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Clinicopathological Characteristics Associated with Failure of Nonoperative Management of Blunt Abdominal Trauma at Kenyatta National Hospital

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Abstract- Background: ***Nonoperative management (NOM) is the preferred initial approach for haemodynamically stable patients with blunt abdominal trauma (BAT), but a substantial proportion of patients fail NOM and require surgical intervention. Data describing the clinicopathological characteristics associated with NOM failure in resource-limited settings such as Kenya remain scarce. Objective: This study aimed to identify the clinicopathological characteristics associated with failed NOM among patients with BAT at Kenyatta National Hospital (KNH). Methods: A retrospective cohort study reviewed the medical records of patients managed nonoperatively for BAT at KNH between June 2017 and June 2024. Systematic sampling was used to select 188 eligible patients. Demographic, clinical, injury-related and radiological characteristics were extracted using a structured data-collection tool and analysed in SPSS version 27, with multiple linear regression used to identify characteristics associated with failure. Results: Most patients were male (87.0%) and aged 19–39 years (74.9%), with road traffic accidents accounting for 79.8% of injuries. Advanced age (p = 0.004), blood transfusion requirement (p = 0.016), a lower Glasgow Coma Scale score (p = 0.036), presence of comorbidities (p = 0.006), mechanism of injury (p = 0.031), and the presence (p = 0.045) and size (p = 0.007) of hemoperitoneum on imaging were significantly associated with failure of NOM. Conclusion: Advanced age, transfusion requirement, depressed consciousness, comorbidities, injury mechanism and hemoperitoneum on imaging are the principal clinicopathological characteristics associated with failure of NOM among patients with BAT at KNH and should inform patient-selection criteria for nonoperative treatment.***

Keywords: Blunt abdominal trauma; Nonoperative management; Clinicopathological characteristics; Predictors of failure; Kenyatta National Hospital

I. INTRODUCTION

Trauma remains a leading cause of hospitalisation, disability and death worldwide, and it disproportionately affects low- and middle-income countries owing to limited prevention and treatment capacity (Larsen et al., 2022). The abdomen is the third most frequently injured body region in trauma, and blunt mechanisms account for the majority of abdominal injuries encountered in emergency care (Choi et al., 2022). In a Northern European cohort, blunt abdominal trauma (BAT) accounted for 91% of admitted abdominal-injury patients, with a median age of 31 years (Larsen et al., 2022), while locally, Musau, Jani, and Owillah (2006) reported that delayed surgical intervention, associated injuries and the need for blood transfusion were linked to mortality among patients with abdominal trauma at Kenyatta National Hospital (KNH).

Over the past decade, the management of haemodynamically stable patients with BAT has shifted from routine laparotomy toward nonoperative management (NOM), which is now regarded as safe and effective when patients are carefully selected and closely monitored (Fodor et al., 2019; Cimbanassi et al., 2018). NOM is nonetheless not uniformly successful: Zenaidi, Ismail, Rebii, and Zoghlami (2020) reported a 13.5% failure rate attributable largely to missed hollow-viscus and diaphragmatic injuries and delayed haemorrhage, while Bhangu, Nepogodiev, and Bowley (2012), in a meta-analysis of 21 studies, reported a 12% failure rate associated with higher mortality and longer hospital stay. Raza et al. (2013) similarly linked failure to the frequency of vital-sign monitoring, repeated clinical examination and laboratory surveillance.

In Kenya, BAT contributes substantially to the burden of surgical emergencies, yet NOM outcomes have not been systematically characterised outside a small number of single-organ studies (Ochieng, 2021; Mutisya, 2022). Clinicians at busy referral centres such as KNH must frequently decide, often with limited radiological and critical-care resources, which patients are suitable candidates for a trial of nonoperative treatment. Identifying the clinicopathological characteristics that accompany failure would allow such decisions to be guided by locally generated evidence rather than extrapolation from higher-resource settings.

Several demographic, clinical, injury-related and radiological characteristics have been proposed as predictors of NOM failure, including advanced age, haemodynamic instability, high-grade solid-organ injury, hemoperitoneum and transfusion requirement (Zenaidi et al., 2020; Bhangu et al., 2012; Leppäniemi, 2019). However, data describing which clinicopathological characteristics are associated with failure of NOM in Kenyan and other African trauma settings remain scarce. This study, therefore, sought to identify the clinicopathological characteristics associated with failed NOM among patients with BAT managed at KNH.

II. LITERATURE REVIEW

A. Blunt Abdominal Trauma and Nonoperative Management

Blunt abdominal trauma follows a direct blow, sudden deceleration or compressive force to the abdomen, and diagnosis rests on a combination of history, examination and imaging findings. Road traffic accidents are the leading cause worldwide, followed by falls, assaults and recreational injuries (Choi et al., 2022). Three mechanisms underlie the pathophysiology of BAT: deceleration, which generates shear forces at fixed visceral attachments; crush injury of solid organs between the vertebral column and the anterior abdominal wall; and external compression, which raises intra-abdominal pressure (Slotta et al., 2014). NOM, comprising close observation with or without adjunctive endovascular or percutaneous intervention, is now the preferred approach for haemodynamically stable patients without peritonitis, provided a surgical team, intensive-care and transfusion services, and at least 48 hours of monitoring are available (Cimbanassi et al., 2018). Reported success rates exceed 90% for blunt hepatic and splenic injury and 80% for renal trauma (Cimbanassi et al., 2018; Anderson et al., 2021).

Approximately 80% of patients with abdominal injuries have a blunt mechanism, and nearly half of trauma patients present with polytrauma, reflecting the high-energy nature of the causative mechanisms (Choi et al., 2022). The spleen and liver are the most frequently injured solid organs and generally respond well to NOM, whereas hollow-viscus injury, although comparatively uncommon, is disproportionately associated with failure of nonoperative treatment (Wadhwa et al., 2021).

B. Clinicopathological Predictors of Failure of Nonoperative Management

Table 1 summarises characteristics that previous studies have associated with failure of NOM. Zenaidi et al. (2020) identified age above 55 years, systolic blood pressure below 100 mmHg, shock on admission, transfusion of more than three units, pancreatic injury and hollow-organ injury as predictors, with a 13.5% failure rate. Bhangu et al. (2012) reported that grade 4–5 solid-organ injury, moderate-to-large hemoperitoneum, rising injury-severity score and age above 55 years predicted failure, with mortality and length of stay both higher among failures. Raza et al. (2013) linked failure to a low frequency of monitoring, transfusion of more than three units, a rising white-cell count and delayed evidence of hollow-viscus perforation, while Velmahos, Toutouzas, and Radin (2003) associated a positive FAST examination and a free-fluid volume exceeding 300 ml on computed tomography with failure.

Table 1: *Previously Reported Predictors of Failure of Nonoperative Management of Blunt Abdominal Trauma*

Study	Predictors of Failure	Failure Rate
Zenaidi et al. (2020)	Age >55 yrs; SBP <100 mmHg; shock on admission; transfusion >3 units/24h; pancreatic injury; hollow-organ injury	13.5%
Bhangu et al. (2012)	Grade 4–5 injury; moderate/large hemoperitoneum; rising ISS; age >55 yrs	12.0%
Raza et al. (2013)	Low monitoring frequency; transfusion >3 units; rising WBC; delayed hollow-viscus perforation	10.1%
Leppäniemi (2019)	Missed bowel injury; continuous bleeding; shock on admission; high-grade splenic injury; inappropriate CT grading	—
Velmahos et al. (2003)	Delayed hemorrhage; hollow-viscus injury; positive FAST; free fluid >300 ml on CT	22.0%

Giannopoulos, Katsoulis, Tzanakis, Patsaouras, and Digalakis (2009) found that extra-abdominal injury, abnormal computed-tomography findings and a high injury-severity score, rather than liver-injury grade alone, predicted failure of hepatic NOM, and Fransvea et al. (2019) reported that injury severity, hemoperitoneum extent, active bleeding on admission computed tomography, patient age and multiple solid-organ injury predicted failure of splenic NOM. Age has since been confirmed as an independent predictor of NOM failure across organ systems (Coccolini et al., 2022).

III. METHODOLOGY

A. Study Design, Site and Duration

This was a retrospective cohort study conducted at Kenyatta National Hospital (KNH), a 1,800-bed national referral and teaching hospital in Nairobi, Kenya. The study reviewed the records of patients managed nonoperatively for BAT over the seven years between June 2017 and June 2024.

B. Study Population and Sample Size

The study population comprised adult patients (above 13 years) with BAT who received NOM at KNH during the study period; patients with missing or incomplete records were excluded. The sample size was calculated using the method of Kelsey and Sowers (2001), applying a failure proportion of 13.5% (Zenaidi et al., 2020), a 95% confidence level, 90% power and a failure-to-success ratio of 1:3, yielding 47 patients with failed NOM and 141 with successful NOM, for a total sample of 188. Eligible files were identified from hospital records, and every fifth file was selected systematically, with consecutive sampling used to complete the sample where necessary.

C. Variables and Data Collection

Demographic (age, sex), clinical (haemodynamic status, Glasgow Coma Scale score, comorbidities), injury-related (mechanism, associated extra-abdominal injury, injured organ) and radiological (ultrasonographic findings, hemoperitoneum) characteristics were extracted from admission, inpatient and theatre records using a structured data-collection tool informed by the literature reviewed above. Failure of NOM, defined as the need for surgical intervention after an initial trial of nonoperative treatment, was the outcome against which characteristics were assessed.

D. Data Analysis

Data were analysed in SPSS version 27.0 (IBM Corp., NY, USA). Categorical variables were summarised as frequencies and percentages, and continuous variables as means or medians. Multiple linear regression was used to identify the clinicopathological characteristics independently associated with failure of NOM, with a p-value of 0.05 or less considered statistically significant. Ordinal characteristics were modelled using their category codes, and categorical characteristics were entered as indicator variables

against a defined reference category, as shown in Table 3; the overall model was assessed for statistical significance before individual coefficients were interpreted.

E. Ethical Considerations

Approval was obtained from the University of Nairobi and the KNH Ethics and Research Committee (P649/08/2024), permitting a waiver of individual consent for the review of archived records. Each file was assigned a unique identifier, and all data were held in a password-protected database accessible only to the principal investigator.

F. Quality Assurance

Data were collected by trained research assistants using a piloted, structured data-collection tool developed from the variables identified in the literature review, and a sample of extracted forms was cross-checked against source records for accuracy before analysis.

IV. RESULTS

A. Clinicopathological Characteristics of Study Participants

Table 2 summarises the characteristics of the 188 study participants. Most patients were male (87.0%) and aged between 19 and 39 years (74.9% of patients: 45.7% aged 19–29 years and 29.3% aged 30–39 years). Road traffic accidents accounted for 79.8% of injuries, and 81.4% of patients had an associated extra-abdominal injury. The liver (50.5%) and spleen (35.1%) were the most frequently injured organs. On admission, 30.9% of patients were hypotensive (systolic blood pressure below 100 mmHg) and 43.1% were tachycardic; 51.1% required at least one unit of blood transfusion. A Glasgow Coma Scale score of 15 was recorded in 63.3% of patients, while 12.8% presented with a score of 12 or less. Comorbidities were uncommon, present in only 2.1% of patients. Abdominal ultrasonography was positive in 86.2% of patients, and hemoperitoneum was present in 51.6%, most commonly of medium size (31.9%).

Table 2: *Clinicopathological Characteristics of Study Participants (N = 188)*

Variable	Category	n	%
Age (years)	≤18	12	6.4
	19–29	86	45.7
	30–39	55	29.3
	40–49	25	13.3
	≥50	10	5.3
Sex	Male	164	87.0
	Female	24	13.0
SBP <100 mmHg	Yes	58	30.9
Pulse >100 bpm	Yes	81	43.1
Transfusion required	Yes	96	51.1
GCS score	15	119	63.3
	13–14	42	22.3
	≤12	24	12.8
Comorbidity present	Yes	4	2.1
Injury mechanism	RTA	150	79.8
	Fall	21	11.2
	Assault	15	8.0
	Sports	2	1.1
Extra-abdominal injury	Yes	153	81.4
Injured organ*	Liver	95	50.5
	Spleen	66	35.1
	Other	41	21.8
Ultrasonography	Positive	162	86.2
Hemoperitoneum	Present	97	51.6
Size	Medium	60	31.9
	Small	23	12.2
	Large	11	5.9

Note. SBP = systolic blood pressure; GCS = Glasgow Coma Scale; RTA = road traffic accident. *Injured-organ percentages sum to more than 100% owing to multi-organ injury in some patients.

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B. Characteristics Associated with Failure of Nonoperative Management

Table 3 presents the multiple linear regression output. Among socio-demographic characteristics, age was significantly associated with failure of NOM (B = 0.105, t = 2.87, p = 0.004), with risk increasing incrementally across older age categories, whereas sex was not significant (p = 0.486). Clinical characteristics significantly associated with failure included the requirement for blood transfusion (B = 0.952, t = 2.45, p = 0.016), a lower Glasgow Coma Scale score (B = 1.752, t = 2.13, p = 0.036), and the presence of comorbidities (B = 3.205, t = 2.85, p = 0.006). Among injury-related characteristics, mechanism of injury was a significant predictor (B = 2.984, t = 2.21, p = 0.031), while an associated extra-abdominal injury approached but did not reach significance (p = 0.058), and the specific organ injured was not significant (p = 0.916). Radiological characteristics were the strongest predictors identified: quantifiable abdominal ultrasonographic findings (B = 0.00005, t = 3.98, p < .001), the presence of hemoperitoneum (B = 1.476, t = 2.03, p = 0.045) and, particularly, the size of hemoperitoneum (B = 2.241, t = 2.76, p = 0.007) were all significantly associated with failure, with large-volume hemoperitoneum carrying the highest risk.

Table 3: *Clinicopathological Characteristics Associated with Failure of Nonoperative Management (Multiple Linear Regression, N = 188)*

Characteristic	B	t-value	p-value
Age	0.105	2.87	0.004*
Sex	−1.213	−0.70	0.486
Blood transfusion	0.952	2.45	0.016*
Glasgow Coma Scale score	1.752	2.13	0.036*
Comorbidities	3.205	2.85	0.006*
Injury mechanism	2.984	2.21	0.031*
Extra-abdominal injury	0.843	1.92	0.058
Injured organ	0.126	0.11	0.916
Ultrasonographic findings	0.00005	3.98	<.001*
Presence of hemoperitoneum	1.476	2.03	0.045*
Size of hemoperitoneum	2.241	2.76	0.007*
Constant	25.439	3.67	<.001

Note. Reference categories: age ≤18 years, male sex, no transfusion, GCS 15, no comorbidities, road traffic accident, no extra-abdominal injury, spleen injury, negative ultrasonography, no hemoperitoneum. *Significant at α = 0.05. Source: Osama (2025).

V. DISCUSSION

The male predominance observed in this cohort (87.0%) is consistent with reports from Europe, where 70% of abdominal-injury patients were male and more than 91% of injuries were attributable to blunt force (Larsen et al., 2022; Choi et al., 2022), and with the 3.7:1 male-to-female ratio reported by Mehta, Babu, and Venugopal (2014). This pattern likely reflects the greater use of motorised transport, including motorcycle taxis, among men in urban Kenyan settings, consistent with the predominance of road-traffic mechanisms (79.8%) in this study. Despite this demographic skew, sex was not a significant characteristic associated with NOM failure, in keeping with the broader literature, in which trauma-outcome differences by sex are inconsistent (Hildebrand et al., 2021).

Most patients in this cohort were aged between 19 and 39 years, mirroring the peak incidence of BAT at 14 to 30 years reported by Larsen et al. (2022). Age nonetheless emerged as a significant, incrementally graded predictor of NOM failure, corroborating findings from Zenaidi et al. (2020) and Bhangu et al. (2012), who identified age above 55 years as predictive of failure, and more recent evidence confirming age as an independent predictor across organ systems (Coccolini et al., 2022). This age-related vulnerability is thought to reflect diminished physiological reserve and impaired capacity to compensate for ongoing haemorrhage in older trauma patients (Perkins et al., 2020).

Clinical characteristics reflecting the severity of physiological derangement at presentation, namely transfusion requirement, a reduced Glasgow Coma Scale score and the presence of comorbidities, were all significantly associated with failure, consistent with earlier work (Raza et al., 2013; Zenaidi et al., 2020; Leppäniemi, 2019; Zago et al., 2023). Even though comorbidities were present in only a small proportion of this predominantly young cohort, their presence substantially increased the odds of failure, echoing evidence that pre-existing disease compounds the physiological impact of acute trauma (Matsushima et al., 2020). These findings support the assessment of overall clinical status, and not the abdominal injury in isolation, when selecting patients for nonoperative treatment.

Mechanism of injury was also significantly associated with failure, underscoring the relevance of injury kinematics and energy transfer to the likelihood of occult or evolving intra-abdominal injury (Renson et al., 2022). Among radiological characteristics, both the presence and the size of hemoperitoneum, together with quantifiable ultrasonographic findings, were strongly associated with failure, echoing the findings of Zenaidi et al. (2020) and Bhangu et al. (2012), who similarly implicated hemoperitoneum volume as an early marker of ongoing bleeding. Kozar et al. (2022) and Letoublon et al. (2023) have likewise shown that structured use of ultrasonography and computed tomography, particularly measurement of hemoperitoneum extent, improves the prediction of NOM outcome and should therefore be central to risk stratification at initial assessment and during subsequent monitoring.

From a practice perspective, these findings suggest that a simple bedside risk-stratification approach combining age, transfusion requirement, Glasgow Coma Scale score, comorbidity status, injury mechanism and hemoperitoneum findings on admission imaging could help clinicians identify patients at greatest risk of NOM failure before clinical deterioration occurs. Such an approach would be particularly valuable in resource-constrained settings such as KNH, where capacity for continuous intensive-care monitoring is limited, allowing scarce critical-care resources to be directed toward the patients most likely to require them.

This study is, to our knowledge, among the first from a Kenyan tertiary referral centre to examine clinicopathological characteristics associated with failure of NOM using multivariable analysis, drawing on an unselected cohort spanning seven years. Its limitations include reliance on the completeness and accuracy of archived clinical records, exclusion of patients with incomplete documentation, which may have introduced selection bias, and the absence of formal injury-severity scoring and organ-injury grading as candidate characteristics, both of which have been shown elsewhere to refine prediction of NOM failure (Bhangu et al., 2012; Giannopoulos et al., 2009). Prospective studies incorporating standardised injury grading and severity scoring are needed to validate and extend these findings.

VI. CONCLUSION

This study identified advanced age, blood transfusion requirement, a reduced Glasgow Coma Scale score, the presence of comorbidities, mechanism of injury, and the presence and size of hemoperitoneum on imaging as the clinicopathological characteristics significantly associated with failure of nonoperative management among patients with blunt abdominal trauma at Kenyatta National Hospital. Sex and the specific organ injured were not significant characteristics in this cohort. These findings support the incorporation of age, transfusion requirement, neurological status, comorbidity burden, injury mechanism and hemoperitoneum findings into a structured risk-stratification approach to guide patient selection and monitoring intensity for nonoperative management of blunt abdominal trauma in similar resource-limited settings.

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