The New Ropanasuri Journal of Surgery

Impact of Advanced Trauma Life Support Training for Improving Mortality Outcome: A Systematic Review and Meta-analysis

Afid B. Putra  
Faculty of Medicine Universitas Indonesia, Jakarta, Indonesia, ads.brilliana@gmail.com

Luthfian A. Nurachman  
Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia, luthfianaby@gmail.com

Bagus A. Suryawiditya  
Faculty of Medicine, Universitas Katolik Atma Jaya, Jakarta, Indonesia, bagusarifadi@gmail.com

Muftah Risyaldi  
Faculty of Medicine, Universitas Indonesia, Dr. Cipto Mangunkusumo National General Hospital, Jakarta, Indonesia, muftah.risyaldi@alumni.ui.ac.id

Lam Sihardo  
Department of Surgery, Faculty of Medicine, Universitas Indonesia, dr. Cipto Mangunkusumo Hospital, Jakarta, Indonesia, lam_sihardo@yahoo.com

Follow this and additional works at: https://scholarhub.ui.ac.id/nrjs

Part of the Surgery Commons

Recommended Citation
DOI: 10.7454/nrjs.v8i2.1152  
Available at: https://scholarhub.ui.ac.id/nrjs/vol8/iss2/4

This Article is brought to you for free and open access by the Faculty of Medicine at UI Scholars Hub. It has been accepted for inclusion in The New Ropanasuri Journal of Surgery by an authorized editor of UI Scholars Hub.
Impact of Advanced Trauma Life Support Training for Improving Mortality
Outcome: A Systematic Review and Meta-analysis

Cover Page Footnote
None.

This article is available in The New Ropanasuri Journal of Surgery: https://scholarhub.ui.ac.id/nrjs/vol8/iss2/4
Impact of Advanced Trauma Life Support Training for Improving Mortality Outcome: A Systematic Review and Meta-analysis

Afid B. Putra,1,2 Luthfian A. Nurachman,1 Bagus A. Suryawidya,3,4 Muftah Risyaldi,1 Lam Sihardo,1,4,5

1. Faculty of Medicine, Universitas Indonesia, Jakarta, Indonesia; 2. Dr. Soehadi Prijongoro Hospital, Surakarta, Indonesia; 3. Faculty of Medicine, Universitas Katolik Atma Jaya, Jakarta, Indonesia; 4. Department of Surgery, Faculty of Medicine, Universitas Indonesia, dr. Cipto Mangunkusumo Hospital, Jakarta, Indonesia.

Abstract

Introduction. The Global Burden of Disease Study has identified injuries as one of the top ten causes of death and disability worldwide. Injury is predicted to rise in the rankings by the year 2030. This study aimed to quantify the effectiveness of an Advanced Trauma Life Support (ATLS) training in improving mortality outcome after trauma injury.

Method. This is a systematic review (of experimental and observational studies) and meta-analysis, reporting mortality outcome from trauma injury between ATLS-trained/certified physicians vs non-ATLS-certified. We performed literature searching through 3 electronic databases, including Cochrane (CENTRAL), MEDLINE (PubMed), and Scopus.

Results. There are summarized results from 7 selected articles. The total patients included in this analysis were 11,595 patients in post-ATLS group and 21,603 patients in pre-ATLS group. There was high heterogeneity among studies (I² > 95%) and therefore random effect model was used for analysis. Pooled analysis showed that ATLS had no significant effect in reducing the risk of mortality (OR: 0.68; 95% CI 0.39 – 1.20; p = 0.18). Although ATLS is not significantly associated with improved mortality outcomes, this meta-analysis has shown a tendency that health facilities and health workers implementing ATLS experienced lower mortality.

Conclusion. ATLS is not the only aspect that contributes to patients’ survival. There are also roles in pre-emergency settings, resource availability, and experience. However, we believe that implementing the ATLS protocol in healthcare facilities will be the leading factor in improving trauma patients’ management.

Keywords: ATLS, emergency, mortality, trauma, training.

Introduction

The Global Burden of Disease Study has repeatedly identified injuries as one of the top ten causes of death and disability worldwide. Injury is predicted to rise in the rankings by the year 2030. Injuries place a disproportionately large burden on young people, causing premature loss of productive life, high medical care costs, significant degrees of disability, and a large socio-economic loss to society. In many high-income countries (HICs), reductions in trauma mortality of 15-20% have been achieved in the last few decades, primarily because of improved healthcare interventions and trauma care systems. Training programs such as Advanced Trauma Life Support (ATLS), established by the American College of Surgeons and introduced in North America, the United Kingdom, and Australia, have presumably contributed to this reduction.1

However, the strong evidence level of effectiveness of ATLS needed to learn better. Therefore, this systematic review and meta-analysis aimed to quantify the efficacy of ATLS training in improving mortality outcomes after traumatic injury.

Method

The design of this study is a systematic review and meta-analysis. Therefore, this study protocol was performed based on the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines, as shown in Figure 1. Literature searching was conducted in three electronic databases, including Cochrane (CENTRAL), MEDLINE (PubMed), and Scopus. The search was conducted from October 19, 2022, to November 1, 2022. The keywords used were ("advanced trauma life support" OR "ATLS") AND ("death" OR "mortality") with adjustments based on the specific electronic databases. Articles included were those reporting mortality as an outcome of all trauma patients at any age. The intervention was the treatment/management of trauma by ATLS-certified medical staff compared with non-ATLS-certified medical staff. Any randomized controlled trials (RCTs), controlled trials (CTs), controlled before-and-after (CBA) studies, and cross-sectional and cohort studies were included. Only full-text articles published in English were included in this systematic review.

Three authors performed the study selection, extraction, and quality assessment (ABP, LAN, and BAS). First, all the studies extracted were imported to Mendeley. Next, duplicate studies were excluded, and we screened the rest of the articles based on their titles and abstracts. Selected studies that meet eligibility criteria were read carefully, then we extracted some information, such as (1) the study design; (2) the location of study; (3) time/period; (4) health facility types; (5) total subjects; (6) the number of survive and death patients before and after ATLS training. Any disagreement between the three authors was resolved by an independent review by a fourth and fifth author (MR and LS).

All extracted data were presented in tabular format and summarized narratively. A meta-analysis was done using Cochrane Review Manager (RevMan) 5.4 (Copenhagen, Denmark). A forest plot demonstrated the association between ATLS training and mortality outcome using an odds ratio (OR) and 95% confidence interval (95% CI). The heterogeneity was calculated using the I², and the random effect model was used. I² values of 25%, 50%, and 75% indicated low, moderate, and high heterogeneity, respectively. The studies were qualitatively evaluated using a funnel plot to visualize the publication bias. A p-value <0.05 was considered statistically significant.

Results

A total of seven studies were included for pooled analysis. The summary of each study is presented in Table 1. Meta-analysis was conducted using Mantel-Haenszel statistical methods with odds ratio as the effect measure. The total number of patients included in this analysis was 11,595 in the post-ATLS group and 21,603 in the pre-ATLS group.
There was high heterogeneity among studies ($I^2 = 95\%$), and therefore random effect model was used for analysis. Pooled analysis showed that ATLS had no significant effect in reducing the mortality risk (OR: 0.68; 95% CI: 0.39–1.20; $p = 0.18$). Forest plot analysis is shown in Figure 2. Furthermore, funnel plot analysis showed a study bias, with studies included for pooled analysis mostly having small standard error and a less distributed odds ratio (Figure 3).

Figure 2. Forest plot analysis of mortality outcome.

Figure 3. Funnel plot analysis (mortality outcome in ATLS-trained). The funnel plot was roughly asymmetrical with presence of bias and dominated by large studies.

Discussion

ATLS training has been shown to enhance knowledge, clinical skills, and medical decision-making abilities. This training is held for medical teams in emergency units, such as general practitioners, surgical residents, nurses, and surgeons who still need ATLS certification. Since the ATLS program was founded in 1970, more than 7,000 training courses have been conducted in North America, and 134,000 medical personnel have been trained in the concepts of trauma resuscitation. The ATLS program covers all the skills needed in trauma resuscitation in the early post-traumatic phase. It provides cognitive training as well as psychomotor skills needed for the management of trauma patients. The main goal of the ATLS program is to improve trauma patient outcomes. This study compared the outcomes of trauma patients at several hospitals with medical teams who had not and had undergone ATLS training. The ATLS training method that is carried out can be in the form of directly attended training and internal training led by a medical team who attend the training directly. This training focuses on the initial management of trauma patients. Trauma patients include traffic accident patients, work accidents, sharp trauma, and blunt trauma. Several skills are trained by the medical team, such as initial surveys, secondary surveys, and determining the initial diagnosis to reduce the time from the emergency room to the operating table if surgery is needed. Clinical skills trained include suturing, insertion of intravenous lines, intubation, and others. Some hospitals assess the cognitive of the medical team after undergoing training by giving multiple choice questions to refresh emergency theory. The patients studied were grouped based on the patient group was assessed for its mortality rate at the main goal of the ATLS program is to improve trauma patient outcomes. The studies included for pooled analysis mostly having small standard error and a less distributed odds ratio (Figure 3).
several studies, it was found that patients with ISS >16 showed a higher mortality rate. Still, there was a decrease in the mortality rate for the group of patients with ISS >16 in the emergency department with medical teams who had undergone ATLS training compared to medical teams who had not undergone training. This happens because of multifactorial, among others, through training in several clinical skills, the medical team can perform initial treatment of trauma patients, at least the patient's vital signs are stable, the ability to make appropriate and fast decisions in determining definitive action on trauma patients, and the responsiveness of the emergency room services, in the hospital. Apart from the impact of the ATLS training, other factors support the reduction in mortality rates, such as several members of the medical team who have experience in handling emergency patients before training and the completeness of infrastructure in service facilities. However, there were findings in one study which showed that medical teams with ATLS certification had a higher mortality rate; this was because a trained medical team was transferred to many trauma patients, so the medical team was overwhelmed, and the patient mortality rate increased.\textsuperscript{2,4,6} The ATLS program has been shown to impact trauma patient outcomes positively. In addition, one of the features of the ATLS program is its focus on nurturing educational principles that recognize the unique needs of young learners, strengthening small group discussions, and demonstrating practitioner skills through presentations.\textsuperscript{3} The introduction of the ATLS program relates to the development of three learning domains: cognitive, psychomotor, and affective. Cognitive assessment through multiple choice questions, Psychomotor assessment can be seen from increasing intervention actions in the emergency room. The affective assessment was carried out using a questionnaire on medical personnel showing a positive attitude and proposing this program to be continued because of its positive impact.\textsuperscript{3,9}

Some of the studies above examined the impact of ATLS from various editions based on the year in which the research was conducted. The current ATLS used is the 10\textsuperscript{th} edition of ATLS, where there are several developments in information related to trauma management compared to previous editions. For example, in (1) initial assessment there is a restriction on the amount of crystalloid given as much as 1 liter where in the previous edition fluids could be given 1-2 L by bolus, (2) airway management and drug-assisted intubation ventilation are prioritized over Rapid Sequence Intubation (RSI), (3) treatment of shock early use of blood products is recommended and use of tranexamic acid within three hours is recommended, (4) treatment of thoracic fluid chest trauma replaced tracheobronchial tree injury as life-threatening trauma, new location for needle thoracentesis in adult patients, modified FAST recommended for identification of a pneumothorax, (5) pelvic and abdominal trauma, prostate examination is no longer recommended as part of the evaluation, preperitoneal pelvic packing included from the hemorrhagic protocol, (6) head trauma, anticoagulant reversal table included in the guideline, (7) spinal trauma and spinal cord, CCR and NEXUS guidelines recommended, spinal immobilization replaced by spinal movement restriction, use of backboard >2 hours avoided, (8) musculoskeletal trauma, use of tourniquets to control severe extremity bleeding is now recommended, described antibiotic dosing regimen for open fractures, (9) thermal injury, new formula of fluid resuscitation e.g. 2 mL/kg/%TBSA, (10) pediatric trauma, PECARN brain injury algorithm is now recommended, (11) geriatric trauma, lower threshold for imaging in elderly population is now recommended, condition pre-existing high-risk patients are highlighted, (12) pregnancy trauma, vaginal fluid pH >4.5 is an indicator of leaking amniotic fluid, (13) transfer to definitive care, avoidance of diagnostic procedures that do not change treatment plans, SBAR communication tools are recommended.\textsuperscript{2,3,7,8,10} ATLS cannot be the only factor that contributed to improve mortality outcomes. It is reasonable why the result of this study was not statistically significant. Optimal trauma management begins from the site of the accident with stabilization and rapid transport to trauma care facilities. Trained staff without support of the established pre-emergency system will lead to same outcome than non-trained staff.\textsuperscript{2,5} Other factors that may contributed are environmental changes, resources availability, changes in guidelines or algorithm, and experiences of staff and health facilities.\textsuperscript{3} In many hospitals, the situation is typically dynamic. A surgical resident (0–6 years of training), nurses, and radiographers are present during on-call hours, but surgeons, anesthesiologists, and radiologists are on call at home. However, all of them are still present during the office hours.\textsuperscript{8} Some types of injury are also failed to show improvement after ATLS training, such as penetrating, knife, or stabbing injury. It may be occurred because the diagnosis is straightforward, there is a clear indication for surgery, and surgical intervention is typically necessary. Different results can be achieved in blunt injury that may be improved after ATLS training because of added knowledge of the trauma care.\textsuperscript{7} Using mortality as the main objective would cause a great deal of confounding variables to interfere.

This research has limitations. The pooled analysis has a high degree of heterogeneity and bias, which may limit the generalizability of our findings. However, some degree of heterogeneity is usually expected in meta-analyses and can reflect differences in study populations, outcome measuring methods, analytic methodologies, and a variety of other factors. Many of the studies included in the meta-analysis are old (the oldest was published in 1992) and there is a significant gap between them and the most recent study (published in 2016). Furthermore, the country and ATLS edition should be put into consideration, however this is beyond the limits of this study.

Conclusions

This meta-analysis has shown a tendency for health facilities and health workers to implement ATLS to reduce mortality. We realized that ATLS is not the only aspect contributing to patients’ survival. There are also roles in pre-emergency settings, resources availability, and experiences. However, we believe that encouraging the presence of ATLS protocol in healthcare facilities will be the utmost effort to improve the management of traumatized patients.

Disclosure

The authors declare no conflict of interest.

Acknowledgment

None.

Role of authors

Conceptualization ABP, LAN, BAS, Data curation ABP, LAN, BAS, Formal analysis LAN, Funding acquisition ABP, LS, Investigation ABP, LAN, BAS, MR, Methodology ABP, Project administration MR, Resources MR, Software MR, Supervision LS, Validation LS, Visualization LAN, Writing original draft preparation ABP, LAN, BAS, Writing review and editing ABP, LAN, BAS, MR, LS.
References


