



Daytime Versus Night-Time Emergency Abdominal Operations: Perspective from a Low–Middle-Income Country

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Abstract

Background Emergency abdominal operations carry significant risk of mortality and morbidity. The time of the day when such operations are performed has been suggested as a predictor of outcome. A retrospective comparison of outcomes of daytime and night-time emergency abdominal operations was conducted.

Methods Clinical data of patients who had abdominal operations over a five-year period were obtained. Operations were classified as ‘daytime’ (group A) if performed between 8.00 am and 7.59 pm or ‘night time’ if performed between 8.00 pm and 7.59 am (group B). Post-operative outcomes were compared.

Results A total of 267 emergency abdominal operations were analysed: 161 (60.3%) were performed in the daytime while 106 (39.7%) were performed at night. The case mix in both groups was similar with appendectomies, bowel resections and closure of bowel perforations accounting for the majority. Baseline characteristics and intra-operative parameters were similar except that ‘daytime’ operations had more consultant participation ($p = 0.01$). Mortality rates (13.7% in group A and 12.3% in group B, $p = 0.2$), re-operation rates (9.3% in group A and 10.4% in group B, $p = 0.7$) and duration of hospital stay (group A—11.1 days, group B—12.4 days $p = 0.4$) were similar. ASA status, re-operation and admission into the intensive care unit were identified as predictors of mortality.

Conclusion Timing of emergency abdominal operations did not influence outcomes. In resource-limited settings where access to the operating room is competitive, delaying operations till daytime may be counterproductive. Patients’ clinical condition still remains the most important parameter guiding time of operation.

Introduction

Emergency abdominal operations constitute a significant proportion of operations performed by general surgeons worldwide [1, 2]. In Nigeria, emergency abdominal

operations constitute about one third of all surgical emergency admissions. This ranges from relatively simple procedures such as appendectomy to more complex operations such as laparotomy for abdominal trauma, bowel perforations and intestinal obstruction [3].

Generally, emergency operations are known to be associated with significant risk of post-operative deaths and morbidity [4]. Unlike elective procedures where sufficient time is available for adequate patient preparation, emergency operations often do not permit extensive patient work up. In some instances, surgical intervention may be required as part of the resuscitative process. The urgency associated with such operations which is premised on the need to save life might result in operating on patients who

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may not have achieved optimal physiological status. Furthermore, emergency operations are sometimes performed at times of the day when the presence of all necessary personnel cannot be guaranteed. Some recent studies evaluating the impact of timing of emergency operations on outcomes suggest that outcomes tend to be worse when such operations are performed during the night shift periods [5].

This has, however, not been studied in sub-Saharan Africa. The differences in the pattern and complexity of emergency operations as well as personnel and infrastructural capabilities across hospitals and regions of the world [6] justify that this subject be studied in various settings. We hypothesize that worse outcomes for emergency surgeries performed at night, as demonstrated in studies from industrialized countries, would also be present in our setting. This study therefore set out to compare outcomes of night-time emergency abdominal operations with those performed in the daytime in a Nigerian tertiary hospital.

Methods

A review of all emergency abdominal operations performed between January 2012 and December 2015 was retrospectively reviewed using the hospital medical records and operating theatre register. The study was approved by the institution's Ethics and Research Committee. Data including socio-demographic characteristics, clinical details, intra-operative details and post-operative outcomes were obtained. Main outcome measures were mortality and re-operation rate.

Operations were classified as either 'daytime' or 'night time' based on the time of commencement of operation. Operations were labelled as daytime if commenced between 8 am and 7.59 pm while night-time operations were defined as those between 8 pm and 7.59 am.

Operations were grouped based on similarity and extent of the procedures for ease of comparison. The main categories were: appendectomies, laparotomy with bowel resection, laparotomy with closure of bowel perforation, laparotomy for solid organ injury, drainage of intra-abdominal abscess and others. Statistical analysis was performed using IBM SPSS version 21 (SPSS Institute, Chicago, Illinois). Categorical data such as gender, type of operation, American Society of Anaesthesiologists (ASA) status, mortality and re-operation rates were compared between both groups using the Chi-square test, while continuous data such as age, duration of symptoms, duration of operation and duration of hospital stay were compared using the Student's *t* test. Predictors of death and re-operation were identified by multivariate analysis. Variables that were significant on univariate analysis as well as

timing of operation were included in the multivariate model. *P* value < 0.05 was considered significant for all statistical tests.

Results

A total of 317 emergency abdominal operations were performed during the study period of which 267 accounting for 84.2% had complete outcome data. Of these, 161 were performed in the daytime while 106 were performed at night. Appendectomy was the most common operation performed, followed by bowel resections and closure of perforations (Table 1). The majority of the operations (161, 60.3%) were performed in the daytime while 106 (39.7%) were performed at night. Comparison of baseline socio-demographic and patient characteristics between the two groups showed no significant difference. Similarly, ASA

Table 1 Baseline socio-demographic and clinical characteristics

Variable	Daytime	Night time	<i>P</i> value
Mean age	38.7 ± 18.3	37.8 ± 17.6	0.68
Gender			
Male	94 (58.4%)	73 (69.9%)	0.08
Female	67 (41.6%)	33 (31.1%)	
ASA status			0.19
1	41 (25.5%)	16 (17)	
2	42 (26.1)	24 (22.6)	
3	41 (25.1)	21 (23.6)	
4	9 (5.6)	12 (11.3)	
Unknown	28 (17.4)	27 (25.5)	
Breakdown of cases			0.44
Appendectomy			
<i>Open appendectomy</i>	47 (28.6)	38 (35.5)	
<i>Laparoscopic appendectomy</i>	7 (4.3)		
<i>Laparotomy with appendectomy (For ruptured appendix)</i>	22 (13.7)	12 (11.3)	
Laparotomy with bowel resection	34 (21.1)	19 (17.9)	
Laparotomy with closure of perforation	20 (12.4)	15 (14.2)	
Laparotomy for solid organ injury	5 (3.1)	6 (5.7)	
Drainage of intra-abdominal abscess	5 (3.1)	4 (4.7)	
Adhesiolysis	5 (3.1)	2 (1.9)	
Repair of obstructed hernia	3 (1.9)	1 (0.9)	
Burst abdomen	2 (1.2)		
Cholecystectomy	2 (1.2)	1	
Colostomy	1 (0.6)	1 (0.9)	
Laparotomy for GI Bleeding	2 (1.2)		
Others	6	7	
Median duration of symptoms (days)	2	2	0.9

Table 2 Peri-operative details

Variable	Daytime	Night time	<i>P</i> value
Duration of surgery (mins)	117.6 ± 58	112.3 ± 55.8	0.47
Consultant participation	46 (28.6)	17 (16)	0.01
Need for intensive care	22 (13.7)	12 (11.3)	0.27
Peri-operative blood transfusion	30 (18.6)	25 (23.6)	0.15

Table 3 Post-operative outcome

Variable	Daytime	Night time	<i>P</i> value
Re-operation rate	15 (9.3%)	11 (10.4%)	0.7
Mortality	22 (13.7%)	13 (12.3%)	0.24
Median duration on admission(days)	7	6	0.89

status, symptom duration before presentation and type of operation performed did not differ significantly between the two groups (Table 1). Operations performed in the daytime were, however, observed to have more consultant participation compared to those performed at night (Table 2). Comparison of other peri-operative events including duration of operation, admission into the intensive care unit and blood transfusion was not statistically different between the two groups (Table 2).

Table 4 Outcome assessment based on type of operation

Surgery type	Mortality		<i>P</i>	Re-operation		<i>p</i>
	Daytime <i>N</i> (%)	Night time <i>N</i> (%)		Daytime <i>N</i> (%)	Night time <i>N</i> (%)	
Laparotomy with bowel resection	10 (29.4)	3 (15.8)	0.27	7 (20.6)	4 (21.1)	1.0
Laparotomy plus closure of bowel perforation	4 (20)	5 (33.3)	0.37	4 (20)	3 (20)	1.0
Laparotomy for solid organ injury	3 (60)	2 (33.3)	0.38	0 (0)	0 (0)	–
Laparotomy for GI bleeding	1 (50)	0 (0)	0.16	0 (0)	0 (0)	–
Colostomy	1 (100)	0 (0)	0.16	0 (0)	0 (0)	–
Repair of obstructed hernia	1 (33.3)	1 (100)	0.25	0 (0)	0 (0)	–
Open appendectomy	0 (0)	0 (0)	–	0 (0)	1 (2.6)	0.3
Laparoscopic appendectomy	0 (0)	0 (0)	–	1 (14.3)	0 (0)	0.1
Laparotomy for complicated appendicitis	0 (0)	0 (0)	–	1 (4.5)	1 (8.3)	0.7
Drainage of intra-abdominal abscess	0 (0)	1 (25)	0.29	1 (20)	1 (25)	0.8
Adhesiolysis	0 (0)	0 (0)	–	0 (0)	0 (0)	–
Burst abdomen	0 (0)	0 (0)	–	0 (0)	0 (0)	–
Cholecystectomy	0 (0)	0 (0)	–	1 (50)	0 (0)	0.1
Others	2 (33.3)	1(14.3)	0.52	0 (0)	1 (9.1)	0.3
Grouped analysis						
Appendectomy	0 (0)	0 (0)	–	1 (1.9)	1 (2.6)	0.80
Non-appendectomy cases	22 (20.6)	13 (19.1)	0.82	14 (13.1)	10 (14.7)	0.76

N number of deaths, % percentage of deaths per surgery type performed during each time period

Mortality rate was 13.7% following daytime operations and 12.3% for night-time operations ($p = 0.24$). Re-operation rates and overall duration on admission were also not statistically different between the two groups (Table 3). A subgroup analysis of outcomes (mortality and re-operation) based on diagnosis showed that the majority of deaths resulted following bowel resections and closure of bowel perforations. Within each group however, there were no statistically significant differences in outcomes between daytime and night-time operations (Table 4).

Multivariate analysis to determine factors predictive of mortality and re-operation showed that ASA status, admission into the Intensive Care Unit, and re-operation were predictive of mortality while pre-operative blood transfusion was the only predictor of re-operation identified in this study (Tables 5, 6).

Discussion

Reducing morbidity and mortality following emergency abdominal operations has been the focus of several research efforts for several decades [7–9]. Over the years, various clinical predictors of poor outcomes following emergency abdominal operations have been identified [1, 10]. More recently, the role of timing of operation has generated increased interest [11]. Similar to earlier reports, this study shows a trend towards the performance of more

Table 5 Predictors of death

	Univariate analysis	Multivariate analysis odds ratio (95% CI)	<i>p</i> value
Age			
< 20	0.001		
20–29			
30–39		0.41 (0.039–4.286)	0.456
40–49		0.27 (0.02–3.571)	0.319
50–59		0.70 (0.062–8.033)	0.778
60–69		0.44 (0.034–5.535)	0.522
70 and above		1.03 (0.084–12.61)	0.98
ASA			
1	0.001		
2		2.231 (0.18–27.691)	0.532
3		3.589 (0.321–40.099)	0.299
4		26.846 (1.833–393.194)	0.016
Timing			
Day time			
Night time	0.74	0.64(0.189–2.165)	0.472
Surgery type			
Appendectomy			
Non-Appendectomy	0.001	0.43(0.099–1.831)	0.25
Blood transfusion			
Yes	0.001	0.80(0.236–2.743)	0.728
No			
Consultant participation			
Yes	0.001	1.4 (0.442–4.432)	0.568
No			
ICU			
Yes	0.001	6.3(2.071–18.98)	0.001
No			
Need for re-operation			
Yes	0.001	8.2(1.63–41.382)	0.01
No			

Variables that were significant on univariate analysis as well as timing of operation were included in the multivariate model

daytime emergency operations. It also highlights some of the challenges of night-time operations alluded to by other studies, such as less participation of senior personnel [12]. In spite of these, no difference in outcomes between daytime and night-time emergency abdominal operations was observed in this study.

The desire to perform more emergency operations in the daytime is premised on the need to have increased participation by senior personnel as well as avoiding operations being performed by surgeons who may have been fatigued after routine work hours [13]. While this is desirable, it is certainly a difficult task to achieve given the nature of some emergency operations which allow for very little waiting time. Appropriate decision on which operations can wait depends largely on the diagnosis, the clinical

Table 6 Predictors of re-operation

	Univariate analysis	Odds ratio with 95% CI	<i>p</i> value
Timing			
Day time	0.77	1.1(0.41–3.075)	0.821
Night time			
Surgery type			
Appendectomy			
Non-appendectomy	0.003	2.4 (0.405–13.958)	0.338
Blood transfusion			
Yes	0.001	7.7 (2.334–24.931)	0.001
No			

Variables that were significant on univariate analysis as well as timing of operation were included in the multivariate model

condition of the patient as well as the clinician's judgement. Cases presenting with major ongoing haemorrhage certainly require immediate operation regardless of the time of presentation. In a review of emergency operations performed in the UK where there is currently a shift towards more daytime emergency operations, urgent complex vascular operations were observed to dominate most of the night-time list [14]. The decision to operate may, however, not be as clear cut in less urgent situations such as appendicitis. In this study, the majority of the operations performed were appendectomies. Some studies have suggested that waiting till the daytime before intervention does not affect outcomes post-appendectomy [15, 16]. Yardeni and colleagues in a prospective comparison of immediate versus delayed appendectomy showed that short delays before appendectomy did not result in any adverse outcomes [17]. Some have, however, observed the contrary, showing that complication rates tend to increase when operative intervention is delayed [16, 18]. Perhaps, the more important question to ask is the advantage derivable from postponing a procedure like appendectomy, given its non-complex nature and the relative ease of execution with minimal senior supervision. In this study, the majority of appendectomies, regardless of time of the day, were performed by trainee surgeons with no mortalities regardless of time of operation. As such, even with less consultant participation, less urgent operations such as appendectomies can be safely performed without increased risk of complications while avoiding unnecessary encroachment into routine work hours. This is particularly important in resource-limited settings where dedicated emergency operating rooms or acute care surgeons are in short supply. In the UK, there is a trend towards less night-time operations in a bid to increase consultant-led service provision [1, 19, 20]. This has been partly achieved by providing more dedicated daytime emergency surgical

services. In resource-limited settings where personnel and theatre spaces are keenly contested for by elective and emergency procedures, patients are best operated whenever the opportunity is available. Furthermore, postponing emergency operations till daytime hours might jeopardize the operative experience of trainee surgeons as this has been associated with increased consultant participation and less experience for junior doctors.

The majority of other cases presented in this series were those requiring laparotomy for control of sepsis. The pattern commonly observed in low-resource settings as observed in this study is that of delay for several days before presenting to the hospital and ultimately before institution of treatment [21]. Patients often require extensive resuscitation prior to surgical intervention. However, much resuscitation is done, and recovery of full physiological status is only achievable after source control. Further delay in operative intervention solely for the purpose of operating in the daytime may not be to the patients' advantage [21]. In this study, the decision about when to operate on patients with intra-abdominal sepsis was based on the patients' condition and other prevailing circumstances such as availability of theatre space. Outcomes did not differ whether such operations were performed at night or in the day.

This study identifies some determinants of mortality, such as ASA status, ICU admission and re-operation. These variables, particularly ASA status and admission into the intensive care unit, are indicators of the severity of the poor pre-operative clinical state of the patients. Re-operation itself was related to the patients' clinical condition, as the only predictor identified in this study was the need for peri-operative blood transfusion. There was no relationship between any of the outcome measures and the presence of senior personnel to justify delaying emergency operations until the availability of a consultant staff.

Our findings might have differed from other studies due to the variations in the case mix. For instance, some studies have reported a higher proportion of more complex emergency operations being performed at night [19, 22]. For such procedures, the absence of senior personnel might have a huge impact on the outcome.

This study being retrospective did not allow for patient randomization based on predetermined criteria. We also admit the limitation of this study in assessing other important outcome measures such as surgical site infection and other wound complications. A prospectively designed study will be better suited to answer these questions as well as explore other important aspects such as surgeons' experiences during night operations.

Within these limits however, this study shows that non-complex emergency operations such as appendectomies, bowel resections and closure of bowel perforations

performed at night had outcomes similar to those performed during the day. In settings similar to ours where access to theatre space in the daytime remains competitive, we advocate that emergency surgical intervention be instituted for patients, even at night while taking the patients' diagnosis and clinical condition into consideration.

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