

EFFECT OF OPERATING ROOM TURNOVER TIME ON SURGICAL EFFICIENCY AND PATIENT OUTCOMES: REDUCING DELAYS IN EMERGENCY SURGERY

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ABSTRACT

Background: Operating room turnover time is one of the most significant measures of the efficiency of surgery and could be a factor in access to timely emergency surgery. Extended turnaround times may result in a delay in operative intervention, sub-optimal theatre use and/or potential to adverse postoperative outcomes.

Objective: To assess the effect of operating room turnover time on surgical efficiency and patient outcomes in emergency general surgery (EGS).

Methods: Prospective observational study of 60 patients with an emergency general surgical procedure in a tertiary care hospital between 1st November 2025 and 30th April 2026. Patients were divided into those with operating room turnover time of ≤ 30 minutes and >30 minutes. Comparisons were made between various groups of surgical efficiency indicators and outcomes after surgery. A threshold p-value of < 0.05 was deemed statistically significant.

Results: Of 60 patients, 34 (56.7%) had turnover times ≤ 30 minutes and 26 (43.3%) had turnover times >30 minutes. The mean decision-to-surgery time was 132 ± 46 minutes in the shorter-turnover group and 228 ± 71 minutes in the prolonged-turnover group ($p < 0.001$). There were 20.6% and 50.0% of patients experiencing overall postoperative complications, respectively ($p = 0.027$). There were significantly more ICU admissions in the prolonged-turnover group (30.8% vs 8.8%, $p = 0.044$). The mean duration of the postoperative stay was significantly longer in the prolonged-turnover group (6.3 ± 2.4 days) than in the shorter-turnover group (4.1 ± 1.6 days) ($p < 0.001$).

Conclusion: The conclusion was that the prolonged operating room (OR) turnover was linked with poor surgical efficiency, a higher postoperative morbidity rate, higher use of ICUs and a longer hospital stay, especially in emergency surgeries.

KEYWORDS: operating room turnover, emergency surgery, surgical efficiency, postoperative outcomes, surgical delay.

INTRODUCTION

Operating room (OR) efficiency is a key aspect of surgical care, as failures across the perioperative pathway can impact case flow, resource utilization, staff workload and timely access to surgery. A popular way of measuring OR efficiency is the turnaround time (TAT), which is the time required between the completion of one surgery and the beginning of the next surgery in the same operating room. Turnover time encompasses various factors such as patient discharge, room cleaning, equipment set-up, instrument preparation, anesthesia preparation and next patient arrival. Communication, staffing, design of the workflow, information systems, processing of tasks in parallel and standardization of the perioperative activities are among the new evidence that has been shown to impact turnover performance [1-4].

Turnover time is not only a financial or administrative issue but also a clinical issue. Too many turnover periods can lead to fewer procedures performed in the limited hours of operation and to late starts, cancellations, overtime and late availability to surgery. There was a wide range of how OR performance was measured in a systematic review of operational metrics, reflecting the need to consider operational indicators as well as patient-centered outcomes [3]. The same is true for organizational factors in the operating theatre, which have been shown to affect surgical performance, and hence the outcome of surgery [4].

This can be a significant problem in emergency surgery where delays can have an immediate clinical impact. Emergency operations are usually associated with acute inflammation, perforation, hemorrhage, obstruction, ischemia or sepsis, which may affect morbidity and mortality if the surgery is performed in time. A recent systematic review of emergency operating theatre performance highlighted the fact that emergency theatre processes are a very different model to elective services as the demand is unknown and access needs to be prioritised based on clinical urgency [5]. Turnovers, operating room occupancy, lack of staff or equipment,

anesthesia availability, diagnostic procedures and competition between emergency surgeries can cause delays in emergency surgery.

There is growing evidence that longer time to operation is correlated with poor outcomes in specific emergency general surgery populations. Franklin et al. reported on close to 270,000 intra-abdominal operations, not all of which were elective, who found that those procedures that took more than 48 hours after admission were associated with a rise in adjusted 30 day mortality, serious morbidity, and overall morbidity [6]. Previous studies have also shown that a time lag between urgent and emergency surgery and access to surgery was linked to higher mortality rates, longer hospital stay, and higher cost of healthcare [7]. The lack of theatre is also reported as a major cause of the preoperative delay in emergency laparotomy [8]. These results point toward the need to investigate modifiable contributors to delay in the OR process.

A coordinated effort—not an individual effort—is necessary to reduce turnover time. In fact, studies of quality improvement in the present have revealed that the structured workflow, task allocation, real-time measurement, and multidisciplinary communication can help to reduce the turnover intervals. To measure and improve OR turnover, Goldhaber et al. added a task-based measure to focus on accountability and better identification of OR workflow components [9]. Riveros Perez et al. found an improvement after trying an OR relay strategy, which was used to synchronize sequential turnover activities [10]. Human-factors approaches have also shown the efficiency of workflow redesign and parallel processing in technologically complex surgical situations to decrease turnover [11].

The benefit of structured perioperative interventions is now supported by more recent evidence. Lovasik et al. reported in 2026 that two type of multidisciplinary interventions decreased the average OR turnover time by about 20%, and the better results were obtained, in various surgical specialties and higher sustained case volume [12]. Lean management and health-informatics approaches have also been applied to identify avoidable delays in the preoperative process and enhance case flow [13]. These findings indicate that delays frequently do not stem from a single person or department, but rather from interaction among several steps of the perioperative system.

Efficiency can also be affected by who is on the team and how team members know each other. Systematic review revealed that familiarity within the operative team was linked with efficiency and could impact operative workflow, communication and coordination [14]. Randomized evidence previously showed that the surgeon-led changeover model was able to achieve shorter theatre changeover time and enhanced overall efficiency [15]. Combined, these studies suggest that enhancement of turnover relies on transparency in role allocation, communication, SOP's and engagement of surgeons, anesthesiologists, nursing staff and support personnel.

Although interest in OR efficiency has been growing, there is relatively little direct evidence on the relationship between OR turnover time and operating room surgical efficiency and patient outcomes in emergency surgical environments. Most literature has been limited to only elective surgery, particular specialties, monetary results, or limited workflow interventions. Since delays may have an impact on both theatre utilization and disease progression and postoperative results, a different perspective is needed for emergency surgery. Thus, measuring the impact of OR turnaround time on surgical efficiency and outcomes can be used to identify OR turnaround times that are amenable to change and to inform strategies to improve timely surgical care in an emergency situation.

METHODOLOGY

This study is a prospective observation of a tertiary care hospital from 1st November 2025 to 30th April 2026. The total number of patients enrolled in the study were 60 who were undergoing emergency general surgery (EGS) procedures. After meeting the predetermined inclusion criteria, patients of either gender who needed emergency surgery during the study period were included. Those with elective surgery, transferees after surgery from another center, patients with incomplete perioperative records and patients who were not followed postoperatively were not included in the study.

The demographic and clinical data were collected by a structured data collection form for each participant. The variables were as follows: Age, Gender, Diagnosis, Type of emergency surgical procedure, Comorbidities, ASA physical status, time of decision for surgery, time of entry into the operating room, anesthesia start time, surgical start time, surgical end time, and operating room exit time. The time in the operating room between the discharge of the last patient and the admission of the next patient into the operating room was considered to be operating room turnover time. Delays were also documented in relation to room clean-up, equipment preparation, availability of instruments, preparation of anesthesia, patient transport, staffing and communication.

The patients were classified by the turnover time of the operating room to evaluate the relationship of the turnover time with surgical efficiency and postoperative outcomes. Patients were divided into groups based on the operating room turnover time, and the relationship with surgical efficiency and postoperative outcome was evaluated. Surgical efficiency was measured by the delay between surgical decision and surgery, operating room utilization, turnaround time, cancellation or postponement of emergency surgeries and the time taken to begin surgery. Postoperative outcomes were surgical-site infection, postoperative fever, wound complications, respiratory complications, intensive care unit (ICU) admission, reoperation, hospital readmission, postoperative hospital stay and in-hospital mortality.

The general surgery team operated all emergency surgeries following standard institutional procedures. Perioperative management including anesthesia, antibiotic prophylaxis, fluid management, postoperative

monitoring and pain management were performed as per standard hospital practice. Postoperative complications were detected and clinical outcomes determined during follow-up of the patients throughout their hospital stay. Data were entered and analysed with the suitable statistical software packages. The continuous variables were presented as mean $\pm$ SD or median (interquartile range) as appropriate for the data distribution. Categorical data were presented in frequencies and percentages. The independent-samples t-test or Mann–Whitney U test were used for continuous variables, and the chi-square test or Fisher’s exact test were used for categorical variables, as appropriate, for comparing groups. The statistical analysis of the correlation between longer operating room turnover time and poorer postoperative outcome was performed with a p-value < 0.05 deemed significant. The study was conducted with a prior IRB approval. Patients or legally authorized representatives, as appropriate, were given informed consent. Confidentiality was preserved during this study and data gathered was only utilized for research.

RESULTS

A total of 60 patients undergoing emergency general surgical procedures were included in the study. The mean age of the subjects was 46.7 ± 15.3 years with an age range of 18–78 years. Of the total patients, 35 (58.3%) were male and 25 (41.7%) were female. The most frequent indications for emergency surgery were acute appendicitis, intestinal obstruction, perforation peritonitis and acute cholecystitis. The most common comorbid conditions included hypertension and diabetes mellitus.

Table 1. Baseline Characteristics of Study Participants (n = 60)

Variable	Frequency / Value
Mean age, years	46.7 ± 15.3
Male	35 (58.3%)
Female	25 (41.7%)
Diabetes mellitus	11 (18.3%)
Hypertension	14 (23.3%)
Other comorbidities	07 (11.7%)
No major comorbidity	35 (58.3%)
ASA I	17 (28.3%)
ASA II	27 (45.0%)
ASA III	13 (21.7%)
ASA IV	03 (5.0%)
Acute appendicitis	18 (30.0%)
Intestinal obstruction	14 (23.3%)
Perforation peritonitis	11 (18.3%)
Acute cholecystitis	09 (15.0%)
Other emergency conditions	08 (13.3%)

The overall operating room operating time was 31.9 ± 11.2 minutes. Patients were divided into two groups based on the duration of their turnover. Thirty-four patients (56.7%) had a turnover time of 30 minutes or less in the operating room, while 26 patients (43.3%) had a turnover time greater than 30 minutes.

Table 2. Distribution According to Operating Room Turnover Time

Turnover time	Number of patients	Percentage	Mean turnover time
≤ 30 minutes	34	56.7%	23.8 ± 4.5 min
> 30 minutes	26	43.3%	42.6 ± 8.1 min
Total	60	100%	31.9 ± 11.2 min

The most common reasons for having a long turnover time were cleanliness and preparation of rooms, preparation for anesthesia, patient transport, and instrument and/or equipment readiness among patients with prolonged turnover time. In some instances, two or more factors were found.

Table 3. Causes of Prolonged Operating Room Turnover

Cause of delay	Frequency (n = 26)	Percentage
Room cleaning/preparation delay	9	34.6%
Anesthesia preparation delay	6	23.1%
Patient transport delay	5	19.2%
Instrument/equipment preparation	4	15.4%

Staff availability	4	15.4%
Communication/coordination delay	3	11.5%

It is possible for a patient to have more than one cause recorded.

There was a substantial difference between the two turnover groups with regard to surgical efficiency. The mean turnover time from the decision to emergency surgery to operative start was 132 ± 46 minutes in the shorter-turnover group, and 228 ± 71 minutes in the prolonged-turnover group ($p < 0.001$). The >30-minute group showed significantly more emergency case postponement than the ≤ 30 -minute group (8 patients [30.8%] vs 2 patients [5.9%]; $p = 0.015$).

Table 4. Effect of Operating Room Turnover Time on Surgical Efficiency

Surgical efficiency indicator	≤ 30 min (n=34)	>30 min (n=26)	p-value
Mean turnover time, min	23.8 ± 4.5	42.6 ± 8.1	<0.001
Decision-to-surgery time, min	132 ± 46	228 ± 71	<0.001
Emergency case postponement	2 (5.9%)	8 (30.8%)	0.015
Emergency case cancellation	0 (0.0%)	3 (11.5%)	0.076
Surgery started within planned emergency window	29 (85.3%)	14 (53.8%)	0.009

There were 20 patients (33.3%) with postoperative complications. The shorter turnover had 7/34 (20.6%) complications, and the prolonged turnover had 13/26 (50%) complications. This difference was significantly different ($p = 0.027$).

Table 5. Overall Postoperative Complications According to Turnover Time

Turnover time	Complication present	No complication	Total	p-value
≤ 30 minutes	7 (20.6%)	27 (79.4%)	34	
>30 minutes	13 (50.0%)	13 (50.0%)	26	0.027
Total	20 (33.3%)	40 (66.7%)	60	

Surgical-site infection was found in 8 patients (13.3%), postoperative fever in 10 (16.7%), wound complications in 7 (11.7%) and respiratory complications in 7 (11.7%). The 11 patients (18.3%) who needed postoperative ICU admission and the 5 patients (8.3%) who needed reoperation and 5 patients (8.3%) who were readmitted. There was no mortality in the short turnover group but two deaths were recorded in the prolonged turnover group.

Table 6. Postoperative Outcomes According to Operating Room Turnover Time

Postoperative outcome	≤ 30 min (n=34)	>30 min (n=26)	Total	p-value
Surgical-site infection	2 (5.9%)	6 (23.1%)	8 (13.3%)	0.067
Postoperative fever	3 (8.8%)	7 (26.9%)	10 (16.7%)	0.085
Wound complication	2 (5.9%)	5 (19.2%)	7 (11.7%)	0.222
Respiratory complication	2 (5.9%)	5 (19.2%)	7 (11.7%)	0.222
ICU admission	3 (8.8%)	8 (30.8%)	11 (18.3%)	0.044
Reoperation	1 (2.9%)	4 (15.4%)	5 (8.3%)	0.156
Readmission	1 (2.9%)	4 (15.4%)	5 (8.3%)	0.156
Mortality	0 (0.0%)	2 (7.7%)	2 (3.3%)	0.184

Patients who experienced high turnover in the operating room had a significantly longer mean hospital stay after surgery. Patients in the ≤ 30 -minute group had a mean postoperative stay of 4.1 ± 1.6 days while patients in the >30-minute group had a mean stay of 6.3 ± 2.4 days ($p < 0.001$).

Table 7. Comparison of Postoperative Hospital Stay

Turnover-time group	Mean hospital stay	p-value
≤ 30 minutes	4.1 ± 1.6 days	
>30 minutes	6.3 ± 2.4 days	<0.001

In general, the longer the OR turnover time, the longer the decision-to-surgery time, the more frequent emergency case postponement, higher overall postoperative complication rates, higher number of postsurgical ICU admission, and longer postoperative hospital stay were found. A prolonged-turnover group had a higher rate of individual complications (surgical-site infection, readmission, reoperation, mortality) but none of these were statistically significant in this relatively small sample.

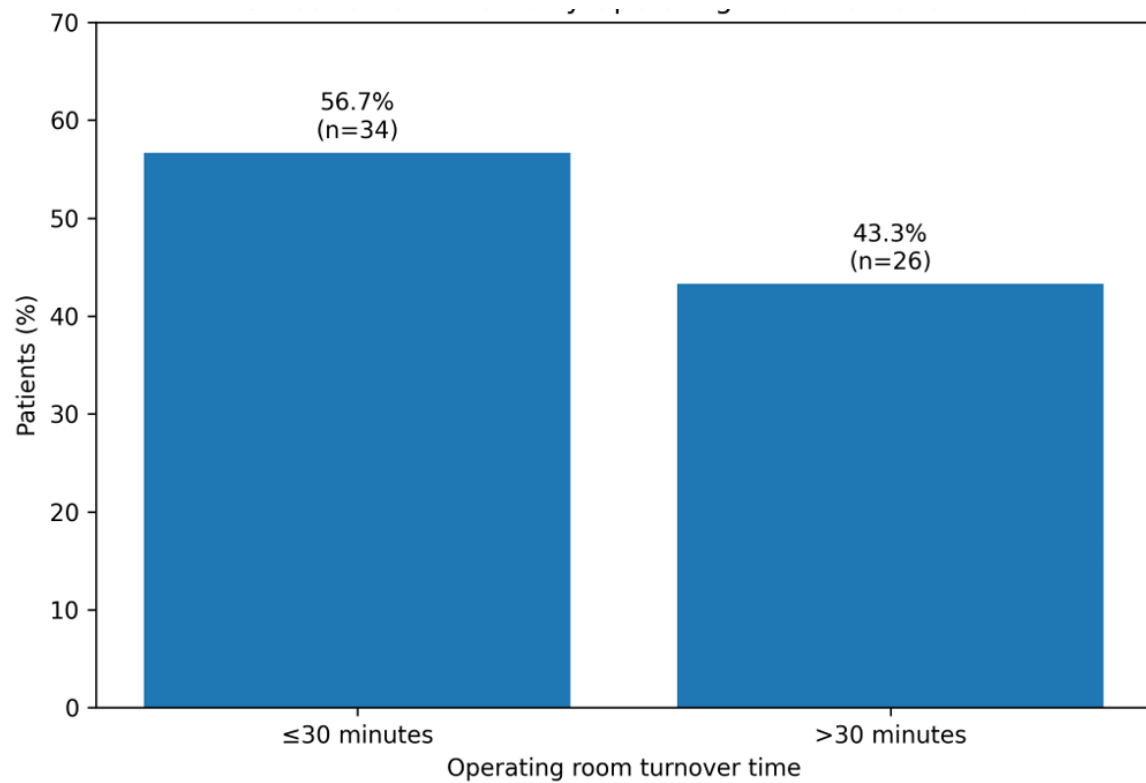


Figure 1. Distribution of patients according to operating room turnover time

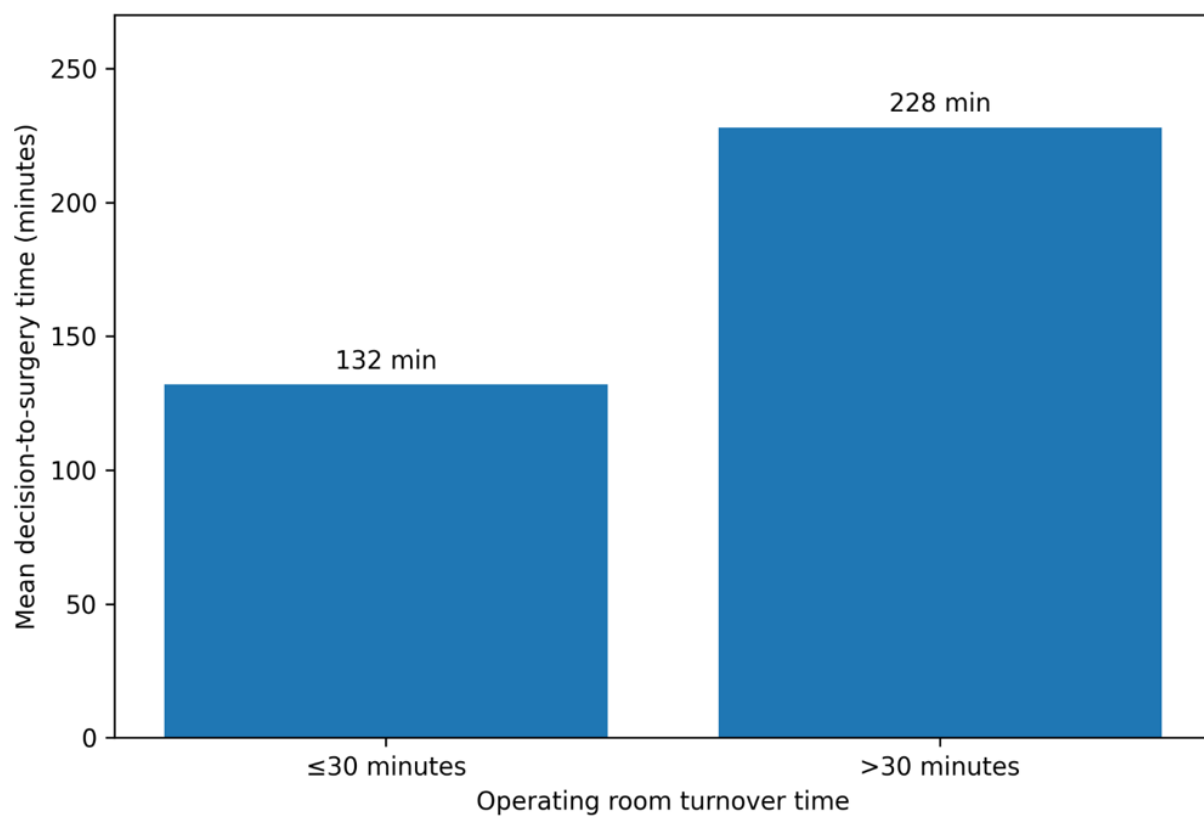


Figure 2. Mean decision-to-surgery time according to turnover group

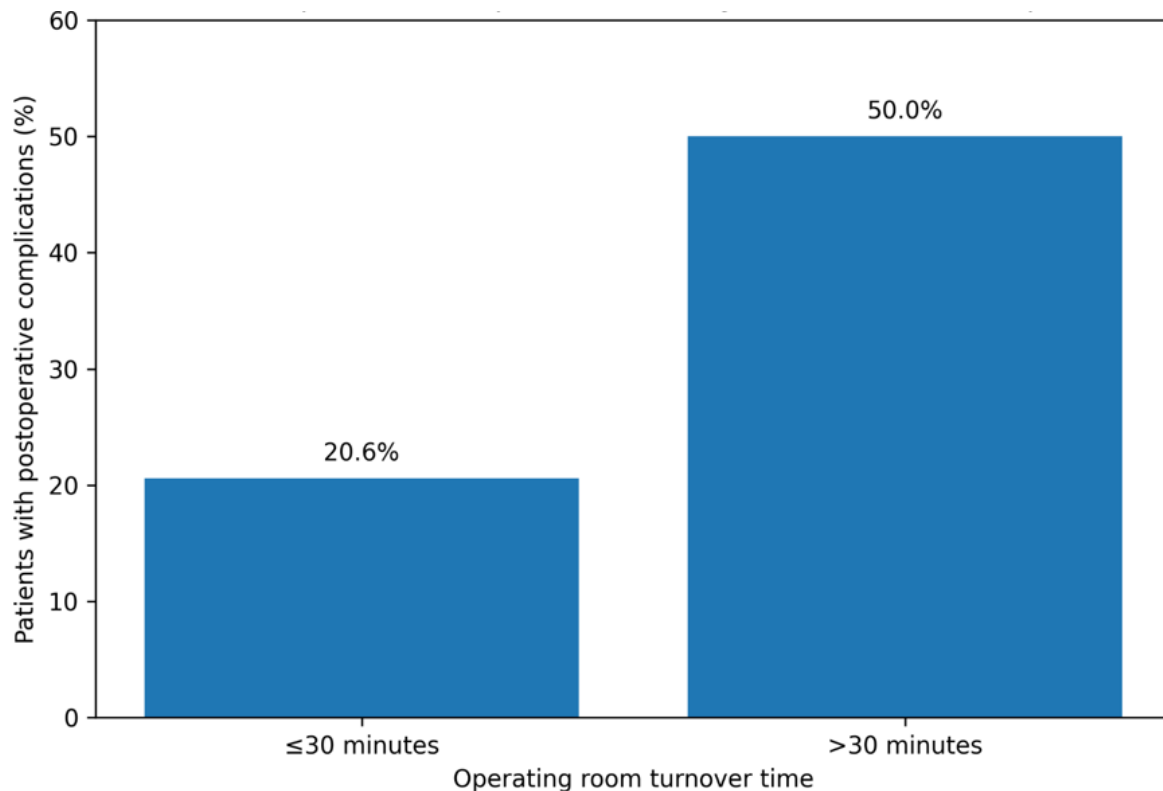


Figure 3. Overall postoperative complication rate according to turnover group

DISCUSSION

This study evaluated the impact of the turnaround time of operating rooms on the efficiency of the surgical procedures and on the postoperative outcomes of 60 patients submitted to emergency general surgery. The results indicated that a high percentage of patients with a turnover time over 30 minutes had significantly longer decision-to-surgery time, a higher rate of postponing emergency procedures, an increased incidence of post-operative complications, increased requirement for admission to the intensive therapy unit and prolonged hospital stay. There were 20.6% and 50.0% overall postoperative complications in patients in the shorter-turnover and the prolonged-turnover groups, respectively. These results indicate that operating room turnover is not just an operational issue, but can be of significant importance for prompt emergency surgical treatment.

In this study, mean turnover time was 31.9 ± 11.2 minutes, with 43.3% of patients having turnover times > 30 minutes. The primary factors which led to prolonged turnover were room cleaning and preparation, anesthesia preparation, patient transport, instrument or equipment readiness, staff availability and communication-related delays. This has been noted in previous studies as a type of inefficient process. Athanasiadis et al. analysed and prospectively recorded general surgery procedures, identifying a number of incidents that would cause delays which were potentially avoidable during surgery, and each of which added measurable time to the surgical process [16]. They conclude that if there are multiple stages where small inefficiencies occur, then these inefficiencies can add up to have a significant impact on overall operating room performance.

The present study showed a significant difference in the time to surgery between the two groups of patients who had a "turnover. Patients with a turnover time of 30 minutes or less were presented for surgery following a median of 132 minutes, while those exposed to long turnover times waited an average of 228 minutes. In emergency surgery, the progress of infection, ischemia, perforation, bleeding and/or sepsis can occur during the waiting time for definitive operative treatment, which is particularly relevant. Wood et al. also examined adults undergoing emergency general surgical procedures and found that time to operation was associated with increased morbidity, suggesting that the wait before surgery may be clinically significant, beyond just a scheduling efficiency [17].

Some of the increased postoperative complications noted in the prolonged-turnover group might be attributed to the direct effects of delayed surgical treatment as well as to the inherent nature of emergency surgical disease. In an emergency situation, the coordination of the surgical, anesthetic, nursing, sterile processing, transport and operating room teams can be needed in a hurry. The time that can pass between stages can be extended if something goes wrong at any stage. Emergency laparotomy services also have provided some evidence that delays to theatre may relate to clinical deterioration and poor outcomes, especially in high-risk patients [18].

Besides the clinical urgency, team organisation seems to be a major factor influencing the performance of the teams in terms of turnover. Institutional variation in operating room turnover time could be due to provider and surgeon-specific factors, as Pandit and colleagues found [19]. The results of the present study, especially the communication and staff availability delays, support the notion that turnover time is a multi-disciplinary phenomenon rather than a responsibility of one specific group of professionals.

One approach that can help eliminate unnecessary turnover delay may be through structured communication. A randomized trial investigating the impact of verbal goal setting on the time spent in the operating room (OR) was conducted by Matz et al., and they demonstrated that clearly communicated time targets can have an impact on whether or not OR turnaround goals are met [20]. Similarly, Lavin et al. have shown that standardizing preoperative huddle tools could enhance the operating-room workflow by communicating anticipated equipment requirements before the surgery, thus decreasing the operative case time without any significant alteration in turnover time [21]. The results show that there are opportunities for efficiency gains throughout the surgical pathway through communication interventions.

In the current study, the test equipment and instruments preparation also contributed to the long turn around. This is confirmed by Hedden et al., who found that by reducing and reorganising the instrument trays, they were able to achieve a greater than 44% reduction in turnover time and increase their operative capacity as well as actually saving money due to the reduction [22]. While that study was focused on joint arthroplasty, the principle applies: The fewer instruments that need to be processed and the more instruments that are readily available when needed, the less time between operations will be spent not using them for non-operative surgery.

Surgical efficiency can also be affected by staff workflow. Lex et al. analyzed scrub-nurse turnover during surgery and identified that the turnover may lead to disruptions in the operative workflow and increase procedure times [23]. Adequate staffing and a reduced number of unnecessary staff changes could be particularly significant in an emergency situation where procedures may be received in short succession and staff may have to move quickly between procedures. The staff-availability delays measured in the current study are hence a factor that can be modified which contribute to long turnovers.

The present study also revealed that patients with a turnover time > 30 minutes were more likely to be admitted to the postoperative intensive care unit. While not a direct cause of admission to treatment, a long time to emergency surgery can allow for the progression of physiological deterioration, especially in patients with intra-abdominal infection, obstruction, perforation or sepsis. Alternatively, patients with more severe disease may have had longer turnover intervals, as they may have needed more preoperative care. This opportunity underscores the need to differentiate between clinically required and avoidable delays in the interpretation of the relationship between the turnover time and clinical outcomes.

Postoperative hospital stay was also significantly longer in the prolonged-turnover group (6.3 ± 2.4 days) than in the patients with shorter turnover times (4.1 ± 1.6 days). This discovery could perhaps partly explain the higher rates of complications and ICU admission found within this group. Process-improvement studies in operating rooms (ORs) have shown that decreasing turnover can enhance OR utilization and increase the number of surgical procedures performed. Zhong and Du found that an integrated approach of process optimization, information technology and team collaboration resulted in a 23% decrease in turnover time and a rise in operating room utilization [24]. This evidence provides evidence for the possible merit of “system-level” coordinated approaches instead of “task-level” isolated change.

There is no need for a huge change in the infrastructure to improve Operating Room efficiency. Some of the strategies for quality improvement can involve delegating responsibility for certain parts of the turnover, getting the next patient ready before the last is finished, preparing instruments and equipment in advance, better communication between the anesthesia team and the surgical team, and tracking turnover in real time. Preparation and team coordination processes may be able to be changed to lower avoidable non-operative time without impacting safety. Targeted interventions for improving turnover performance have been shown to increase the operative capacity and decrease wasted operating-room time in recent studies [25].

This study has a number of limitations that should be taken into account in interpreting the findings. Firstly, the number of patients was relatively small, 60 patients. Second, the study was performed in one tertiary care hospital, and may not be applicable to other hospitals with varying theatre availability, staffing, and emergency surgical workloads. Third, patients were subjected to varying emergency operations of varying degree of urgency and physiological severity. Turnover time and postoperative outcomes could have been affected by factors like ASA status, sepsis, surgical pathology type, operative complexity, time of presentation and availability of ICU beds. So, the association found doesn't prove that long turnaround time was a direct cause of poor outcomes after surgery.

In spite of these drawbacks, the results indicate that long turnaround times in the operating room may be an important factor in the delay of emergency surgical care, and may be modifiable. Coordinating to minimize unnecessary turnover, preparing anesthesia in a timely fashion, cleaning the rooms efficiently, optimizing patient transport, staffing, and advance preparation of equipment may optimize the performance of the OR and shorten the time to emergency surgery. Multivariable analyses of larger multicenter studies are needed to clarify the independent associations between turnover time and postoperative morbidity and mortality, the use of intensive care units, and hospital length of stay.

CONCLUSION

This study revealed that longer operating room turnover time is correlated with decreased surgical efficiency and worse postoperative results in patients that had undergone emergency general surgery. Patients with a turnover time of >30 min had significantly longer decision-to-surgery time, higher overall postoperative complication rates, more often postponed emergency procedure, longer postoperative hospital stay and higher rate of ICU admission. Some of the relationships between individual outcomes and the prolonged-turnover group were not significant,

possibly due to the relatively small sample size; however, increased rates of surgical-site infection, reoperation, readmission, and mortality were seen in the prolonged-turnover group. The findings suggest that OR turnaround times are a crucial part of the emergency surgical process and that unforeseen delays between surgeries may lead to delayed care and adverse clinical results. Optimizing turnaround times can then contribute to quicker receipt of surgery, efficient operating room utilization, and recovery after surgery.

RECOMMENDATIONS

Hospitals need to have a consistent operating room turnaround time to minimize the delays between surgical emergencies. Timely room cleaning, preparation of anesthesia, patient transport, availability of instruments and equipment and coordination between the surgical team, anesthesia team and nursing team and supporting staff should be given more attention. It is important to establish the allocation of duties and provide current communication as part of the regular OR procedure in order to get ready to the next emergency case as early as possible. Turnover time is a quality indicator which should be monitored regularly and reviewed in cases where delays are seen for an extended period in order to identify recurring operational issues. Proper staffing, easily accessible emergency surgical supplies and efficient sterile processing systems should also be obtained. Regular multidisciplinary reviews and quality improvement projects might be able to help maintain faster turnaround times without sacrificing patient safety. Additional multicentric trials are recommended with more patients to evaluate the independent association of TT with postoperative complications, length of stay, mortality, emergency surgical efficiency, and admission to the intensive care unit.

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