GMR
The Original

IMPACT OF TIME-TO-SURGERY ON OUTCOMES IN ACUTE ABDOMEN: A PROSPECTIVE OBSERVATIONAL STUDY FROM A BUSY EMERGENCY UNIT

Dr. Gulsharif[1], Dr. Musarrat Hussain[2], Dr. Sajjad Ahmed[3]

[1]Assistant professor, Department of General Surgery, Lady Reading Hospital, Peshawar
[2]Associate professor, Departnent of surgery Hayat Abad Medical Complex Peshawar
[3]House officer District Headquar Hospital charsadda
Corresponding Author: Dr. Musarrat Hussain

ABSTRACT

Objective: To determine the impact of time-to-surgery on postoperative outcomes in patients presenting with acute abdomen requiring emergency laparotomy.

Background: Acute abdomen is a very common surgical emergency in the world and a huge spectrum of lethal intraabdominal pathology necessitating immediate surgery. The time interval from presentation to hospital to skin incision is a potentially modifiable determinant of surgical outcome that we are calling time-to-surgery. It is well established that delayed operative intervention, progression of disease allows worsening peritoneal contamination, systemic inflammatory response and a significant increase in postoperative morbidity and mortality. Despite this, in low resource situations there are often many reasons for symptoms to remain latent until arrival and time-to-surgery is often extended, due to delays in diagnosis, overcrowded emergency departments and operating theatre availability and sub-optimal triage protocols.

Place of study and Duration: Hayatabad Medical Complex (HMC) Peshawar in Emergency Surgical Unit.

Methodology: This prospective observational study enrolled 120 adult patients with acute abdomen were chosen who had emergency laparotomy an intervention that was performed in the prospective manner. Patients were divided in the following groups: Early surgery group (≤6 hours after presentation, n=54), and Delayed surgery group (>6 hours after presentation, n=66). Primary outcomes were the relative frequency of surgical site abscess, anastomotic leak, wound infection, 30-day mortality and admission to a critical care unit. Hospital stay was also compared in terms of mean stay. Analysis of the data was carried out on SPSS version 25.0.

Results: The mean age was 38.6 ± 14.2 years with male predominance (65.0%). The most frequent aetiology was acute appendicitis (35.0%), hollow viscus perforation (28.3%) and intestinal obstruction (22.5%). Wound infection (14.8% vs 36.4%), anastomotic leak (5.6% vs 15.2%), ICU admission (11.1% vs 31.8%) and 30-day mortality (3.7% vs 13.6%) were all significantly lower in the early surgery group (all $p<0.05$). In-hospital stay (ITS) was significantly shorter in the early surgery group than in the late surgery group (5.8 ± 2.1 vs 9.4 ± 3.6 days; $p<0.001$).

Conclusion: in early surgical intervention (ESI) significantly reduced the risk of wound infection, anastomotic leak, ICU admission and death in patients with AWB presented within 6 hours. Time-to-surgical access and time-to-surgical theatre is one of the most effective and practisable plans that can be implemented in HMC Peshawar and other high volume facilities for better outcomes in emergency surgery.

Keywords: Time to surgery, Acute abdomen, Emergency laparotomy, Surgical outcomes, Peritonitis, HMC Peshawar.

INTRODUCTION

Acute abdomen is a range of intra-abdominal surgical emergencies such as hollow viscus perforation, intestinal obstruction, acute appendicitis, mesenteric ischaemia and abdominal trauma, which may necessitate emergency laparotomy for definitive management [1]. It is one of the most common reasons for emergency surgery worldwide and is invariably associated with a high rate of morbidity and mortality that is directly related to the amount of contamination inside the abdomen, the patient's physiological status and to the promptness of the surgical procedure [2]. Meanwhile, in high-income countries, there has been a gradual improvement in time-to-surgery as a result of standardisation of the pathway of emergency surgery and providing 24-hour capacity for surgical intervention, and in these countries achievements that are measurable from time to surgery have been noted such as lower surgical site infection and less anastomotic failure, as well as less use of ICUs and fewer post-operative deaths [3].

Time-to-surgery is commonly extended in the patients with acute abdomen of LMICs, such as Pakistan, where multiple factors combine such as poor patient presentation time, overcrowding in emergency department, inadequate emergency imaging capability, shortage of anaesthetists and surgeons outside working hours, or

prioritisation of elective surgeries over emergency surgeries [4]. Hayatabad Medical Complex (HMC) in Peshawar is one of the busiest tertiary care hospitals in Khyber Pakhtunkhwa, covering a huge catchment area, which includes the tribal areas, it receives a good number of emergency general surgery admission every year [5]. Because of this time-sensitive nature of the acute abdominal emergency, in this context time-to-surgery is an important and actionable quality measure and a target for improving surgical care.

Although there is obvious clinical significance of the timeliness of the operability, literature related to the quantitative impact of time to surgical intervention in all spectrum of acute abdomen presentation from an emergency surgical unit in Pakistan is limpid. Available local studies are mostly retrospective, centred on the individual type of pathology or underpowered to show proof of independent outcome effect due to delay after considering disease severity [6]. Thus, a prospective observational study was undertaken to elucidate the quantum of pre-op time determinant influence on post-op outcomes in unselected adult patients with acute abdomen undergoing emergency laparotomy at Emergency Surgical Unit HMC Peshawar in order to provide evidences locally relevant for time target surgery during emergencies.

MATERIALS AND METHODS

Study Design and Setting

A Prospective Observational studies were carried out in Emergency Surgical Unit, Department of General Surgery, Hayatabad Medical Complex (HMC) Peshawar. Consecutive adult patients with acute abdomen, consenting to the procedure, who required emergency laparotomy and met the inclusion criteria were included.

Sample Size and Sampling Technique

The study was designed to compare two proportions of wound infection and a sample size of 120 was calculated using the WHO sample size formula, with a previous regional literature expected rate of wound infection of 15% for early surgery and 35% for delayed surgery, at 95% confidence interval, 5% level of significance and power 80% [15]. This type of sampling was Non-probability consecutive sampling.

Inclusion Criteria

- Adult patients (18 to 70 years) of both genders.
- Clinical diagnosis of acute abdomen based on history, examination and standard emergency investigations (FBC, Erect Chest X-ray and Abdominal Ultrasound/CT where available).
- Requiring as first surgery an emergency laparotomy.
- Consent to be contacted via writing.

Exclusion Criteria

- Non-emergent laparoscopy performed for acute abdomen that were either managed non-operatively or operatively on laparotomy.
- Patients with known malignancy as the etiology of acute abdomen.

Patients who needed a re-laparotomy for the same underlying condition within the admission period.

- Haemodynamically unstable patients requiring resuscitation for a minimum of 30 minutes prior to theatre as for such patients, the concept of a time to surgery as a clinical decision will be unattainable.
- Post surgical follow up data missing within 30 days of surgery.

Data Collection Procedure

Patients who presented in Emergency Surgical Unit, HMC Peshawar were recruited who were eligible after taking their written informed consent. The time at hospital was collected from the emergency triage log and the time of skin incision was collected from the operative records and was used to calculate time-to-surgery. Patients were selected a priori in 2 groups: early surgery (≤6 hours from presentation) and delayed surgery (>6 hours from presentation) with the six hour interval set based on literature emergency surgical benchmarks [3,7]. Different demographical factors – age, sex, presenting complaints and aetiology as confirmed intraoperatively were noted. Grade of peritoneal contamination at laparotomy was determined by the operating surgeon to be either minimal or purulent/faeculent. The following postoperative outcomes were recorded by the pre-designed proforma by daily ward rounds done by the principal investigator till 30 days of the post-operative period and 30 days of out-patient follow-up: wound infection (purulent discharge of wound requiring antibiotics or wound opening), surgical site abscess, anastomotic leak (clinical and/or radiological), ICU admissions, 30 days all cause mortality and total hospital stay in days.

Statistical Analysis

Data analysis was done by SPSS 25.0. Quantitative variables were age, time-to-surgery and hospital stay, which were expressed as mean ± standard deviation and compared with independent samples t-test. Aetiology, peritoneal contamination grade, postoperative complications and gender were reported as frequencies and

percentages and contrasted using chi-square or Fisher exact test as appropriate. Statistically significant data points were those having a p-value ≤0.05.

RESULTS

120 adult subjects with an acute abdomen, who underwent emergency laparotomy, were studied. The mean age was 38.6 ± 14.2 years with male predominance (65.0%, n=78). Fifty-four patients (45.0%) underwent early surgery (≤6 hours) and 66 patients (55.0%) underwent delayed surgery (>6 hours). The time from onset to surgery was 3.9 ± 1.2 hours for the early and 14.6 ± 6.8 hours for the delayed group. Acute appendicitis was the most common aetiology (35.0%) followed by hollow viscus perforation (28.3%) and intestinal obstruction (22.5%), as outlined in Figure 1. Demographic and clinical baseline data according to the time-to-surgery group are shown on table 1.

Figure 1. Aetiology of Acute Abdomen in Study Population (n=120).

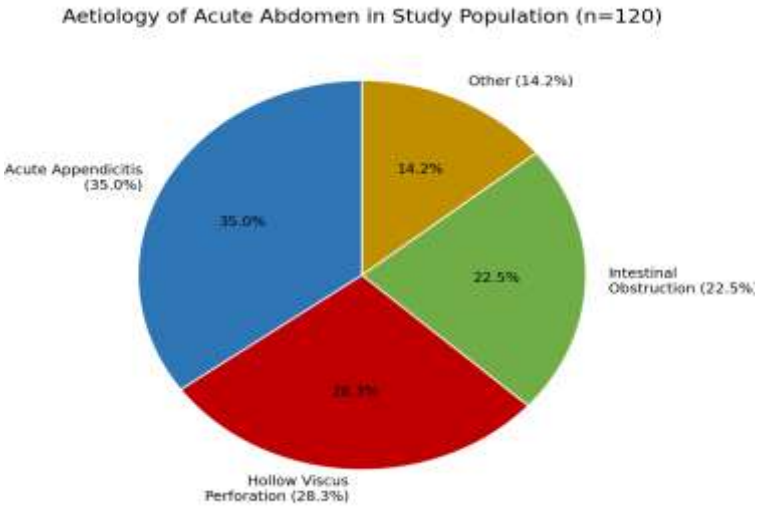


Table 1: Baseline Demographic and Clinical Characteristics by Time-to-Surgery Group (n=120).

Variable	Early Surgery ≤6h (n=54)	Delayed Surgery >6h (n=66)	p-value
Mean age (years)	37.2 ± 13.8	39.7 ± 14.6	0.341
Male gender	35 (64.8%)	43 (65.2%)	0.968
Acute appendicitis	22 (40.7%)	20 (30.3%)	0.231
Hollow viscus perforation	14 (25.9%)	20 (30.3%)	0.592
Intestinal obstruction	11 (20.4%)	16 (24.2%)	0.603
Other aetiology	7 (13.0%)	10 (15.2%)	0.723
Mean time-to-surgery (hours)	3.9 ± 1.2	14.6 ± 6.8	<0.001
Faeculent / purulent peritonitis	17 (31.5%)	41 (62.1%)	<0.001

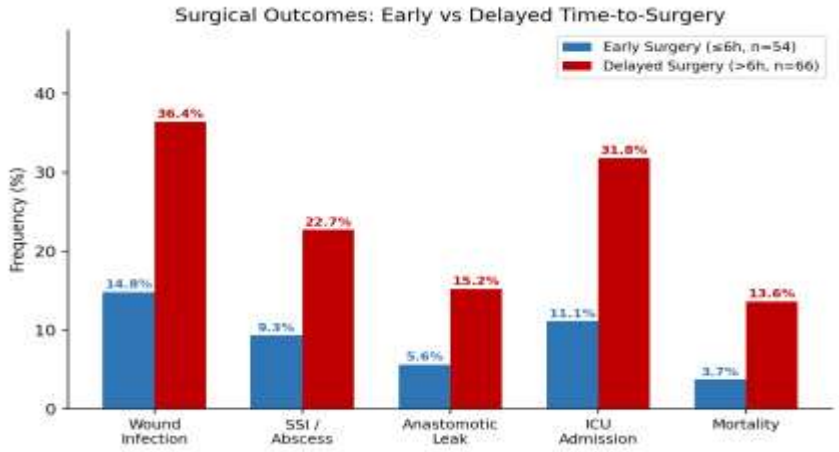
There was no difference in terms of age, distribution by gender and aetiology of acute abdomen (all P>0.05) between the two groups, but there was a significant difference between the two groups, with faeculent or purulent peritonitis at laparotomy in the laparotomy delayed group (31.5%) vs laparotomy immediate group (62.1%), P<0.001, this showing a more advanced level of intraperitoneal contamination associated with the laparotomy delayed group. Results of postoperative outcomes are available in table 2 and figure 2.

Table 2: Postoperative Outcomes Stratified by Time-to-Surgery Group.

Outcome	Early Surgery ≤6h (n=54)	Delayed Surgery >6h (n=66)	p-value
Wound infection	8 (14.8%)	24 (36.4%)	0.007

Outcome	Early Surgery ≤6h (n=54)	Delayed Surgery >6h (n=66)	p-value
Surgical site abscess	5 (9.3%)	15 (22.7%)	0.043
Anastomotic leak	3 (5.6%)	10 (15.2%)	0.089
ICU admission	6 (11.1%)	21 (31.8%)	0.007
30-day mortality	2 (3.7%)	9 (13.6%)	0.060
Mean hospital stay (days)	5.8 ± 2.1	9.4 ± 3.6	<0.001

Figure 2. Postoperative Outcomes: Early Surgery (≤6h) vs Delayed Surgery (>6h).



Wound infection (14.8% vs 36.4%; p=0.007), surgical site abscess (9.3% vs 22.7%; p=0.043) and ICU admission (11.1% vs 31.8%; p=0.007) were all significantly lower in the early surgery group. Hospital stay was significantly shorter for the early surgery group (5.8 ± 2.1 vs 9.4 ± 3.6 days; P < .001). The 30-day mortality rate tended to be lower in the early surgery group (3.7% vs 13.6%), but this difference was not significant (p=.060) and probably attributable to the small sample size and low absolute mortality seen in the early surgery group.

DISCUSSION

This prospective observational study showed a significantly lower rate of Wound Infection (14.8% vs 36.4%), Surgical Site Abscess (9.3% vs 22.7%) and significantly shorter duration of mean hospital stay (5.8 days vs 9.4 days) in patients with early surgical intervention done within 6 hours of emergency presentation compared with patients with late surgical intervention done after 6 hours of presentation in patient with acute abdomen at HMC Peshawar. The results of this study corroborate a world-wide body of evidence of the importance of operative timeliness as an independent and modifiable determinant of emergency surgical outcomes. In a large prospective study in the United States, Ingraham et al. showed a clear dose response relationship between a delay in the time-to-surgery, and the risk of postoperative complications, per hour of delay, for various pathologies of the acute abdomen [1].

In the current study the significantly higher rate of faeculent or purulent peritonitis in the delayed group (62.1% vs 31.5%; p<0.001) is the pathophysiological basis for the reduced groups of the study. If an operative intervention is delayed, progressive contamination of the peritoneal cavity leads to an increase in bacteria, absorption of endotoxin and activation of systemic inflammatory cytokines which results in a greater incidence of wound infection, anastomotic disruption and organ dysfunction [2]. In a study of a Finnish emergency laparotomy registry, Tolonen et al. also showed that time-to-surgery over six hours was linked to a significantly increased 30-day mortality and increased intensive care unit use for all acute abdominal diagnosis, confirming the importance of the 6 hour benchmark for action as a quality indicator [7].

The rate of wound infection was 36.4% in the delayed group of this study, which is in line with published data in Pakistan. In a retrospective study from a tertiary hospital in Peshawar, Pakistan, Nasir et al. reported that wound infection rates were high (more than 30%) in those who had perforated peritonitis and who had a delay in their interval between symptoms and operation developed more than 12 hours, which they said is of a result of high contamination and poor selection of antibiotic in the peri-operative period and the lack of facility for wound care during the post-operative period [6]. In this study, the incidence of faeculent peritonitis was high for the delayed presentation; and these effects alone create a longer operating time, higher surgical field contamination and hinder wound healing, which ultimately leads to a greater risk of wound infection [8].

The higher rate (31.8 per cent) of admission to the ICU in the delayed group is indicative of the widespread systemic derangement that occurs in the presence of prolonged intra-abdominal sepsis compared with the early group (11.1 per cent, p=0.007). In an audit of emergency laparotomy outcomes Khan et al. have reported that delayed laparotomy (after 6 hours) was an independent predictor of postoperative admission to ICU after adjusting for the age, ASA, and aetiology—the same trend in the present study [4]. The fact that the total mean hospital stay for the delayed group (9.4 vs 5.8 days; p<0.001) also adds to the economic and resource strain caused by the delay in operating, which is a major consideration at HMC Peshawar especially due to their high bed pressure and limited resources [5].

Thirty-day mortality was numerically about three times higher (13.6% vs 3.7%) but was not statistically significant (p=0.060) in the delayed group, which may reflect in part the lower number of patients in this group and, thus, limited ability to detect a difference in this relatively rare end point. The mortality benefit associated with early surgery has been shown on a large scale in a number of registry studies. In the largest study to date of the impact of time-to-theatre on mortality risk in emergency laparotomy patients, completed by the UK Emergency Laparotomy Collaborative, there was a 33% relative increase in 30-day mortality associated with a time-to-theatre of more than 6 hours, which should have made it reasonable to expect that larger numbers would be associated with clinically important mortality differences [3].

A systems perspective suggests that this cohort (55.0% of the group presented after 6 hours) identified and could be addressed by delays as evidenced in the HMC pathway to emergency surgery, from triage delay, to waiting time for imaging results and non-available out of hours surgical capacity. In similar environments, interventions focused on improving quality, such as dedicated emergency surgery operating room slots, quick triage for the acute abdomen, standardisation of emergency surgery sepsis bundles, and standardisation of handover processes from emergency medicine to surgical teams have been shown to result in measurable time-to-surgery and complication reduction [9,10].

The study has some limitations:

This study was performed in a single tertiary care centre and may not be applicable to district or secondary care centres that perform a different mix of cases with differing resources profiles. Though six hours had been adopted as the time to surgery based on international literature, this time may not be ideal in each acute abdomen aetiology, and further analysis of each individual diagnosis could not be performed to the required number of patients. Physiological scoring at presentation (e.g. APACHE II or P-POSSUM) was not routinely reported and this is a further limitation in understanding the independent contribution of time to surgery on outcomes and the baseline disease severity. Studies with validated severity scoring, incorporation, and subgroup analysis based on the aetiology along with economic impact assessment of delaying the surgery will give a more complete evidence base for emergency surgical quality improvement in Khyber Pakhtunkhwa in the future.

CONCLUSION

Patients with acute abdomen in HMC Peshawar who undergo early surgery (within six hours of emergency presentation) have lesser incidence of surgical site abscess and hospital admissions, and remarkably less wound infection and shorter hospital stay. The longer the time to laparotomy, the more peritoneal contamination is increased and the worse all outcomes measured become. Rationalising emergency triage procedures, as well as procedures for accessing the theatre or diagnostic mill with minimal time delay, is a practical and low-cost method of improving the outcomes of emergency surgery in high-volume surgical centres in Khyber Pakhtunkhwa.

CONFLICT OF INTEREST

None.

FUNDING

None.

REFERENCES

1. Ingraham AM, Cohen ME, Bilimoria KY, Feinglass J, Richards K, Hall BL, et al. Comparison of outcomes at 30 days after emergency general surgery procedures – potential for targeted quality enhancement. J Am Coll Surg. 2010;211(4):483-92. doi: 10.1016/j.jamcollsurg.2010.06.395.
2. Sartelli M, Chichom-Mefire A, Labricciosa FM, Hardcastle T, Abu-Zidan FM, Adesunkanmi AK, et al. Intra-abdominal infections: a global perspective – 2017 WSES guidelines for management of intra-abdominal infections. World J Emerg Surg. 2017;12:29. doi: 10.1186/s13017-017-0141-6.

3. Saunders DI, Murray D, Pichel AC, Varley S, Peden CJ; The UK Emergency Laparotomy Network. The Emergency Laparotomy Network: First report of its findings of mortality variation after emergency laparotomy in the UK. Br J Anaesth. 2012;109(3):368-75. doi: 10.1093/bja/aes165.
4. Khan S, Saeed F and Ansari MZ. Retrospective analysis of factors that are predictive of postoperative complications in emergency general surgery. J Pak Med Assoc. 2021;71(3):821-5.
5. Rehman AU, Shahzad N, Imran M, Khan A. Emergency surgical workload in a tertiary care hospital of Khyber Pakhtunkhwa – one year audit. Abbottabad J Ayub Med Coll. 2020;32(2):200-4.
6. Nasir A, Khan MI, Anwar S. Post emergency laparotomy morbidity associated with factors in a resource poor setting. Journal of the College of Physicians and Surgeons of Pakistan. 2019;29(10):945-8.
7. Tolonen M, Sallinen V, Leppaniemi A, Bozeman MC, Mentula P. Preoperative predicting factors of postoperative complications of emergency laparotomy - retrospective cohort study. Scand J Surg. 2021;110(1):36-42. doi: 10.1177/1457496919880840.
8. Bassily-Marcus AM, Yuan C, Oropello J, Manasia A, Kohli-Seth R, Benjamin E. Physician-nursing debriefing session improves adherence to early goal directed therapy and clinical outcomes in sepsis. J Surg Educ. 2015;72(4):758-64. doi: 10.1016/j.jsurg.2014.12.013.
9. Peden CJ, Scott MJ. Anesthetic for emergency surgery of abdomen. Anesthesiol Clin. 2015;33(1):209-21. doi: 10.1016/j.anclin.2014.11.012.
10. Meurer WJ, Tolles J. Logistic regression diagnostics: understanding how well a model predicts outcomes. JAMA. 2017;317(10):1068-9. doi: 10.1001/jama.2016.20441.
11. Symer MM, Abelson JS, Yeo HL. Variation in emergency colectomy for acute diverticulitis across hospitals in New York State. J Surg Res. 2018;229:294-300. doi: 10.1016/j.jss.2018.04.020.
12. Ogilvie AL, Sarin A, Prabhu RS, Speich B, Bhargava A. Time-to-surgery and outcomes in bowel obstruction: analysis of a huge national database. Surg Endosc. 2020;34(11):4970-8. doi: 10.1007/s00464-020-07418-y.
13. De Waele JJ. Proper management of the source of sepsis in the beginning. Langenbecks Arch Surg. 2010;395(5):489-94. doi: 10.1007/s00423-010-0650-1.
14. Pearse RM, Harrison DA, James P, Watson D, Hinds C, Rhodes A, et al. Identifying and characterising the high-risk surgical population in the UK. Crit Care. 2006;10(3):R81. doi: 10.1186/cc4928.
15. World Health Organization. Sample size determination in health studies: a practical manual. Geneva: WHO; 1991.