

# Impact of Nighttime Emergency Surgeries on Patients' Outcome: A Prospective Study

Ashok Kshirsagar, Shirish Kannur

Department of Surgery,  
Krishna Hospital and Medical  
Research Centre, Krishna  
Institute of Medical Sciences  
"Deemed to be" University,  
Karad, Maharashtra, India

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## INTRODUCTION

Increasing public attention has been focused on the role of a resident physician's fatigue in the occurrence of medical errors, including percutaneous needlestick laceration injuries and post call motor vehicle crashes.<sup>[1-3]</sup>

Less is known about the effects of extended durations of work shifts on the performance of attending physicians. Attending physicians who perform emergency operations during nighttime often schedule elective procedures on the following day. It is possible that experienced attending physicians may be better to cope with the effects of sleep deprivation than residents.

According to a report published in 1999 by the Institute of Medicine, surgical complications are considered the second leading preventable cause of morbidity/

**ABSTRACT** **Background and Aim:** The aim of this study was to evaluate the relationship between the time of the day the surgery is conducted and its outcome to provide better protection for patients against fatigue-related errors and reduce the incidence of postoperative morbidity/mortality. **Methods:** All general surgical emergency operations recorded prospectively on the operation theater database of Krishna Hospital and Medical Research Centre, Karad, between April 01, 2018, and March 31, 2019, were included in this study. The operations were categorized according to whether they commenced during the daytime (08:01–20:00 h), or nighttime (20:01–08:00 h). The type of procedure and grade of the participating surgical personnel were also recorded. **Results:** In total, 1128 emergency operations were performed over the study period. The number of emergency procedures performed during the daytime and nighttime was 652 (57.8%) and 476 (42.2%), respectively. Laparotomies and complex vascular procedures collectively accounted for half of all the cases performed after midnight, whereas they represented only 30% of the combined daytime emergency workload. Thirty-two percent ( $n = 152$ ) of all nighttime operations were supervised or performed by a consultant surgeon. **Conclusion:** When considering a surgical procedure, surgeons must bear in mind that cases that start after the routine hours may face an elevated risk of complications that warrants further evaluation and surgical start times are associated with risk-adjusted patient outcomes.

**KEYWORDS:** *Complications, daytime, emergency, nighttime, operations, procedures*

mortality. Fatigue and excessive working hours are potential factors for medical errors.<sup>[4]</sup> Medical activity performed beyond regular working hours may represent risk for patients and health professionals.<sup>[5-7]</sup> Doctor's proficiency and situation awareness are smaller at night, and several studies have shown the effects of fatigue and sleep deprivation in performance.<sup>[1,8]</sup> Sleep deprivation affects cognitive and psychomotor performance, leading to a higher risk of surgical complications.<sup>[9,10]</sup>

**Address for correspondence:** Dr. Shirish Kannur, Resident, Department of Surgery, Krishna Hospital and Medical Research Centre, Krishna Institute of Medical Sciences "Deemed to be" University, Karad, Maharashtra - 415 110, India.  
E-mail: kannur.shirish@gmail.com

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Several studies have associated nighttime surgery with increased surgical complications, comprising different areas such as organ transplantation, gynecology, and orthopedics.<sup>[5-7,11,12]</sup> Therefore, the most effective method to reduce the complications' risk is rethinking what pathologies and respective presentations constitute a need for nighttime surgery and which interventions should be delayed.<sup>[10,13]</sup>

Apart from the fact that patients needing emergency and nighttime surgery are generally sicker, there are several factors involved in this decision, namely patient factors (comorbidities) that may require optimization before the surgical procedure and hospital factors that may arise from elective procedures' list performed during the day, leaving few theaters available for emergency cases.

For surgery, in particular, the impact of time of day on teamwork is important. You are often operating with a team that is likely different from your daytime team. All members of that team (physicians, nurses, anesthesiologists, techs, etc.) may not have the same level of expertise or experience as your regular daytime team and the team dynamics between members is likely to be different. The postoperative recovery unit is likely to be staffed much differently as well. Moreover, some of the other hospital support services (e.g., radiology, laboratory, and sterile processing) may have lesser staffing during nighttime. Just as importantly, many or all of the staff that make up the nighttime surgical team have likely worked a full daytime shift that day, so fatigue enters as a potential contributory factor.

## METHODS

This study was conducted after taking approval from the institutional ethics committee. The data used in the study were acquired from the operation theater database. An electronic database system is used to capture theater data prospectively. Recorded theater data comprise of the type of procedure performed, the timing and duration of an operation, as well as the key theater personnel involved in the procedure.

The time when anesthesia was commenced was used as the procedure's "start time." It was then recoded according to whether the procedure commenced during the daytime (08:01–20:00 h) or nighttime (20:01–08:00 h). In addition, surgical personnel that performed or participated in emergency procedures were recoded according to whether they were consultants or trainees.

## Study population

This study was conducted as a prospective review of the time of the day the surgery was conducted and its effect on the complications and postoperative mortality in patients who underwent emergency surgeries at Krishna Hospital and Medical Research Centre, Karad, between April 01, 2018, and March 31, 2019.

## Inclusion criteria

All emergency surgeries that were carried out at Krishna Hospital and Medical Research Centre, Karad.

## Exclusion criteria

Emergency surgeries conducted in the Department of Obstetrics and Gynecology such as cesarean deliveries.

## OBSERVATIONS AND RESULTS

Figure 1 and Tables 1-6.

## DISCUSSION

Emergency conditions considerably contributed to the number of patients admitted to surgical departments. These admissions were associated with high mortality, high rates of complications, and significant costs for surgical departments. Many of these patients need careful investigations and require complex decision-making about the management and need for intervention under the care of the surgical team.

In total, 1128 general surgical and vascular emergency operations were performed [Figure 1].

Overall, 57.8% ( $n = 652$ ) of all study procedures were carried out during the daytime, whereas, a further 42.2% ( $n = 476$ ) occurred during the midnight.

Nearly 53.6% of all procedures were performed on men ( $n = 605$ ) and 46.3% of procedures were performed on women. However, among patients operated during the daytime, 60% were females and 40% were males with an average age of 59 years and among patients operated during the nighttime, 44% were males and 56% were females with an average age of 57 years [Table 1].

A consultant surgeon was present in 40% ( $n = 452$ ) of all emergency surgical cases recorded throughout the study. Consultant presence was greatest during daytime (46% cases) compared to 32% of all nighttime cases.

Regarding body mass index, 64% of patients in the daytime and 36% of patients in the nighttime were underweight. Furthermore, 48.6% of patients in the daytime and 51.4% of patients in the nighttime were obese [Table 2].

About half of the patients (48.4%) had an American Society of Anesthesiologists score of I and II [Table 3].

Nearly three-fifth of the patients who presented during the nighttime had a normal leukocyte count (59.5%) [Table 4] and 69.5% of patients presenting during the nighttime had a normal hemoglobin level [Table 5]. The comparative analysis of the nighttime surgery group and daytime group revealed similar sociodemographic and clinical characteristics, except for a high incidence of preoperative anemia in the nighttime surgery group ( $P < 0.001$ ).

The mean hospital length of stay was 9 days in the daytime and 16 days in the nighttime group [Table 6].

However, more than half of all the patients did not need hospitalization in the intensive care unit (ICU) after surgery. The necessity of relaparotomy was comparable between the two groups. Nearly 22% of all the patients required a redo procedure. Half of the patients had no postoperative medical morbidity (48.7%). Statistical analysis demonstrated differences between groups regarding length of stay in the hospital ( $P = 0.008$ ), with an increased mean length of stay in the nighttime group.

The results were contrary to those of a study conducted by Fernandes *et al.* who reported that patients operated during the daytime had higher anemia rate. However, they also reported that this was only a clinical finding, because using multivariate analysis, anemia did not predict a longer hospital length of stay nor there are other statistically significant associations that could be explained by this finding.

The primary outcomes were the presence of preventable surgical complications, defined as adverse events, occurring as a result of care during an operation and likely attributable to the performance of the attending surgeon.

Preventable complications were complications judged to have likely been due to a surgical error. Adverse outcomes due to patient condition, adverse events judged

to be unlikely associated with the attending surgeon, and adverse events of unclear relationship to intraoperative care were excluded.

Surgical complications included infections, massive hemorrhage, organ injury, anastomotic dehiscence, and others such as failed procedures. The most common surgical complications were wound infections and bleeding, of which 62.2% of patients who developed wound infections and 61.8% of patients who had bleeding were operated during the nighttime.

**Table 1: Relation of mean age (years) and sex of patients presenting in daytime and nighttime**

Variables	Total	Daytime, n (%)	Nighttime, n (%)
Mean age (years)		59	57
Sex			
Male	605	338 (55.9)	267 (44.1)
Female	523	314 (60)	209 (40)

**Table 2: Relation between body mass index of patients presenting in daytime and nighttime**

BMI (kg/m <sup>2</sup> )	Total	Daytime, n (%)	Nighttime, n (%)
<18.5	319	204 (64)	115 (36)
18.5-24.9	302	207 (68.5)	95 (31.5)
25-29.9	392	185 (47.1)	207 (52.9)
>30	115	56 (48.6)	59 (51.4)

BMI: Body mass index

**Table 3: Comparison of American Society of Anesthesiologists grading of patients taken for emergency surgery in daytime and nighttime**

ASA score	Total	Daytime, n (%)	Nighttime, n (%)
I	209	126 (60.2)	83 (39.8)
II	337	270 (80.1)	67 (19.9)
III	458	211 (46)	247 (54)
IV	97	35 (36)	62 (64)
V	28	9 (32.1)	17 (68.9)

ASA: American Society of Anesthesiologists

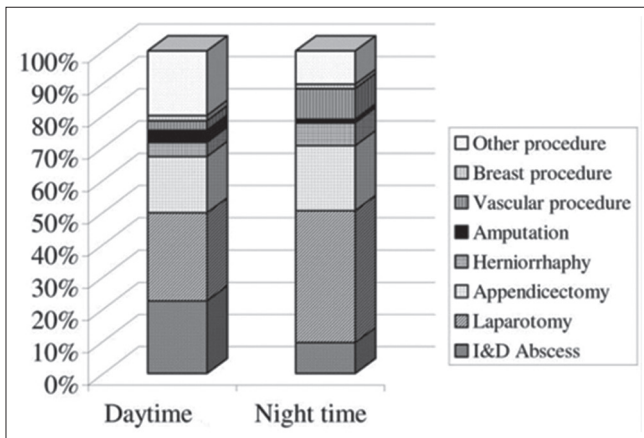
**Table 4: Relation between white blood cell count of patients presenting in daytime and nighttime**

WBC count (cells/ml)	Total	Daytime, n (%)	Nighttime, n (%)
Normal	791	508 (64.2)	283 (35.8)
≥12,000	337	144 (42.7)	193 (57.3)

WBC: White blood cell

**Table 5: Relation between hemoglobin levels of patients presenting in daytime and nighttime**

Hemoglobin levels (g/dl)	Total	Daytime, n (%)	Nighttime, n (%)
≥11.0	553	345 (62.3)	208 (37.7)
9-11	358	236 (65.8)	123 (34.2)
7-9	152	51 (33.8)	100 (66.2)
<7	65	20 (30.8)	45 (69.2)



**Figure 1: The operative content of the emergency workload (% of total) according to the timing of surgery**

**Table 6: Relation of postoperative characteristics and complications of patients operated in daytime and nighttime**

Variables	Total	Daytime, n (%)	Nighttime, n (%)
Length of hospital stay (mean in days)		9	16
ICU hospitalization	633	277 (43.7)	356 (56.3)
Re-do procedures	248	121 (48.8)	127 (51.2)
Medical morbidity	550	249 (45.3)	301 (54.7)
Wound infection	648	245 (37.8)	403 (62.2)
Anastomotic dehiscence			
Fistula	247	118 (47.8)	129 (52.2)
Bleeding	699	267 (38.2)	432 (61.8)
Intraoperative complications	508	223 (43.9)	285 (56.1)
Abscess	168	75 (44.7)	93 (55.3)
Miscellaneous			
Neural damage	12	3 (0.4)	9 (1.8)
Wrong site/retained foreign object	0	0 (0)	0 (0)
Intraoperative cardiac arrest	3	1 (0.1)	2 (0.4)
Postoperative mortality			
72 h	33	13 (1.9)	20 (4.2)

ICU: Intensive care unit

Patients undergoing nighttime surgery showed slightly higher rates of anastomotic leakage (52.2%) in relation to patients undergoing daytime surgery (47.8%).

Patients operated in the nighttime were two times more likely to die within 72 h post surgery than those operated during the daytime.

It was found that the total number of cases performed by the residents significantly increased in the nighttime. This may be because emergency surgeries getting delayed till the end of elective surgeries list and then be performed by the junior staff. Only 32% of all nighttime operations and 46% of daytime operations were supervised or performed by a consultant surgeon. However, one should assume that some cases will need to go to the theater in the middle of the night and a significant proportion of these cases will require senior supervision.

In 2003, the National Confidential Enquiry into Patient Outcome and Death (NCEPOD) repeated a comprehensive "Who Operates When" audit to investigate the provision of emergency surgical services in the United Kingdom. The first audit of this kind was performed in 1997 and following that important recommendations were made.

More specifically, the NCEPOD stated that emergency surgical patients should expect to be treated by trained personnel regardless of when they presented or required surgery. In consequence, recommendations were made to enhance senior-led service provision.

In a study conducted by Faiz *et al.*, concerns have been raised that the recent increase in consultant participation in the emergency service has resulted in decreased operative experience among the junior staff.

Furthermore, many of the emergency operations performed in suboptimal circumstances at nighttime can be postponed to the following day. However, unplanned emergency surgeries can lead to cancellation or postponement of the scheduled elective cases. Therefore, good communication is required between the surgeon and the theater staff to finalize on the order, in which patients would be taken for surgery shortly before the commencement of the theater session in order to accommodate unexpected emergencies.

Not all surgeons accept the operative delays incurred on emergency patients solely on the basis of their timing of presentation. In addition, operative delays are often underestimated, and anecdotal experience suggests that many deferred patients suffer significant ongoing delays following prioritization of the following days' surgery list. Hence, many surgeons feel that there are considerable arguments to be made in favor of prompt surgical treatment.

A culture of teamwork along with a critical redesign of schedules can mitigate the chance of unduly fatigued attending physicians performing procedures. When possible, adequate backup personnel should be available to relieve the physicians who detect impaired performance due to severe fatigue in themselves and others.

The Association of Surgeons of Great Britain and Ireland and the Royal Australasian College of Surgeons advocated the provision of dedicated emergency surgery theater space. It was reported that in institutions where 24-h emergency theater space could not be provided, even half-day emergency surgery theater improved

the emergency surgery services without causing much hindrance to the scheduled elective surgeries.

The surgeon should, however, not forget that some, often old and chronically ill patients, poor outcome with death can be predicted. For these patients, a dignified end to life is important. For the surgeon, this sometimes means avoiding surgery, with prolonged and futile postoperative treatments in the ICU. Palliative care merits careful consideration, demanding honest and direct communication with patients and their representatives. This is always difficult, yet it is a fundamental attribute of the surgeon who undertakes the care of surgical emergencies.

## CONCLUSION

- This study concluded that nighttime emergency surgeries were associated with greater postoperative medical and surgical morbidity risk when compared with daytime emergency surgeries
- Large physician groups can avoid scheduling elective procedures following overnight on-call responsibilities and consider canceling or postponing elective procedures if they are not alert enough to operate safely
- A culture of teamwork along with a critical redesign of schedules can mitigate the chance of unduly fatigued attending physicians performing procedures
- Adequate backup personnel should be available to relieve the physicians who detect impaired performance due to severe fatigue in themselves and others
- Although costly, providing a separate emergency surgery theater would be effective in reducing the number of nighttime surgeries
- For some old and chronically ill patients, palliative care merits careful consideration, demanding honest and direct communication with patients and their representatives. This is always difficult, yet it is a fundamental attribute of the surgeon who undertakes the care of surgical emergencies.

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## Conflicts of interest

There are no conflicts of interest.

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