International Journal of
Emergency Medicine

RESEARCH   **Open Access**

Impact of advanced trauma life support training on 30-day mortality in severely injured patients at a Kenyan tertiary center: a retrospective matched case-control study

Charbel Kamau[1], Idris Chikophe[2], Abdulkarim Abdallah[1] and Edwin Mogere[1*]

Abstract

Introduction Trauma is a leading cause of mortality worldwide, particularly in low and middle-income countries (LMICs) like Kenya. This study evaluates the impact of Advanced Trauma Life Support (ATLS) training on 30-day mortality outcomes in severely injured patients at a tertiary care center in Kenya.

Methods A retrospective matched case-control study was conducted at Aga Khan University Hospital, Nairobi. The study included adult patients (≥ 18 years) with polytrauma (Injury Severity Score [ISS] > 15) from 2011 to 2022. Propensity score matching was used to pair 81 post-ATLS cases with 81 pre-ATLS controls based on age and ISS. Data analysis was performed using R Statistical language (version 4.3.0).

Results The 30-day mortality rate decreased significantly from 17% (95% CI: 9.4–27.4%) pre-ATLS to 6% (95% CI: 2.0-13.5%) post-ATLS ($p = 0.028$). No significant differences were found in baseline characteristics between the two groups. Road traffic accidents were the primary cause of trauma in both groups (72% pre-ATLS vs. 78% post-ATLS).
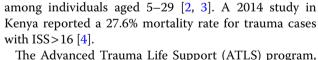
Conclusion ATLS training significantly reduced 30-day mortality in severely injured patients, demonstrating its effectiveness even in resource-limited settings. Further prospective randomized studies are recommended to confirm these findings and evaluate long-term outcomes.

Introduction

Trauma is a significant contributor to global mortality and morbidity, with over five million deaths annually, comparable to deaths from HIV, malaria, and tuberculosis combined [1]. 90% of injury-related deaths occur in LMICs, including Kenya, where road traffic accidents (RTAs) are the leading cause of trauma, particularly

among individuals aged 5–29 [2, 3]. A 2014 study in Kenya reported a 27.6% mortality rate for trauma cases with ISS > 16 [4].

The Advanced Trauma Life Support (ATLS) program, developed by the American College of Surgeons, aims to improve trauma outcomes through standardized care protocols [5]. While ATLS has been widely implemented in high-income countries, its effectiveness in resource-limited settings remains understudied [6].

This study evaluates the impact of ATLS implementation at Aga Khan University Hospital, Nairobi (AKUHN), on 30-day mortality outcomes in severely injured patients. We hypothesized that ATLS training would lead

*Correspondence:
Edwin Mogere
edwin.mogere@aku.edu
[1]Department of Surgery, Aga Khan University Hospital, Nairobi, Kenya
[2]Department of Anesthesia, Aga Khan University Hospital, Nairobi, Kenya

to a significant reduction in mortality among polytrauma patients.

Methodology

Study design and setting

A retrospective matched case-control study was conducted at AKUHN, a tertiary care center in Nairobi, Kenya. The hospital is a major national referral center with a comprehensive emergency/trauma system, including a dedicated in-hospital trauma team.

Participants

The study included adult patients (≥18 years) with polytrauma (ISS≥16) from January 2011 to December 2022. Patients were divided into pre-ATLS (2011–2015) and post-ATLS (2017–2022) groups. Exclusion criteria included patients managed outside the ATLS protocol or lacking complete outcome measures.

ATLS training implementation

ATLS training was implemented at AKUHN in 2016, following the standardized curriculum developed by the American College of Surgeons. All emergency department physicians and key trauma team members completed the 2-day course, which included didactic sessions, skill stations, and simulated patient scenarios.

Data collection

Data were extracted from electronic medical records using a standardized form. Variables collected included demographics, mechanism of injury, ISS, Revised Trauma Score (RTS), length of hospital stay, and 30-day mortality.

Sample size and power

A sample size of 162 patients (81 per group) was determined to detect a 15% reduction in mortality with 80% power and a 5% significance level, based on historical data and previous studies [7, 8].

Propensity score matching

Propensity score matching was performed using a nearest-neighbor algorithm to pair 81 post-ATLS cases with 81 pre-ATLS controls based on age and ISS. This method helps reduce selection bias and control for confounding factors.

Statistical analysis

Data analysis was conducted using R Statistical language (version 4.3.0). Descriptive statistics were presented as medians with interquartile ranges for continuous variables and frequencies with percentages for categorical variables. Comparisons between groups were made using Wilcoxon rank-sum test for continuous variables and Pearson's Chi-squared test for categorical variables. A p-value < 0.05 was considered statistically significant.

Ethical considerations

The study received approval from the AKUHN Ethics Review Committee (Ref: 2023/ISERC-25). Patient confidentiality was maintained throughout the data collection and analysis process.

Human Ethics and consent to participate declarations: Not applicable.

Results

The study included 162 patients, with 81 in each group. Baseline characteristics, including age, sex, mechanism of injuries, and injury severity, were similar between the groups (Table 1).

The 30-day mortality rate decreased significantly from 17% (14/81) in the pre-ATLS group to 6% (5/81) in the post-ATLS group ($p=0.028$) (Table 2). The absolute risk reduction was 11% (95% CI: 1.3–20.7%), with a number needed to treat of 9.1 (95% CI: 4.8–76.9) (Table 2).

Discussion

This study demonstrates a significant reduction in 30-day mortality following ATLS training implementation at a tertiary care center in Kenya. The decrease in mortality from 17 to 6% is consistent with findings from other studies evaluating the impact of ATLS in various settings [9, 10]. For instance, a study in Rwanda reported a similar reduction in mortality rates following the introduction of ATLS training, highlighting its effectiveness in sub-Saharan Africa [9]. In high-income countries, ATLS has also been associated with improved trauma outcomes, as evidenced by studies showing reductions in preventable mortality rates [10].

The standardized approach of ATLS likely contributed to improved patient outcomes by enhancing the rapid and effective management of critically injured patients. This is particularly important in resource-limited settings where efficient utilization of available resources is crucial.

The implementation of ATLS principles may help address some of the challenges faced in trauma care in these settings, such as limited resources and variability in provider experience.

Our findings support the growing body of evidence suggesting that structured trauma care protocols can significantly improve outcomes in LMICs. For example, a systematic review found that trauma training programs, including ATLS, are effective in improving knowledge and skills, though the translation into improved patient outcomes varies [11]. Additionally, studies in LMICs have shown that trauma training courses tailored to local contexts can be cost-effective and sustainable, although challenges remain in scaling these programs [8].

Table 1 Baseline characteristics

Characteristic	Overall, N = 162	Pre-ATLS, N = 81[1]	Post-ATLS, N = 81[1]	*p*-value[2]
Age (years)	39 (28, 50)	38 (28, 47)	39 (29, 51)	**0.4**
Sex				**0.6**
Female	35 (22%)	16 (20%)	19 (23%)	
Male	127 (78%)	65 (80%)	62 (77%)	
Mechanism of injury				**0.6**
Assault	31 (19%)	18 (22%)	13 (16%)	
Falls	10 (6.2%)	5 (6.2%)	5 (6.2%)	
RTA	121 (75%)	58 (72%)	63 (78%)	
Nature of injury				**0.2**
Blunt	138 (85%)	66 (81%)	72 (89%)	
Penetrating	24 (15%)	15 (19%)	9 (11%)	
Revised Trauma Score	7.84 (6.90, 7.84)	7.84 (6.90, 7.84)	7.84 (6.90, 7.84)	**0.5**
Injury Severity Score	22 (17, 27)	22 (17, 27)	22 (18, 27)	**0.9**

Table 1: [1]*Median (IQR); n (%)*, [2]*Wilcoxon rank sum test; Pearson's Chi-squared test*

Data presented as median (IQR) or n (%)

RTA: Road Traffic Accident; ISS: Injury Severity Score; RTS: Revised Trauma Score

Table 2 Mortality rates of the pre ATLS vs. Post-ATLS groups

Group	Alive	Dead	p-value[2]
Pre-ATLS	67(83%)	14 (17%)	0.028
Post-ATLS	76 (94%)	5 (6%)	

Table 2: *Data presented as n (%)*

However, several limitations of this study should be considered:

1. The retrospective nature of the study introduces potential for bias and confounding factors.
2. As a single-center study, the results may not be generalizable to all settings in LMICs.
3. We were unable to account for potential improvements in hospital resources or other systemic changes over time that may have influenced outcomes.
4. The study focused on 30-day mortality and did not evaluate other important outcomes such as morbidity, functional status, or quality of life.
5. Additional data on changes in care processes, such as the use of blood transfusions, tourniquets, and chest tubes, would have supported the conclusions on the impact of ATLS training.

Future research should address these limitations through prospective, multi-center studies that evaluate a broader range of outcomes. Additionally, cost-effectiveness analyses would be valuable in determining the feasibility of widespread ATLS implementation in resource-limited settings.

Conclusion

ATLS training significantly reduced 30-day mortality in severely injured patients at a tertiary care center in Kenya. This study supports the implementation of standardized trauma care protocols in resource-limited settings to improve patient outcomes. Further research, including prospective randomized studies, is recommended to validate these findings and explore the long-term impact of ATLS training on trauma care in LMICs.

MeSH Key Terms

ATLS   Advanced Trauma Life Support
ISS   Injury Severity Score
RTS   Revised Trauma Score
eCDF   empirical cumulative distribution function
GCS   Glasgow Coma Scale

Author contributions

C.K.,A.A and E.M. wrote the main manuscript text and prepared Tables 1 and 2 I.C. reviewed the methodology and statistical analysis All authors reviewed the manuscript.

Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethical approval

This study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.
The Aga Khan Univeristy Hospital-Nairobi Institutional Ethics Comitte (IIRC) approved this study.

Consent to participate

Not applicable.

Consent for publication

Not applicable.

Kamau *et al. International Journal of Emergency Medicine*   (2024) 17:153

Page 4 of 4

References

1. Haagsma JA, Graetz N, Bolliger I, et al. The global burden of injury: incidence, mortality, disability-adjusted life years and time trends from the Global Burden of Disease study 2013. Inj Prev. 2016;22(1):3–18. https://doi.org/10.1136/injuryprev-2015-041616.
2. World Health Organization. Global Status Report on Road Safety 2018. Geneva: World Health Organization; 2018.
3. Botchey IM Jr, Hung YW, Bachani AM, et al. Epidemiology and outcomes of injuries in Kenya: a multisite surveillance study. Surgery. 2017;162(6S):S45–53. https://doi.org/10.1016/j.surg.2017.01.030.
4. Saidi H, Mutiso BK, Ogengo J. Mortality after road traffic crashes in a system with limited trauma data capability. J Trauma Manag Outcomes. 2014;8:4. https://doi.org/10.1186/1752-2897-8-4.
5. American College of Surgeons Committee on Trauma. Advanced Trauma Life Support (ATLS) Student Course Manual. 10th ed. Chicago, IL: American College of Surgeons; 2018.
6. Jayaraman S, Sethi D, Wong R. Advanced training in trauma life support for ambulance crews. Cochrane Database Syst Rev. 2014;8CD003109. https://doi.org/10.1002/14651858.CD003109.pub3.
7. Ali J, Adam R, Butler AK, et al. Trauma outcome improves following the advanced trauma life support program in a developing country. J Trauma. 1993;34(6):890–9. https://doi.org/10.1097/00005373-199306000-00022.
8. van Olden GD, Meeuwis JD, Bolhuis HW, Boxma H, Goris RJ. Clinical impact of advanced trauma life support. Am J Emerg Med. 2004;22(7):522–5. https://doi.org/10.1016/j.ajem.2004.08.013.
9. Wang P, Li NP, Gu YF, et al. Comparison of severe trauma care effect before and after advanced trauma life support training. Chin J Traumatol. 2010;13(6):341–4.
10. Hashmi ZG, Haider AH, Zafar SN, et al. Hospital-based trauma quality improvement initiatives: first step toward improving trauma outcomes in the developing world. J Trauma Acute Care Surg. 2013;75(1):60–8. https://doi.org/10.1097/TA.0b013e31829880a0.
11. Mock C, Juillard C, Brundage S, Goosen J, Joshipura M. Guidelines for trauma quality improvement programmes. Geneva: World Health Organization; 2009.

Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.