovery times and fewer adverse events. Effective perioperative management strategies were essential in reducing complication rates across all groups. **Conclusion:** Surgical duration is a significant determinant of postoperative outcomes in SCD-positive patients. Minimizing operative time where feasible, combined with a structured multidisciplinary perioperative protocol, can substantially reduce morbidity in this high-risk population.

KEYWORDS

Sickle Cell Disease (scd), Surgical Duration, Postoperative Outcomes, Vaso-occlusive Crisis (voc), Perioperative Management

INTRODUCTION

Sickle Cell Disease (SCD) is a significant genetic disorder affecting millions worldwide, with a particularly high prevalence in regions such as sub-Saharan Africa, the Middle East, and parts of India. Characterized by the presence of abnormal hemoglobin S, SCD leads to the sickling of red blood cells, resulting in various complications, including chronic anemia, vaso-occlusive crises, and organ damage. These complications often necessitate surgical interventions, ranging from minor procedures to major surgeries.(1)

Surgical care for SCD-positive patients presents unique challenges due to their heightened risk of perioperative and postoperative complications. Factors such as hypoxia, dehydration, and physiological stress during surgery can trigger vaso-occlusive crises, making it essential to optimize perioperative management. Despite advances in understanding SCD, outcomes in this vulnerable population remain inadequately explored.(2)

Surgical duration has emerged as a key variable in determining perioperative risk. Prolonged anesthesia exposure, increased fluid shifts, and extended periods of physiological stress may collectively worsen outcomes for SCD patients. However, systematic data quantifying this relationship and guiding perioperative protocols remain limited. The present study sought to address this gap through a structured retrospective analysis of 620 SCD-positive surgical patients.(3)

AIM

To evaluate the impact of surgical duration on postoperative outcomes in SCD-positive patients.

OBJECTIVES

1. To correlate surgical duration with postoperative complications including vaso-occlusive crises (VOC) and infections.
2. To assess recovery times and length of hospital stay across surgical duration groups.

3. To identify risk-mitigating perioperative factors in SCD-positive patients.
4. To provide evidence-based recommendations for perioperative management.

METHODOLOGY:

This retrospective observational study was conducted at Zydus Medical College and Hospital, Dahod, Gujarat, over a two-year period spanning 2022 to 2023. The study included SCD-positive patients aged 18 years and above who underwent surgical procedures during the study period and had complete medical records available for review. Written ethics committee approval was obtained prior to data collection.

A total of 620 SCD-positive patients were enrolled and stratified by surgical duration into three groups: Short (<2 hours), Medium (2–4 hours), and Long (>4 hours). Demographic data, surgical procedure category, preoperative hemoglobin S levels, perioperative management strategies, and postoperative outcomes were recorded. Outcomes of interest included occurrence of vaso-occlusive crises (VOC), wound infections, acute chest syndrome (ACS), recovery time, and total hospital stay.

Preoperatively, all patients underwent optimization including adequate hydration, supplemental oxygen, and pain management review. Intraoperatively, vigilant monitoring of vital signs, oxygen saturation, and fluid balance was maintained. Postoperatively, a structured protocol was followed encompassing early mobilization, high-protein nutritional support, physiotherapy, and close monitoring for complications.(4)

Statistical analysis was performed using SPSS version 20. Continuous variables were expressed as mean $\pm$ standard deviation and categorical variables as frequencies and percentages. Chi-square test and ANOVA were used to compare outcomes across surgical duration groups, with a p-value of <0.05 considered statistically significant.

Inclusion Criteria:

Confirmed diagnosis of Sickle Cell Disease (SCD).
Age 18 years and above.
Surgical procedures performed between 2022–2023.
Complete medical records available.

Exclusion Criteria:

Paediatric patients (<18 years).
Emergency surgeries with incomplete perioperative data.
Patients with unrelated major comorbidities affecting surgical outcomes.
Patients with missing or incomplete medical records.

RESULTS:

The study enrolled 620 SCD-positive patients with a mean age of 34.2 ± 10.8 years. The majority of patients fell in the 25–44 age group (52%), with male patients comprising 58% of the cohort. Diabetic comorbidity was present in 18% of patients, while hypertension was noted in 12%. The most common surgical procedures were abdominal surgeries (38%), followed by orthopedic procedures (27%), vascular surgeries (18%), and other categories (17%).

Table 1: Age and Sex Distribution of Study Participants (N=620)

Variable	Short (<2 hrs) (n=214)	Medium (2–4 hrs) (n=238)	Long (>4 hrs) (n=168)	Total (N=620)	p-value
18–24	46 (21.5)	48 (20.2)	24 (14.3)	118 (19.0)	0.102
25–44	116 (54.2)	126 (52.9)	81 (48.2)	323 (52.1)	
45–60	38 (17.8)	46 (19.3)	46 (27.4)	130 (21.0)	
>60	14 (6.5)	18 (7.6)	17 (10.1)	49 (7.9)	
Sex					0.482
Male	126 (58.9)	140 (58.8)	94 (56.0)	360 (58.1)	
Female	88 (41.1)	98 (41.2)	74 (44.0)	260 (41.9)	

Table 2: Surgical Procedure Categories by Duration Group (N=620)

Procedure Type	Short (<2 hrs) (n=214)	Medium (2–4 hrs) (n=238)	Long (>4 hrs) (n=168)	Total (N=620)	p-value
Abdominal	72 (33.6)	98 (41.2)	66 (39.3)	236 (38.1)	0.214
Orthopedic	72 (33.6)	60 (25.2)	36 (21.4)	168 (27.1)	
Vascular	34 (15.9)	46 (19.3)	32 (19.0)	112 (18.1)	
Other	36 (16.8)	34 (14.3)	34 (20.2)	104 (16.8)	

The overall complication rate differed significantly across the three surgical duration groups. Patients who underwent procedures lasting more than 4 hours had markedly higher rates of vaso-occlusive crises, infections, and acute chest syndrome compared to those in the short and medium duration groups (p < 0.05). The mean hospital stay was 4.2 ± 1.4 days in the short duration group, 6.8 ± 2.1 days in the medium group, and 11.6 ± 3.4 days in the long duration group.

Table 3: Postoperative Complications by Surgical Duration (N=620)

Complication	Short (<2 hrs) (n=214)	Medium (2–4 hrs) (n=238)	Long (>4 hrs) (n=168)	p-value
Vaso-occlusive crisis (VOC)	14 (6.5%)	38 (16.0%)	52 (30.9%)	0.001*
Wound infection	8 (3.7%)	22 (9.2%)	34 (20.2%)	0.001*
Acute Chest Syndrome (ACS)	4 (1.9%)	12 (5.0%)	18 (10.7%)	0.002*
Delayed recovery (>7 days)	10 (4.7%)	36 (15.1%)	62 (36.9%)	0.001*
Mean hospital stay (days)	4.2 ± 1.4	6.8 ± 2.1	11.6 ± 3.4	0.001*

Perioperative management strategies including adequate hydration, supplemental oxygen, patient-controlled analgesia (PCA), and early mobilization were associated with significantly reduced complication rates across all groups. Antibiotic stewardship guided by culture and sensitivity results was effective in managing infectious complications. Multidisciplinary collaboration involving surgeons, anesthesiologists, hematologists, and nursing staff was identified as a critical element in achieving favorable outcomes.

Table 4: Perioperative Management Strategies and Complication Reduction (N=620)

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Metric	Strategy Applied (n=448)	Not Applied (n=172)	p-value
VOC rate	14.7%	28.5%	0.003*
Infection rate	7.1%	18.6%	0.002*
Mean hospital stay	6.4 ± 2.8	9.8 ± 3.6	0.001*
Delayed recovery	12.5%	32.0%	0.001*

DISCUSSION :

This retrospective observational study evaluated the impact of surgical duration on postoperative outcomes in 620 SCD-positive patients. The findings demonstrate a clear and statistically significant relationship between prolonged surgical duration and increased postoperative complication rates, extended hospital stays, and delayed recovery.

The demographic distribution of the study, with a mean patient age of 34.2 ± 10.8 years and a slight male predominance (58%), reflects the typical profile of the SCD-positive surgical population in tertiary care centers. Similar demographic patterns have been reported by Firth et al. (2018), who documented a younger age of presentation and higher surgical burden in male SCD patients, likely attributable to increased exposure to traumatic injuries and orthopedic complications.(5)

The primary finding of this study — that prolonged surgical duration (>4 hours) is significantly associated with higher rates of vaso-occlusive crises (30.9%), wound infections (20.2%), and acute chest syndrome (10.7%) — is consistent with the pathophysiology of SCD. Extended anesthesia exposure, greater fluid shifts, temperature dysregulation, and prolonged physiological stress collectively increase sickling risk, endothelial activation, and inflammatory burden.(6) These observations align with findings by Vichinsky et al. (2020), who demonstrated that intraoperative hypoxia and dehydration were the most critical triggers for perioperative vaso-occlusive events in SCD.(7)

The mean hospital stay in the long duration group (11.6 ± 3.4 days) was nearly three times that of the short duration group (4.2 ± 1.4 days), highlighting the significant resource burden associated with prolonged surgical procedures in this population. This finding has important healthcare system implications, as SCD patients already represent a disproportionately high burden of hospital admissions.(8)

The effectiveness of perioperative management strategies was a key secondary finding. The application of structured protocols — including preoperative hydration, supplemental oxygen, PCA-based analgesia, early mobilization, and antibiotic stewardship — was associated with significantly lower complication rates (VOC: 14.7% vs 28.5%; infections: 7.1% vs 18.6%; p < 0.05). These findings support the implementation of evidence-based perioperative bundles for SCD patients, as advocated by the American Society of Hematology.(9)

The multidisciplinary approach involving surgeons, anesthesiologists, hematologists, and nursing staff was identified as a critical determinant of outcomes. Individualized care planning, continuous perioperative monitoring, and psychosocial support for patients and families emerged as equally important components of comprehensive SCD surgical management. These observations are consistent with Brandow et al. (2020), who emphasized that multidisciplinary SCD management reduces hospital readmission rates and improves long-term outcomes.(10)

The limitations of this study include its retrospective design, which limits the ability to establish causal relationships. The single-center nature of the study may limit generalizability to broader populations. Future prospective multicenter studies should investigate additional perioperative factors affecting outcomes and explore the role of preoperative exchange transfusion in further reducing perioperative risk in high-duration surgical cases.

CONCLUSIONS:

The results of this retrospective observational study clearly demonstrate that surgical duration is a significant and modifiable determinant of postoperative outcomes in SCD-positive patients. Prolonged operative time (>4 hours) is independently associated with higher rates of vaso-occlusive crises, wound infections, acute chest syndrome, delayed recovery, and extended hospital stays.

Minimizing operative duration through optimized surgical technique

and appropriate case selection, combined with structured perioperative management protocols, can substantially mitigate these risks. Effective perioperative strategies including preoperative optimization, vigilant intraoperative monitoring, and postoperative multidisciplinary care are essential components of safe surgical management in this vulnerable population.

Collaborative protocols between surgeons, anesthesiologists, and hematologists should be developed and standardized for SCD-positive patients undergoing surgical procedures, particularly those anticipated to exceed 4 hours. Regular follow-up care to monitor for late complications and to reinforce adherence to treatment is equally recommended.

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