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"Evaluating the Effect of Anaesthesia Duration on Postoperative Infection: A Prospective Observational Study"

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Abstract

Introduction: Postoperative infections remain a significant cause of morbidity and prolonged hospital stay in surgical patients. Among various perioperative factors, the duration of anaesthesia has been suggested as an important determinant influencing the risk of postoperative infections. The aim of the study is to evaluate the effect of anaesthesia duration on postoperative infection in patients undergoing surgical procedures. ***Materials and Methodology:*** This prospective observational study was conducted in a tertiary care hospital and included 100 patients undergoing elective surgeries under general or regional anaesthesia. Patients were categorized based on anaesthesia duration into three groups: <60 minutes, 60–120 minutes, and >120 minutes. Data regarding demographic profile, ASA status, type of surgery, anaesthesia duration, and postoperative infections were collected. Postoperative infections including surgical site infections (SSI), urinary tract infections (UTI), and pneumonia were identified based on clinical and microbiological criteria. Statistical analysis was performed using the Chi-square test, with $p < 0.05$ considered significant. ***Results:*** The overall incidence of postoperative infection was 15%. Infection rates increased with longer anaesthesia duration, being lowest in <60 minutes (4%) and highest in >120 minutes (26.47%). A statistically significant association was observed between prolonged anaesthesia duration and postoperative infections ($p = 0.04$). Surgical site infections were the most common, and gram-negative organisms, particularly Escherichia coli, were predominantly isolated. ***Conclusion:*** Prolonged anaesthesia duration is significantly associated with an increased risk of postoperative infections. Optimizing anaesthesia time and perioperative care may help reduce infection rates and improve surgical outcomes.

Keywords: Anaesthesia duration, Postoperative infection, Surgical site infection, Perioperative risk factors, Prospective study

INTRODUCTION

Postoperative infections remain a major cause of morbidity, prolonged hospitalization, and increased healthcare costs in surgical patients. Surgical site infections (SSIs) and other postoperative infectious complications significantly delay recovery and adversely affect clinical outcomes. Multiple patient-related, surgical, and perioperative factors contribute to their occurrence, among which the duration of anaesthesia and surgical exposure has been identified as an important determinant [1].

The duration of anaesthesia reflects the total time a patient is exposed to anaesthetic agents, surgical stress, and invasive procedures. Prolonged anaesthesia is often associated with longer operative duration, increased tissue handling, and extended exposure to environmental pathogens, all of which may increase the risk of postoperative infections. Previous studies have demonstrated that longer operative and anaesthesia times are significantly associated with higher rates of SSIs and other complications [2].

Anaesthetic management also influences immune function and wound healing. Certain anaesthetic agents and perioperative physiological changes may impair host defense mechanisms, thereby increasing susceptibility to infection. Additionally, prolonged procedures may result in hypothermia, blood loss, and fluid imbalance, which are known contributors to postoperative infections [3]. Therefore, identifying modifiable factors such as anaesthesia duration is crucial for improving perioperative care and patient safety. Preventive

strategies including adherence to aseptic techniques, appropriate antibiotic prophylaxis, and minimizing unnecessary surgical duration play a key role in reducing infection rates [4].

However, the relationship between anaesthesia duration and postoperative infection remains complex. While several studies have demonstrated a positive correlation between prolonged operative time and increased infection risk, others have highlighted the role of confounding factors such as patient comorbidities and surgical complexity [5–7]. Retrospective analyses have provided valuable insights into these associations but are limited in establishing causality [8].

Emerging evidence suggests that prolonged anaesthesia may contribute to immunosuppression, systemic inflammatory responses, and increased postoperative complications, thereby elevating infection risk [9–11]. Furthermore, extended procedures often require prolonged use of invasive devices, which further predisposes patients to infection [12].

Despite existing evidence, inconsistencies persist due to variations in study design, patient populations, and perioperative practices. Hence, well-designed prospective observational studies are required to better elucidate this relationship. The present study aims to evaluate the effect of anaesthesia duration on postoperative infection in surgical patients.

MATERIALS AND METHODS

The present study was conducted as a prospective observational study in the Department of Anaesthesia in collaboration with the Department of General Surgery at a tertiary care teaching hospital, in western Gujarat, over a period of 6 months. The study included a total of 100 patients to evaluate the association between anaesthesia duration and postoperative infection outcomes.

Adult patients aged between 18- and 65-years undergoing elective surgical procedures under either general or regional anaesthesia were included. Patients with pre-existing infections, immunocompromised status, emergency surgeries, or incomplete clinical records were excluded to minimize confounding factors, in accordance with prior methodological approaches.

After obtaining approval from the Institutional Ethics Committee and written informed consent from participants, data were collected prospectively using a structured proforma. Baseline demographic variables such as age, gender, and comorbidities were recorded, along with clinical parameters including ASA classification. Surgical details such as type and duration of surgery, and anaesthetic variables including type of anaesthesia and duration of anaesthesia were documented. Anaesthesia duration was defined as the time from induction to recovery/emergence and was recorded in minutes, consistent with previously established definitions. Patients were categorized into groups based on duration of anaesthesia as <60 minutes, 60–120 minutes, and >120 minutes, facilitating comparative analysis of infection rates across exposure durations.

The primary outcome measured was the occurrence of postoperative infections, including surgical site infections (SSI), urinary tract infections (UTI), and respiratory infections such as pneumonia. These were identified based on clinical findings, laboratory investigations, and microbiological evidence where applicable. Patients were followed throughout their hospital stay for the development of any postoperative infectious complications.

All collected data were entered into Microsoft Excel and analyzed using SPSS software. Descriptive statistics were expressed as mean ± standard deviation for continuous variables and frequency with percentage for categorical variables. The association between anaesthesia duration and postoperative infection was assessed using the Chi-square test, with a p-value of <0.05 considered statistically significant.

RESULTS

A total of 100 patients undergoing elective surgical procedures were included in the present prospective observational study. The mean age of the study population was approximately 40–55 years, with a predominance of male patients (58%) compared to females (42%).

Table 1: Demographic Characteristics of Study Participants

Demographic Variables		Frequency (%)
Age (years)	Mean ± SD	45 ± 12
	18–30 years	25 (25%)
	31–45 years	35 (35%)
	46–60 years	30 (30%)
	>60 years	10 (10%)
Gender	Male	58 (58%)
	Female	42 (42%)

Table 2: ASA Classification of Patients

ASA Grade	Frequency (%)
ASA I	33 (33%)
ASA II	48 (48%)
ASA III	19 (19%)

Most patients belonged to ASA grade II (48%), followed by ASA I (33%) and ASA III (19%), indicating that the majority had low to moderate preoperative risk.

Table 3: Distribution of Surgical Procedures

Type of Surgery	Frequency (%)
General Surgery	40 (40%)
Orthopaedic Surgery	25 (25%)
Gynecological Surgery	20 (20%)
Others	15 (15%)

The distribution of surgical procedures showed that general surgery accounted for the highest proportion (40%) of cases, indicating its predominance in the study population. This was followed by orthopaedic surgeries (25%) and gynecological procedures (20%), representing a substantial share of the surgical workload. The remaining 15% comprised other types of surgeries, reflecting a diverse but comparatively smaller contribution. Overall, the data suggest that general surgical cases formed the major component of the study cohort.

Table 5: Duration of Anaesthesia

Duration	Frequency (%)
<60 minutes	25 (25%)
60–120 minutes	41 (41%)
>120 minutes	34 (34%)

The distribution of anaesthesia duration showed that the majority of patients had procedures lasting 60–120 minutes (41%), indicating a predominance of moderately timed surgeries. This was followed by prolonged duration (>120 minutes) in 34% of cases, while 25% of patients had shorter procedures lasting less than 60 minutes. Overall, most surgeries required moderate to longer durations of anaesthesia.

Table 6: Association Between Anaesthesia Duration and Postoperative Infection

Duration of Anaesthesia	Infection Present n (%)	Infection Absent n (%)	Total
<60 minutes	1 (4%)	24 (96%)	25
60–120 minutes	5 (12.20%)	36 (87.80%)	41
>120 minutes	9 (26.47%)	25 (73.53%)	34
P value (Chi square)	0.04		

The association between anaesthesia duration and postoperative infection demonstrated a progressive increase in infection rates with longer duration of anaesthesia. Patients with anaesthesia duration <60 minutes had the lowest infection rate (4%), whereas those with duration 60–120 minutes showed a higher rate (12.2%). The highest infection rate was observed in patients with anaesthesia duration >120 minutes (26.47%). This trend indicates a positive correlation between prolonged anaesthesia and increased risk of postoperative infections. The association was found to be statistically significant (p = 0.04).

Table 7. Type of Postoperative Infections and organism isolated

Variables		Frequency (n)	Percentage (%)
Type of Infection	Surgical Site Infection (SSI)	8	53.3%
	Urinary Tract Infection (UTI)	4	26.7%
	Pneumonia	3	20.0%
Organism isolated	Escherichia coli	6	40.0%
	Klebsiella spp.	3	20.0%
	Pseudomonas aeruginosa	2	13.3%
	Staphylococcus aureus	2	13.3%
	Enterococcus spp.	1	6.7%
	Candida spp.	1	6.7%

The distribution of postoperative infections revealed that surgical site infections (SSI) were the most common (53.3%), followed by urinary tract infections (26.7%) and pneumonia (20.0%). With respect to microbiological profile, Escherichia coli was the most frequently isolated organism (40%), followed by Klebsiella spp. (20%). Other organisms included Pseudomonas aeruginosa (13.3%), Staphylococcus aureus (13.3%), while Enterococcus spp. and Candida spp. each

accounted for 6.7% of isolates. Overall, the findings indicate a predominance of gram-negative organisms, particularly *E. coli*, in postoperative infections.

Table 8. Antibiotic sensitivity and resistant pattern of isolated organisms

Variables	Antibiotic	E. coli (n=6)	Klebsiella (n=3)	Pseudomonas (n=2)	S. aureus (n=2)	Enterococcus (n=1)
Sensitivity pattern	Amikacin	5	2	2	-	-
	Gentamicin	4	2	1	-	-
	Ceftriaxone	3	1	0	1	-
	Piperacillin-Tazobactam	5	2	2	-	-
	Ciprofloxacin	3	1	1	1	-
	Vancomycin	-	-	-	2	1
Resistant pattern	Ceftriaxone	3	2	2	1	-
	Ciprofloxacin	3	2	1	1	-
	Amoxiclav	4	2	2	1	-
	Gentamicin	2	1	1	-	-

Gram-negative organisms, particularly *E. coli*, were the most isolated pathogens. Higher sensitivity was observed with amikacin and piperacillin-tazobactam, whereas significant resistance was noted against ceftriaxone and amoxiclav, indicating emerging antimicrobial resistance patterns.

DISCUSSION

The present prospective observational study evaluated the effect of anaesthesia duration on postoperative infections and demonstrated a significant association between prolonged anaesthesia duration and increased risk of postoperative infections. The overall incidence of postoperative infection in the present study was approximately 15%, which is comparable to previously reported rates in surgical patients [1,7]. Postoperative infections remain a major contributor to morbidity, prolonged hospitalization, and increased healthcare costs, emphasizing the importance of identifying modifiable perioperative risk factors.

In the present study, the majority of patients belonged to ASA grade II (48%), followed by ASA I and III. This distribution is consistent with earlier studies, where most surgical patients fall within low to moderate risk categories [5]. Although higher ASA grades are known to be associated with increased postoperative complications, the present study suggests that even patients with relatively low preoperative risk may develop infections when exposed to prolonged anaesthesia.

A key finding of this study was the progressive increase in infection rates with increasing duration of anaesthesia. Patients with anaesthesia duration <60 minutes had the lowest infection rate (4%), while those with duration >120 minutes had the highest infection rate (26.47%), with a statistically significant association ($p = 0.04$). These findings are in agreement with previous studies which have demonstrated that prolonged operative duration significantly increases the risk of surgical site infections [2,4]. Cheng et al. reported that longer operative times are strongly associated with increased SSI risk, supporting the observations of the present study [4]. Similarly, meta-analyses have shown that each additional hour of surgery may substantially increase infection risk [3].

The underlying mechanisms linking prolonged anaesthesia duration to postoperative infections are multifactorial. Prolonged exposure to anaesthetic agents has been shown to modulate immune responses and may contribute to immunosuppression, thereby increasing susceptibility to infections [9]. In addition, longer procedures are associated with factors such as hypothermia, blood loss, and fluid shifts, which are well-established contributors to impaired wound healing and increased infection risk [6]. The use of invasive devices such as urinary catheters and ventilators during prolonged surgeries further increases the likelihood of infections such as UTI and pneumonia [10].

The microbiological profile observed in the present study showed a predominance of gram-negative organisms, particularly Escherichia coli, followed by Klebsiella and Pseudomonas, which is consistent with previous reports on postoperative infections [11]. Surgical site infections were the most common type of infection, aligning with global trends reported in literature [1].

However, the relationship between anaesthesia duration and infection risk remains complex. Some studies suggest that anaesthesia duration may not be an independent predictor but rather a surrogate marker for surgical complexity and patient-related factors [13]. This highlights the importance of considering confounding variables such as type of surgery, comorbidities, and intraoperative management.

Despite these considerations, the present study reinforces the importance of minimizing unnecessary prolongation of anaesthesia and surgical duration. Optimizing perioperative care, maintaining strict aseptic techniques, and implementing evidence-based infection prevention strategies can significantly reduce postoperative infection rates.

CONCLUSION

The present prospective observational study demonstrates a significant association between prolonged anaesthesia duration and an increased risk of postoperative infections. Patients with longer anaesthesia exposure, particularly beyond 120 minutes, showed a higher incidence of infections compared to those with shorter durations. These findings highlight that anaesthesia duration is an important and potentially modifiable perioperative risk factor. Optimizing surgical efficiency, minimizing unnecessary prolongation of anaesthesia, and adhering to strict infection control measures may help reduce postoperative infection rates. Further large-scale prospective studies are recommended to strengthen causal inference and guide improved perioperative management strategies.

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