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Preoperative mortality risk evaluation in abdominal surgical emergencies: development and internal validation of the NDAR score from a national multicenter audit in Senegal

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Abstract

Introduction Abdominal surgical emergencies have a high mortality rate. Effective management primarily relies on the early identification of patients at high risk of postoperative complications. The objective of our study was to determine the prognostic factors associated with poor outcomes from abdominal surgical emergencies in Senegal and to establish a predictive score for mortality for preoperative risk evaluation (NDAR (New Death Assessment Risk) score).

Methodology This was a retrospective national cross-sectional study conducted over one year in 14 regions of Senegal. Adult patients (aged > 15 years) who presented with a traumatic or non-traumatic abdominal surgical emergency were included. The studied variables included clinical and paraclinical data. The variable of interest was death

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within 30 days of the surgery. Logistic regression was used to identify the factors independently associated with mortality. Risk factors identified after logistic regression analysis were weighted using odds ratio (OR) values rounded to the nearest whole number. The predictive capacity of the score was evaluated by analyzing the ROC (Receiver Operating Characteristic) curve based on the area under the curve (AUC).

Results A total of 1114 patient records were included, with a mortality rate of 4.4%. Diagnoses were observed in patients included appendicitis in 39.8% of cases ($n=444$), followed by peritonitis in 22.3% ($n=249$), intestinal obstruction in 18.5% ($n=205$), strangulated hernias in 10.5% ($n=117$), and abdominal trauma in 6.1%. Logistic regression, established the following scores: age > 40 years (score 2), ASA status grade 2 or higher (score 1), presence of a positive QSIRS score (score 2), diagnosis of peritonitis (score 2), diagnosis of intestinal obstruction (score 1), and the presence of intestinal necrosis (score 3). The score is positive if the total is strictly greater than 5, indicating a 17.7% risk of mortality. This score had a high predictive capacity with an AUC of 0.7397.

Conclusion This study enabled the establishment of a score that allows for the early identification of at-risk patients, even in constrained resource settings, facilitating appropriate perioperative management and timely surgical intervention to reduce the risk of complications. This approach, focused on early recognition of high-risk patients, is crucial for improving clinical outcomes in abdominal surgical emergencies.

Keywords Emergency, Abdomen, Africa, Mortality, Surgery, Score

Introduction

Abdominal surgical emergencies comprise a set of pathologies requiring urgent surgical intervention to minimize morbidity and mortality risks. The overall mortality rate is estimated to be 5 to 7%, but can reach 20% in the elderly [1–3]. Furthermore, this mortality rate is higher in low-income countries, where there is less than one operating room per 100,000 inhabitants [4]. Effective management primarily relies on the early identification of patients at high risk of postoperative complications. This process requires studies to evaluate and identify prognostic factors, as well as to develop scoring systems for classifying patients [5]. This allows for optimal preoperative preparation, efficient anesthetic and surgical intervention, and close postoperative monitoring. These prognostic factors are generally patient-specific factors, including comorbidities and acute physiological disturbances [6]. Several studies have documented these factors, ranging from complex scales such as POSSUM (Physiological and Operating Severity Scale for Mortality and Morbidity) to simpler evaluations such as the ASA (American Society of Anesthesiologists) score [7]. However, the literature on prognostic scores on abdominal surgical emergencies in resource-limited settings remains scarce. Besides, most existing scores, such as SOFA and POSSUM, require certain complementary examinations, which are not always available, making their use difficult in resource-limited countries [8, 9]. The objective of our study was to determine the prognostic factors associated with poor outcomes from abdominal surgical emergencies in Senegal. A predictive score was developed to estimate the 30-day mortality risk of abdominal surgical emergencies using the risk factors identified after multivariate analysis (NDAR (New Death Assessment Risk) score).

Methodology

This study follows the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational studies in epidemiology [10].

Type of study

This was a retrospective cross-sectional study. The study period extended over one year, from August 1, 2022, to July 31, 2023.

Study setting

The study was conducted in 14 regions of Senegal, a West African country, with an estimated population of 18,032,473 in 2023, corresponding to a density of 92 inhabitants per square kilometer. The population was predominantly male (50.6%) [11]. Most of the population is concentrated in urban areas, with Dakar being the most populous city, representing 21.6% of the total population [12]. The Senegalese health system has three tiered pyramidal structures: central, intermediate, and peripheral. The health system in Senegal comprises 56 district health units [13]. According to the National Agency for Statistics and Demography in 2019, there were 40 public health facilities [14].

Population and sampling

This study included all patients treated for abdominal surgical emergencies in public health facilities in Senegal. However, private structures were not included in this study. The list of health facilities and services held by the Directorate of Public Health Facilities of the Ministry of Health and Social Action of Senegal was used in this study. No sampling was performed, as this was an exhaustive one-year study. All available hospitals and services were contacted. As this study was unfunded and depended on voluntary participation, not all the hospitals participated.

Inclusion criteria

Adult patients (> 15 years of age) with traumatic or non-traumatic abdominal surgical emergencies were included. In our country's practice, all patients under 15 years old are managed in the pediatric surgery departments [15]. An abdominal surgical emergency was defined as "any condition that may require emergency laparotomy, usually of digestive origin, excluding vascular, urological, and gynecological-obstetric causes". Examples include intestinal obstruction, acute generalized peritonitis, acute appendicitis, and abdominal trauma. Patients with incomplete records were not included. Patients with abdominal emergencies of gynaecological, vascular, or urological origin were excluded.

Data collection

Data were collected from patient records using an online survey form using Ona.io which is a cloud-based data collection and analysis platform built on the Open Data Kit (ODK) framework [16]. The collection form was filled by medical doctor in different hospitals and is accessible in the Supplementary File.

Studied variables

The studied variables included clinical and biological data such as age, sex, consultation delay, medical history, ASA score, vital signs measured upon patient admission (blood pressure, temperature, heart rate, respiratory rate, and state of consciousness), hemoglobin level, hematocrit, white blood cell count, creatinine, potassium, sodium, chloride levels, presence of intestinal necrosis on imaging or intraoperatively, diagnosis, duration of the surgical intervention, and length of hospital stay (in days). Bloodwork was also performed upon patient admission. The QSIRS (Quick Systemic Inflammatory Response Syndrome) score, which combines the Systemic Inflammatory Response Syndrome (SIRS) and quick Sequential Organ Failure Assessment (qSOFA) scores, was evaluated. The QSIRS score was considered positive in the presence of at least two of the following criteria: systolic blood pressure ≤ 100 mmHg, respiratory rate ≥ 20 breaths/min, Glasgow score ≤ 14, temperature > 38.3 °C or < 36 °C, heart rate > 90 beats/min, respiratory rate > 20 breaths/min, and white blood cell (WBC) count > 12,000/mm3 or < 4,000/mm3 [17]. Complications were assessed according to the Dindo-Clavien classification [18]. This classification is a standardized system used to categorize postoperative complications based on their severity, ranging from minor deviations requiring no intervention (Grade I) to death (Grade V). It helps objectively evaluate and compare patient outcomes [18].

Variable of interest

The primary outcome of the study was the 30-day post-operative mortality. In-hospital deaths were determined from discharge records.

Statistical analysis

Qualitative variables were described as numbers and percentages, and quantitative variables were described as means with standard deviations and extremes. Bivariate analyses were performed using the outcome variable (30-day post-operative mortality). For qualitative variables, Pearson's chi-square or Fisher's test was used. For normally distributed quantitative variables, Student's t-test or Mann-Whitney test was used. Differences were considered statistically significant at $p < 0.05$. Variables associated with death in our study population were selected using bivariate analysis (prognostic factors). The parameters included in the multivariate logistic regression were those with $p < 0.20$ in the bivariate analysis in order to ensure that potentially important variables are not prematurely excluded from the model [19]. Patients with missing data were excluded from analysis. A backward stepwise method using Wald's p was used. The consistency of the logistic regression model was assessed using the goodness-of-fit test (Hosmer-Lemeshow) [19]. A p-value < 0.05 indicates poor consistency of the predictive score model, while a p-value > 0.05 indicates good consistency. All analyses were performed using the RStudio software version 2024.04.0 [20].

Development of the predictive score

A 30-day mortality predictive score was developed to facilitate clinical application. The risk factors identified after logistic regression were weighted using odds ratio (OR) values for mortality, rounded to the nearest whole number [21]. For simplicity, 1 was subtracted from each variable because all the variable weights were at least 2. To optimize the clinical utility of the mortality predictive score, we prioritized sensitivity, which measures the model's ability to correctly identify patients at real risk of death (true positives). Sensitivity is crucial in this context because a lack of sensitivity would result in a high number of false negatives (deaths incorrectly identified as not at risk), potentially leading to severe consequences in clinical management. Indeed, false negatives could delay or deprive some patients of adequate treatment, thereby compromising clinical outcomes. By setting a score threshold that maximizes sensitivity, we ensured that the majority of high-risk patients were correctly identified, enabling early and targeted interventions to improve clinical outcomes. After achieving this score, an application allowing ease of use in the clinic was developed using the Shiny R package [22].

Evaluation of predictive performance

The capacity of the predictive score model was evaluated by analyzing the ROC (Receiver Operating Characteristic) curve.

The ROC curve was used to evaluate the model's capacity by taking into account sensitivity and specificity across different thresholds, and by analyzing the area under the curve. The area under the curve was used as a summary measure of the model's overall discriminatory ability, with values closer to 1 indicating better performance [23]. Predictive capacity was classified based on the area under the curve (AUC): AUC $\leq$ 0.5 indicates no predictive value; 0.5 $\leq$ AUC < 0.7 indicates moderate predictive capacity; 0.7 $\leq$ AUC < 0.9 indicates high predictive capacity; and AUC $\geq$ 0.9 indicates very high predictive capacity [24].

Ethical considerations

This study was approved by the local hospital administrative committee under the number 000299/23/04/2023.

Results

Of the 40 solicited hospitals, 17 participated in 13 out of the 14 regions (Fig. 1). A total of 1,350 patients were recruited, of whom 141 were excluded for not meeting the inclusion criteria, as detailed in Fig. 1. Finally, 1209 patients were considered eligible, of whom 95 were lost to follow-up with no mortality information (loss to follow-up rate, 7.8%). Thus, 1114 patients were successfully followed-up. Figure 2 illustrates the flow diagram in accordance with the STROBE recommendations.

Cohort description

The mean patient age was 37 years, with a standard deviation of 18. Besides, 62.7% (n = 699) of the patients were under 40 years of age. The QSIRS score, which accounts for vital signs and white blood cell counts, was positive in 64.1% of cases (n = 711). Diabetes was present in 3.3% of the patients (n = 63) and hypertension in 5.5% (n = 63). The ASA score was grade 1 in 85.2% of the patients (n = 950). Intestinal necrosis was observed in 3.3% of the cases. The most frequently diagnosed condition was appendicitis 39.8% of cases (n = 444), followed by peritonitis (22.3% (n = 249)), intestinal obstruction (18.5% (n = 205)), strangulated hernias (10.5% (n = 117)), and abdominal trauma (6.1% (n = 68)). Detailed patient characteristics are presented in Table 1. The mortality rate was 4.4% (n = 49). Complications according to the Clavien-Dindo classification were observed in 11.6% (n = 130) of the patients with Grade I (n = 42, 3.8%); Grade II (n = 7, 0.6%); Grade IIIa (n = 6, 0.5%); Grade IIIb (n = 13, 1.2%); Grade IVa (n = 9, 0.8%); Grade IVb (n = 4, 0.4%); Grade V (death, n = 49, 4.4%).

Logistic regression

In our multivariate analysis, the following factors were identified as independent risk factors associated with

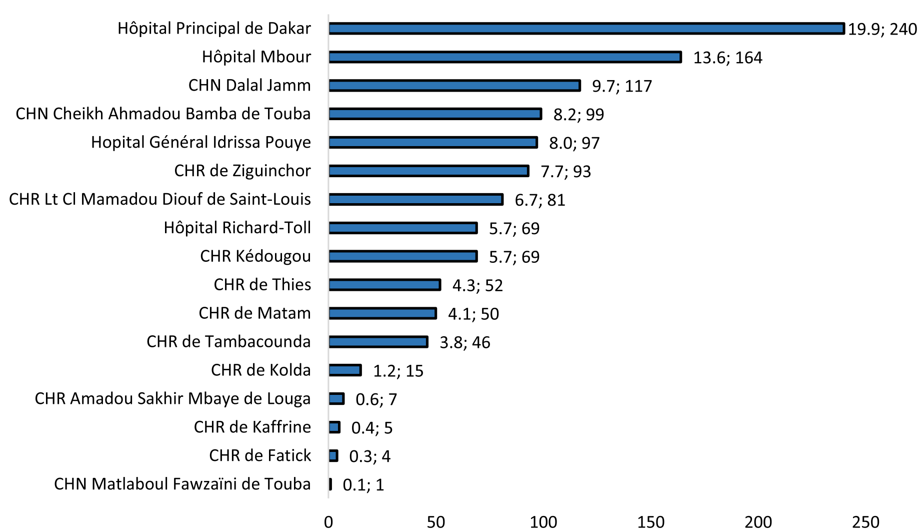

Fig. 1 Distribution of patients by Hospital (n = 1209)

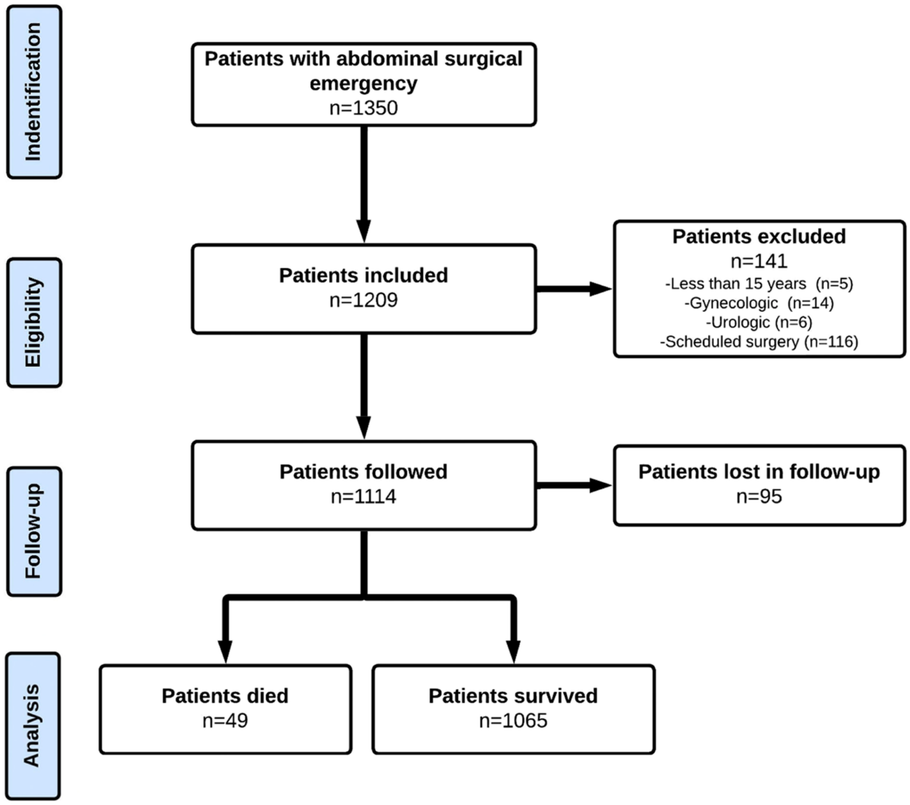

Fig. 2 Flowchart of patients inclusion using STROBE guidelines

30-day mortality in patients with abdominal surgical emergencies: Age over 40 years ($p=0.012$, OR = 2.92 [95% CI: 1.53–5.74]); ASA grade 2 or higher ($p=0.070$, OR = 1.87 [95% CI: 0.93–3.63]); Positive QSIRS score ($p=0.016$, OR = 2.51 [95% CI: 1.23–5.66]); Diagnosis of peritonitis ($p=0.004$, OR = 2.90 [95% CI: 1.41–6.01]); Diagnosis of intestinal obstruction ($p=0.047$, OR = 2.16 [95% CI: 1.00–4.65]); The presence of intestinal necrosis ($p=0.004$, odds ratio [OR] = 4.37 [95% CI: 1.53–11.3]). The Hosmer–Lemeshow test indicated good calibration of the logistic regression model ($p=0.780$).

Development of the predictive score

Considering the ORs from the logistic regression model, the following score with a total of 11 was established: Age over 40 years (score 2); ASA grade 2 or higher (score 1); Positive QSIRS score (score 2); Diagnosis of peritonitis (score 2); Diagnosis of intestinal obstruction (score 1); Presence of intestinal necrosis (score 3).

ROC curve analysis yielded an AUC of 0.7397 with a 95% confidence interval [0.6642–0.8152], indicating a high predictive capacity for the occurrence of deaths (Fig. 3).

By analyzing the coordinates of the ROC curve and prioritizing sensitivity, a threshold of 5 was selected. This allowed for a final score of two classes, as described in Table 2. The chi-square test between the score and postoperative mortality showed a mortality rate of 17.7% when the score was positive (greater than or equal to 6), and a mortality rate of 2.5% when the score was negative (less than or equal to 5).

To facilitate clinical use, an application developed with the Shiny R package deployed on Shinnyapp is available at NDAR_online_app.

Discussion

Predicting the mortality risk in surgical patients is crucial for perioperative management. This information enables the identification of high-risk patients and provision of appropriate care, thereby reducing mortality and postoperative complications. It is well established that mortality risk is associated with a patient's general condition, diagnosis, and presence of sepsis.

However, most assessment tools incorporate biological parameters or other complementary examinations, which are not always widely available in resource-limited countries. For example, the SOFA score includes blood gases and serum bilirubin, whereas the POSSUM score incorporates elements such as electrolytes and electrocardiograms [8, 9]. The existing scores

Table 1 Patient characteristics and bivariate analysis of factors associated with death

Variable	*N* (%) /mean ± standard deviation)			*p*-value (bold* means < 0.05)
	Total	**Survived**	**Died**	
	1114 (100)	**1065 (95.6)**	**49 (4,4)**	
Age (years)	37 ± 18	36 ± 18	48 ± 20	**< 0.001***
Age class				**< 0.001***
≤40 years	699 (62.7)	683 (64.1)	16 (32.6)	
>40 years	415 (37.3)	382 (35.9)	33 (67.4)	
Sex				
Female	346 (31)	331 ± 31	15 ± 30.6	> 0.9
Male	768 (69)	734 ± 69	34 ± 69.4	
Systolic blood pressure (mmHg)	122 ± 19.5	122 ± 19	123 ± 23	0.8
Diastolic blood pressure (mmHg)	75 ± 17.2	75 ± 17	79 ± 18	0.10
Temperature (°C)	37.2 ± 3.2	37.2 ± 3.2	37.1 ± 0.7	0.5
Heart rate (pulsations/minute)	91 ± 19.1	91 ± 19	100 ± 22	**0.002***
Respiratory rate (cycles/minute)	23.6 ± 13.6	23.6 ± 13.9	24.7 ± 6.5	0.061
Glasgow				**0.001***
Normal (15)	1070 (96)	1027 (96.4)	43 (87.7)	
Abnormal (⩽14)	44 (4)	38 (3.6)	6 (12.3)	
QSIRS				**0.008***
Negative	403 (35.9)	394 (36.9)	9 (18.3)	
Positive	711 (64.1)	671 (63.1)	40 (81.7)	
Diabetes				
No	1078 (96.7)	1037 (97.3)	41 (83.6)	**0.002***
Yes	36 (3.3)	28 (2.7)	8 (16.4)	
Hypertension				
No	1051 (94.3)	1009 (94.7)	42 (85.7)	0.2
Yes	63 (5.7)	56 (5.3)	7 (14.3)	
Sickle cell disease				
No	1103 (99)	1056 (99.1)	47 (95.9)	> 0.9
Yes	11 (1)	9 (0.1)	2 (4.1)	
Asthma				
No	1092 (98)	1046 (98.2)	46 (93.8)	0.6
Yes	22 (2)	19 (1.8)	5 (6.2)	
ASA score				**< 0.001***
ASA 1	950 (85.2)	917 (86.1)	33 (67.3)	
ASA 2,3 or 4	164 (14.8)	148 (13.9)	16 (32.7)	
Hemoglobin level (g/dL)	12.6 (4.2)	12.73 (4.42)	11.30 (2.66)	**0.004***
Hematocrit (%)	36.8 ± 7.4	37 ± (7)	34 ± (8)	**0.039***
White blood cells (elements/mm3)	11,584 ± 7845	11,512 ± 7883	13,329 ± 6712	**0.0021 ***
Natremia (mmol/L)	136.5 ± 5.8	136.6 ± 5.7	134.3 ± 6.3	0.2
Serum potassium (mmol/L)	4.0 ± 4.4	4.06 ± 4.5	3.8 ± 0.72	0.4
Serum creatinine (mg/L)	11.4 ± 6	11.3 ± 5.7	14.0 ± 9.6	0.10
Diagnostic				**0.034***
Appendicitis	444 (39.8)	441 (41.4)	3 (6.1)	
Peritonitis	249 (22.3)	232 (21.7)	17 (34.7)	
Bowel obstruction	205 (18.5)	189 (17.8)	16 (32.6)	
Strangulated hernias	117 (10.5)	111 (10.4)	6 (12.3)	
Abdominal trauma	68 (6.1)	64 (6.1)	4 (8.2)	
Others	31 (2.8)	28 (2.6)	3 (6.1)	

Table 1 (continued)

Variable	*N* (%) /mean ± standard deviation) Total 1114 (100)	Survived 1065 (95.6)	Died 49 (4,4)	*p*-value (bold* means < 0.05)
Intestinal necrosis				
No	1077 (96.7)	1035 (97.2)	42 (85.7)	**< 0.001***
Yes	37 (3.3)	30 (2.8)	7 (14.3)	
Surgery waiting time (hours)	23.7 ± 74.2	27 ± 75	35 ± 3	**0.017***
Operating time (minutes)	64.7 ± 29.7	64 ± 29	87 ± 43	**0.034***
Length of hospitalization (days)	7.1 ± 7.5	6.9 ± 11.7	8.7 ± 14.2	0.5

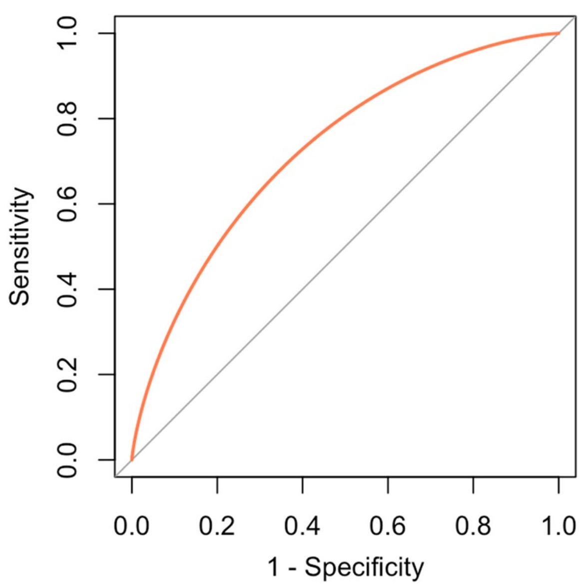

Fig. 3 ROC curve of the NDAR score with an area under the curve of 0.7397(0.6642–0.8152)

Table 2 Classification into two risk levels of the score predicting death in abdominal surgical emergencies

Total score = 11	Score value	Mortality (%)
• Age over 40 = 2 • ASA grade 2 or more = 1 ; • Positive QSIRS = 2 • Diagnosis of peritonitis = 2 • Diagnosis of intestinal obstruction = 1 • Existence of intestinal necrosis = 3	0–5 = Negative 6–11 = Positive	2.5% 17.7%

adapted for easy use in resource-limited settings, such as qSOFA, SIRS, and QSIRS, only consider vital signs and hemogram results, thereby neglecting the patient's general condition, diagnosis, and age, which are important factors in the occurrence of complications and preoperative assessment [17, 25].

The NDAR score proposed in this study addresses these gaps by integrating all these elements. It allows for the evaluation of severity and mortality risk from the patient's admission, facilitating early and appropriate resuscitation measures and close postoperative monitoring. Moreover, it includes two elements that account for multiple criteria, illustrating its holistic approach to patient assessments. Indeed, the ASA score considers not only the existence of comorbidities but also their control and potential organ failure. The QSIRS, which is a score combining qSOFA and SIRS, includes vitals (systolic blood pressure, respiratory rate, heart rate, temperature, and Glasgow score) and hemogram results, including white blood cell count [17, 25]. Thus, this proposed score evaluates elements that are easily available to all patients and allows for rapid triage regardless of the resource context. It goes beyond previous scores designed for resource-limited contexts, such as the Surgical Apgar Score (SAS), which includes only three elements: the lowest heart rate, the lowest mean arterial pressure, and the estimated blood loss [26]. The ideal approach when designing a score would be to have a score with both clinical and readily available biological elements, without falling into the extremes of having too few variables—thereby reducing the predictive effectiveness of the score—or including variables that are not always available in emergency situations, which would limit the score's practical use.

In addition to patient age, the inclusion of preoperative diagnostic suspicion or intraoperative confirmation (diagnosis of peritonitis, obstruction, or intestinal necrosis) adds crucial information, as it has already been demonstrated that these diagnoses are strongly associated with complications in several studies [27, 28]. The inclusion of age as a weighted factor in the score is important. It makes the score applicable to all patients, regardless of their age. Previous scores, such as the Geriatric

Emergency Surgery Mortality (GEM) score, which uses five variables (Acute Kidney Injury, ASA Class, BMI, Charlson Score, and Serum Albumin), were developed but only usable for the elderly [21].

Another advantage is that this score was developed considering all abdominal emergencies without limiting it to a specific type of emergency, broadening its scope and relevance for generalized use. In developing countries where intensive care units are often saturated, this score could be a valuable tool for prioritizing the admission of high-risk surgical patients. This would optimize the use of limited resources and improve patient outcomes.

Strengths

A large number of cases from multiple hospital centers were included, allowing for a robust and representative analysis. The developed score integrates standard clinical and biological elements that are easily accessible and provide an effective preoperative risk assessment for surgical patients. Another strength is that the score was developed using data from a resource-constrained context. Most of the available scores were designed and developed for other practice contexts. Therefore, this score might better fit our context and facilitate effective implementation.

Limitations

The sample could not be divided into training and validation sets because of the low mortality rate (4.4%, $n=49$). Our score demonstrates good internal validity; however, further studies are needed to evaluate its external validity in different populations and surgical contexts.

Another limitation is the retrospective nature of the data collection, which may introduce inaccuracies and bias. Additionally, not all public health facilities participated, and private hospitals were excluded which may introduce bias due to a lack of diversity in patient recruitment in Senegal. Consequently, the results may have restricted generalizability. Prior research shows that approximately 40% of healthcare services in Africa, including Senegal, are provided by the private sector [29]. For a more thorough assessment, future investigations should include private healthcare institutions.

Conclusion

Our study resulted in the development of a score that allows for the early identification of at-risk patients, facilitating appropriate perioperative management, and timely surgical interventions to reduce the risk of complications. This approach, which focuses on the early recognition of high-risk patients, is crucial for improving the clinical outcomes in abdominal surgical emergencies. The NDAR score offers a simple and practical tool for predicting the mortality risk in surgical patients, particularly in resource-limited countries. Its potential use in risk stratification, prioritizing intensive care unit admissions, and improving patient outcomes warrants further exploration.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12893-024-02613-x.

Supplementary Material 1.

Supplementary Material 2.

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Clinical trial number

Not applicable.

Authors' contributions

Literature search: AN, ACD, LT, MF, PMF. Data collection: AN, ACD, LT, MF, PMF, AD, NS, AN, ACF, CTM, MSB, PDN, MD, MG, CTK, BMD, TF, FT, TATD, MG, NY, HK, EK, MT, ADD, AB, CS, CHB, CMJD, MAN, SMAF, MC, JIF, AKN, PSD, AN, DAD, OS, AD, YS, ISSS, MLG, MLD, PM, EGAPD, IS, OF, AS, JNT, OT, MS, CD, IK, AOT, BD, PAB, PSD, MC, KN, IK. Statistical analyses: AN, ACD. Online app development with R-shiny: ACD. Writing main manuscript text and prepared figures and tables: AN, ACD, LT. Correction the manuscript text, figures and tables: KN, IK.

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Data availability

Data supporting the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Institutional review board (IRB) Centre. Hospitalier Regional de Saint-Louis/ Université Gaston Berger (CHRSL/UGB) Number: 000299/23/04/2023. Consent to participate was waived due to retrospective nature.

Competing interests

The authors declare no competing interests.

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References

1. Ay N, Derbent A, Şahin AS, Yalçın N, Çelik M. Variables affecting mortality rates in patients undergoing emergency abdominal surgery: a retrospective cross-sectional study. Ulus Travma Acil Cerrahi Derg. 2023;29:505–13. https://doi.org/10.14744/tjtes.2022.01264.
2. Arenal JJ, Bengoechea-Beeby M. Mortality associated with emergency abdominal surgery in the elderly. Can J Surg. 2003;46:111.
3. Ndong A, Togtoga L, Bah MS, Ndoye PD, Niang K. Prevalence and mortality rate of abdominal surgical emergencies in Sub-saharan Africa: a systematic review and meta-analysis. BMC Surg. 2024;24:35. https://doi.org/10.1186/s12893-024-02319-0.
4. Stewart B, Khanduri P, McCord C, Ohene-Yeboah M, Uranues S, Vega Rivera F, et al. Global disease burden of conditions requiring emergency surgery. Br J Surg. 2014;101:e9–22. https://doi.org/10.1002/bjs.9329.
5. GlobalSurg C. Mortality of emergency abdominal surgery in high-, middle- and low-income countries: GlobalSurg Collaborative. Br J Surg. 2016;103:971–88. https://doi.org/10.1002/bjs.10151.
6. Havens JM, Peetz AB, Do WS, Cooper Z, Kelly E, Askari R, et al. The excess morbidity and mortality of emergency general surgery. J Trauma Acute Care Surg. 2015;78:306–11. https://doi.org/10.1097/TA.0000000000000517.
7. Matsuyama T, Iranami H, Fujii K, Inoue M, Nakagawa R, Kawashima K. Risk factors for postoperative mortality and morbidities in emergency surgeries. J Anesth. 2013;27:838–43.
8. Khwannimit B, Bhurayanontachai R, Vattanavanit V. Comparison of the performance of SOFA, qSOFA and SIRS for predicting mortality and organ failure among sepsis patients admitted to the intensive care unit in a middle-income country. J Crit Care. 2017;44:156–60. https://doi.org/10.1016/j.jcrc.2017.10.023
9. Copeland GP, Jones D, Walters M. POSSUM: a scoring system for surgical audit. Br J Surg. 2005;78:355–60. https://doi.org/10.1002/bjs.1800780327.
10. Vandenbroucke JP. Strengthening the reporting of Observational studies in Epidemiology (STROBE): explanation and elaboration. Ann Intern Med. 2007;147:W. https://doi.org/10.7326/0003-4819-147-8-200710160-00010-w1.
11. ANSD (Agence Nationale de la Statistique et de la Démographie), 2023. *Rapport préliminaire. Recensement général de la population et de l'habitat (rgph-5)*. Dakar : ANSD.
12. Banque mondiale. Au Sénégal, les priorités de la Banque mondiale sont les suivantes: croissance accélérée, création de richesses, développement humain, croissance partagée, synergies milieux rural et urbain. Statistiques pays Sénégal. https://donnees.banquemondiale.org/indicator/NY.GDP.PCAP.CD?locations=SN. Sénégal | Data https://donnees.banquemondiale.org/pays/senegal n.d
13. Ministère de la Santé et de l'Action Sociale (MSAS) Direction Générale de la Santé Plan National de Développement Sanitaire et Social (PNDSS) 2019–2028, Sénégal. (2019) n.d.
14. ANSD (Agence Nationale de la Statistique et de la Démographie), 2019. Situation économique et sociale du Sénégal en 2019. 2019.
15. Bickler S, Kyambi J, Rode H. Pediatric surgery in sub-saharan Africa. Pediatr Surg Int. 2001;17:442–7. https://doi.org/10.1007/s003830000516.
16. Hartung C, Lerer A, Anokwa Y, Tseng C, Brunette W, Borriello G. Open data kit: tools to build information services for developing regions. Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development, London United Kingdom: ACM; 2010, pp. 1–12. https://doi.org/10.1145/2369220.2369236
17. Ndong A, Diallo AC, Tendeng JN, Diallo AI, Diao ML, Sagna SA, et al. QSIRS can improve accuracy of QSOFA and SIRS in Prediction of Mortality in Surgical emergencies. Surg J. 2021;7:e199–202.
18. Dindo D, Demartines N, Clavien P-A. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004;240:205.
19. Hosmer DW Jr, Lemeshow S, Sturdivant RX. Applied logistic regression. Volume 398. Wiley; 2013.
20. Racine JS. RStudio: a platform-independent IDE for R and Sweave. 2012.
21. Olufajo OA, Reznor G, Lipsitz SR, Cooper ZR, Haider AH, Salim A, et al. Preoperative assessment of surgical risk: creation of a scoring tool to estimate 1-year mortality after emergency abdominal surgery in the elderly patient. Am J Surg. 2017;213:771–e7771. https://doi.org/10.1016/j.amjsurg.2016.08.007.
22. Chang W, Cheng J, Allaire J, Xie Y, McPherson J. Package 'shiny', See. Http://Citeseerx Ist Psu Edu/Viewdoc/Download 2015.
23. Bola R, Ujoh F, Ukah UV, Lett R. Assessment and validation of the community maternal Danger score algorithm. Global Health Res Policy. 2022;7:6. https://doi.org/10.1186/s41256-022-00240-8.
24. Xue G, Liang H, Ye J, Ji J, Chen J, Ji B, et al. Development and validation of a predictive scoring system for In-hospital death in patients with intra-abdominal infection: a single-center 10-Year retrospective study. Front Med (Lausanne). 2021;8:741914. https://doi.org/10.3389/fmed.2021.741914.
25. Green SL, Smith MTD, Cairns C, Clarke DL, Bruce J, Bekker W, et al. The combined SIRS + qSOFA (qSIRS) score is more accurate than qSOFA alone in Predicting Mortality in patients with Surgical Sepsis in an LMIC Emergency Department. World J Surg. 2020;44:21–9. https://doi.org/10.1007/s00268-019-05181-x.
26. Singh K, Hariharan S. Detecting major complications and death after emergency abdominal surgery using the Surgical Apgar score: a retrospective analysis in a caribbean setting. Turk J Anaesthesiol Reanim. 2019;47:128–33. https://doi.org/10.5152/TJAR.2019.65872.
27. Fukuda N, Wada J, Niki M, Sugiyama Y, Mushiake H. Factors predicting mortality in emergency abdominal surgery in the elderly. World J Emerg Surg. 2012;7:12. https://doi.org/10.1186/1749-7922-7-12.
28. Surek A, Gemici E, Ferahman S, Karli M, Bozkurt MA, Dural AC, et al. Emergency surgery of the abdominal wall hernias: risk factors that increase morbidity and mortality—a single-center experience. Hernia. 2021;25:679–88. https://doi.org/10.1007/s10029-020-02293-5.
29. Montagu D, Chakraborty N. Standard Survey Data: insights into private Sector utilization. Front Med. 2021;8. https://doi.org/10.3389/fmed.2021.624285.

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