

CASE REPORTS

PENETRATING ABDOMINAL INJURY IN PREHOSPITAL CARE: EXPECTATIONS AND LIMITATIONS RELATED TO CURRENT TREATMENT GUIDELINES IN POLISH EMERGENCY MEDICAL SERVICES SYSTEM PRESENTED AS A CASE REPORT

Przemysław Kluj, PhD, EMT-P^{*1,2}; Paweł Guzik¹; Krystyna Frydrysiak, MD³; Paweł Ratajczyk, MD¹; Tomasz Gaszyński, MD¹

Author Affiliations: 1. Department of Anesthesiology, Intensive Care, and Pain Management, Medical University of Łódź, Łódź, Poland; 2. National EMS Agency, Łódź, Poland; 3. Emergency Medicine and Disaster Medicine Department, Medical University of Łódź, Łódź, Poland.

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**Corresponding Author:*

przemyslaw.kluj@umed.lodz.pl

ABSTRACT

Introduction: Among multiple organ trauma, abdominal injuries occupy a special place, as they are associated with a high risk of severe complications and frequently require careful prehospital treatment and urgent surgical intervention. This type of injury carries a high risk of damage to the organs located not only in the abdominal cavity but also in the chest – depending on the angle of penetration. This increases the risk of complications during treatment. One of the modern methods used in the prehospital care to control bleeding is tranexamic acid, which has been used for years in other clinical settings. Taking into account the variety of treatment protocols, the indications for its use deserve a broader perspective in prehospital care.

Methods: We performed detailed description of a case study of a 60-year-old woman with a penetrating abdominal injury resulting from a self-inflicted stab wound with suicidal intent. We also describe the treatment implemented in prehospital care with tranexamic acid administration and the use of a non-obvious method of immobilization of a foreign body in an existing wound.

Aim: The aim of our study was to evaluate the prehospital management of a woman with a penetrating abdominal injury, with particular attention to the administration of tranexamic acid and improvised method of foreign body immobilization.

Findings: The prehospital treatment described in this paper enabled the inhibition of the progression of hypovolemic shock, securing the foreign body in the wound and safe transport of the patient to the trauma center, where she was admitted in a stable condition.

Conclusion: Efficient teamwork, proper immobilization of the foreign body and appropriate, targeted medication administration enabled the patient's safe transport to the hospital. In this particular case, prehospital administration of tranexamic acid and restrictive fluid resuscitation did not worsen the patient's condition.

INTRODUCTION

Traumatic injuries represent a major global public health problem and remain one of the leading causes of death and disability, especially in people under 30 years old (World Health Organization [WHO], 2024). In prehospital care, trauma accounts for a considerable proportion of emergency medical services (EMS) interventions, frequently requiring rapid assessment, early recognition of life-threatening conditions, hemorrhage control, and rapid transport to specialized trauma centers.

In Poland, a small mid-Eastern European country with 38 million citizens, over 1 million patients with traumatic injuries are admitted to emergency departments (ED) each year (Sanak et al., 2025). Among all, abdominal injuries are present in roughly 36-53% of the cases (Kopta et al., 2026; Kuli et al., 2007; Sulej-Niemiec et al., 2024). Abdominal trauma can be subcategorized into 2 types: blunt and penetrating. The vast majority are blunt injuries (approximately 80%), whereas penetrating injuries constitute about 20% of cases.

Penetrating abdominal trauma in the Polish setting occurs less frequently than in countries with a higher prevalence of firearm related violence; nevertheless, it remains a significant diagnostic and therapeutic challenge. The most common mechanisms include stab wounds and, much less frequently, gunshot wounds. However, compared with blunt trauma, penetrating injuries are more often associated with interpersonal violence and carry a higher risk of direct damage to multiple internal organs. The estimated overall mortality for abdominal trauma in Poland ranges from 5% to 10% and may be considerably higher in the most severe cases (Brongel, 2003; Kopta et al., 2026; Kuli et al., 2007). At the same time, the absence of a comprehensive national trauma registry limits the ability to precisely assess the true incidence, mechanisms, and treatment outcomes of penetrating abdominal injuries.

The priority in prehospital care after initial stabilization of the patient, which includes airway management, oxygenation, establishing circulatory access, pain relief, and fluids administration, is rapid transport to the hospital, as approximately one-third of stab wound cases require urgent surgical intervention (Brongel, 2003; Kasperczyk et al., 2025). At the same time, external and internal bleeding control is crucial. To achieve this goal, the wound should be appropriately dressed, and the foreign body should be immobilized if it is still present. According to the latest Prehospital Trauma Life Support (PHTLS), Tactical Combat Life Support (TCCC), and International Trauma Life Support (ITLS) recommendations that we follow in the Polish EMS system, tranexamic acid (TXA) should also be considered, as it reduces the intensity of bleeding when administered in specific time frame (Campbell & Alson, 2020; National Association of Emergency Medical Technicians [NAEMT], 2023). On the other hand, TXA administration principles remain inconsistent when we take into account other clinical areas and specific groups of patients. This article highlights the success of using TXA in controlling active bleeding in a 60-year-old woman with a penetrating abdominal injury. Moreover, we present our point of view on the prehospital use of TXA upon the specific case study and undertake the attempt to develop a structured framework using the principles of TXA use in the prehospital environment.

METHODS

The political and economic transformation after 1989 initiated major reforms in the Polish healthcare system. A major milestone occurred in 2006 with the “Act on State Emergency Medical Services” that formally stated the recognition of emergency medicine as a medical specialization and paramedicine as an independent healthcare profession (Act of 8th September 2006 on State Emergency Medical Services [Journal of Laws], 2006). This significantly changed the structure of prehospital care and created multiple roles for the new paramedic profession in critical care to include among others: advanced life support, advanced instrumental airway management (enabling intubation in cardiac arrest episodes), prehospital ECG transmission, and specific medication administration. This represented a transition from a purely physician-centered system toward a mixed physician-paramedic model.

In the Polish EMS system, personnel are obligated to perform emergency medical procedures in accordance with the latest medical knowledge based on evidence-based medicine (EBM). There are no specific national guidelines nor specific local protocols. Therefore, personnel may utilize both American and European translated algorithms, freely, to ensure the best patient care.

To present the case accurately and in details, the trauma and “ABCDE” assessment scheme, derived from the 10th edition PHTLS course manual (National Association of Emergency Medical Technicians [NAEMT], 2023) will be used. This approach is routinely applied in Polish EMS and, in summary, includes: A (Airway) – assessment of airway patency, B (Breathing) – assessment of breathing, C (Circulation) – assessment of the circulatory system, D (Disability) – neurological assessment, E (Exposure, Environment) – patient exposure, assessment of the scene of the incident, and overall evaluation of the situation. Detailed steps of the trauma examination approach are presented in Figure 1.

CASE REPORT

Around 5 p.m. in the middle of last year’s autumn, a two-person EMS team was dispatched to a 60-year-old woman with a penetrating abdominal injury resulting from a self-inflicted stab wound with suicidal intent. The call was assigned the highest priority code. The response time from dispatch to arrival on scene was seven minutes. Due to the absence of a police patrol at the scene, the paramedics made an independent decision to enter the building.

Upon arrival at the scene, located on the first floor of a single-family house, the team found the woman lying in bed. At the time of the rescuers’ arrival, she was calm, positioned supine.

The initial impression was poor. The woman was agitated, diaphoretic, and appeared to be under the influence of alcohol and/or medications. A knife handle measuring several centimeters was protruding from the abdominal cavity at the level of the umbilicus (see Figure 2). Small amounts of dried blood were visible around the handle, and the abdominal circumference appeared distended. The primary assessment revealed compensated hypovolemic shock resulting from the blood loss into the abdominal cavity.

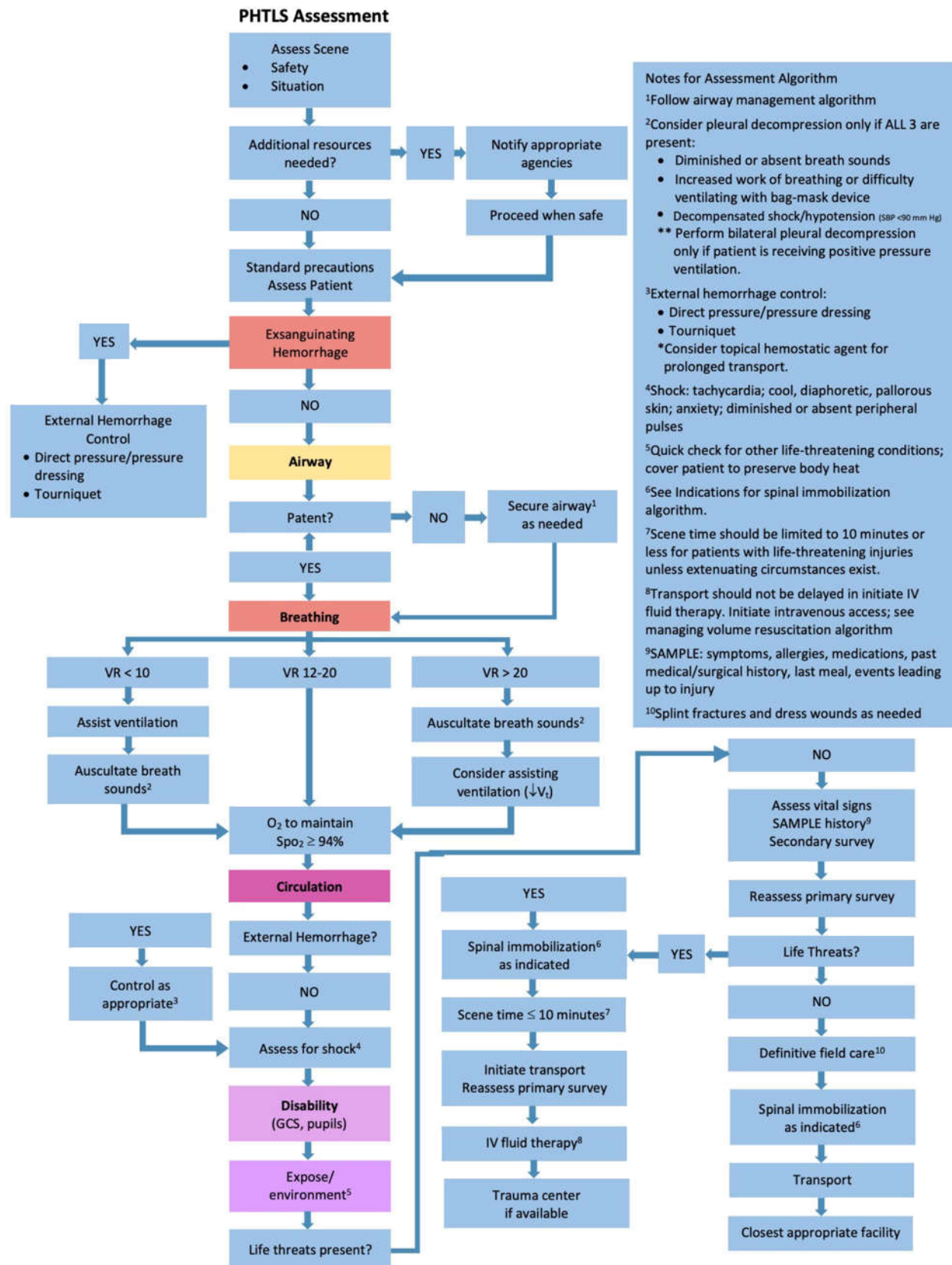


Figure 1. PHTLS examination approach.

Note: From "PHTLS: Prehospital Trauma Life Support 10th Edition," by National Association of Emergency Medical Technicians, 2023, Jones & Bartlett Learning.



Figure 2. Woman with a penetrating abdominal injury resulting from a self-inflicted stab wound with suicidal intent - photo taken during the first contact with the patient.

Note: Photograph from the author's personal collection.

INITIAL ASSESSMENT "ABC"

The airway was patent with no intervention required. The respiratory rate was 20 breaths per minute, SpO_2 was 98%, and bilateral vesicular breath sounds were present over all lung fields. Skin was diaphoretic and pink. A pulse was palpable on the carotid and radial arteries (peripherally thready), approximately 110 to 120 beats per minute. Blood pressure was 90/60 mmHg. Heart sounds were audible. Intravenous access was secured with a 20-gauge cannula. Capillary refill time was approximately four seconds. The blood glucose level was 113 mg/dL. Due to concerning circulatory parameters ("C") and the need to secure the foreign body within the wound, a full assessment in categories C, D, and E was deferred.

MEDICAL INTERVIEW (BACKGROUND OF THE EVENT)

The patient's father was present at the scene and had been at home with his daughter at the time of the incident. Several years earlier, the daughter had been diagnosed with par-

anoid schizophrenia, depression, and alcohol dependence syndrome. Suicidal ideation had occurred in the past but had never previously resulted in a suicide attempt. When asked about the approximate size of the knife used by the patient to inflict the injury, the father, due to strong emotional distress, was unable to specify exact dimensions but stated that the knife was “large.”

For approximately one week prior to the incident, the patient had been on an alcohol binge (most commonly consuming vodka), and she had expressed suicidal thoughts and a desire to end her life for approximately three days. In the past, she had been hospitalized multiple times for her mental conditions and had been prescribed long-term medications; however, the EMS team was unable to locate these medications at the scene.

Additionally, the father reported that his daughter had previously ingested various oral medications together with alcohol and then slept continuously for several hours. He did not attempt to remove the knife from the wound, nor did he apply any form of wound management; instead, he called the emergency number 112 to obtain medical assistance for his daughter.

Both the patient and her father consistently stated that no other individuals were present at the scene and that the wound resulted from a self-inflicted stab to the abdomen. Approximately five minutes after entering the building, a unit of the Volunteer Fire Brigade arrived on scene. Upon approaching the patient, firefighters were asked to take over and gently immobilize the patient's upper limbs to prevent potential attempts to deepen the wound or remove the foreign body.

INTERVENTION PERFORMED AFTER THE PRE-EXAMINATION

There was no need for airway management. The patient was communicating fluently with the EMS team. Oxygen supplementation was provided via non-rebreather face mask at a flow rate of 15 L/min with an SpO₂ of 99%. Rescuers established a second intravenous line and administered a 250 mL IV bolus of 0.9% NaCl and 1g TXA as a slow IV bolus via the second IV line. Four-lead ECG monitoring was initiated. Analgesic treatment of fentanyl 100 µg IV was provided.

Implementation of the above interventions allowed for more thorough inspection of the wound, completion of a full trauma assessment, and planning of further patient management.

To immobilize the foreign body within the wound, one of the stabilizers from a spinal board was used. The opening of the stabilizer encompassed the entire protruding knife handle and allowed it to rest against the upper edge of the device, preventing potential displacement. The stabilizer was secured to the patient using an elastic bandage wrapped circumferentially around the torso. Additionally, several gauze pads were placed inside the stabilizer opening (around the protruding handle) to monitor for potential bleeding (see Figure 3).

Due to the presence of a foreign body within the abdominal cavity, which could cause further tissue penetration at any moment, the decision was made to transport the patient urgently to the hospital following initial stabilization and immobilization of the object. Unfortunately, due to the time pressure and too few hands to work at the subsequent

stages of the patient's treatment, it was not possible to capture the original, improvised method of immobilization in a photo.

SUBSEQUENT VITAL SIGNS OBTAINED IN THE FULL ABCDE ASSESSMENT

Airways remained patent with no intervention required. Respiratory rate was 18 breaths/min, SpO₂ 99% on 12 L/min oxygen, and bilateral vesicular breath sounds remained present over all lung fields. Skin was pink and mildly diaphoretic. Pulse was palpable on carotid and radial arteries, approximately 105 beats per minute, consistent with monitor readings. Blood pressure was 100/70 mmHg. Heart sounds remained audible. Intravenous access remained patent. Capillary refill time was approximately 3 seconds. Due to satisfactory hemodynamic parameters, a second fluid bolus was withheld. The patient was alert with a GCS of 14 points. Blood glucose was 110 mg/dL. Pupils were equal and symmetrical. Temperature was 35.9 C. Neurological examination showed no focal deficits; however, due to alcohol intoxication, findings were not considered fully reliable.

In observation, the patient had moderate obesity, was independently functioning, had no other visible injuries noted (slightly increased abdominal circumference). was under the influence of alcohol and possible influence of medications. The last hospital admission was approximately three years prior.

To minimize the risk of wound progression caused by the provisionally immobilized foreign body, the patient was placed on a rigid spinal board. Firefighters assisted with carrying the patient down the stairs and transferring her into the ambulance.

Transport, which took about 20 minutes, to the destination hospital after prior notification of the emergency department physician proceeded without complications and without signs of worsening shock. During communication with the receiving physician, preparation of group O Rh-negative blood products for the patient was suggested.



Figure 3. Improvised method of knife stabilization – reconstruction.

Note: Photograph from the author's personal collection.

DISCUSSION

WHAT DOES THE POLISH EMERGENCY MEDICAL SYSTEM LOOK LIKE?

The National EMS System (NEMS) in Poland was formally established in The Act of September 8, 2006. This legislation created a unified, nationwide framework for the provision of prehospital emergency care and defined the organizational, operational, and financing principles of the system (Dick, 2003). The Polish NEMS is mainly based on the Anglo-American model, with noticeable elements of the Franco-German model. Primarily, the NEMS combined elements of both models, yet in recent years it has been increasingly moving towards the Anglo-American model, which is due to the reduction in the number of teams including physicians, and the improvement in the qualifications and skills of paramedics, who are taking on more and more tasks in the area of patient care. Currently, the personnel consist of paramedics (85%), physicians (3%), and nurses (12%) (Mitura et al., 2026; Ramesh, Uma & Farhath, 2019). Over time, Poland increasingly shifted toward the paramedic-led model of prehospital care (85% which represents 1415 ambulances), reducing the number of physician-staffed ambulances (15%, which represents 250 ambulances) – 1665 total in 2025 all over the country (Polish Central Statistical Office, 2026). Moreover, in 2025, the Polish Chamber of Paramedics was established. Its immediate objectives include the introduction of a formal professional license for paramedics and the long-term guidance and development of the paramedic profession nationwide.

Paramedics in Poland are currently educated exclusively at the university level within a two-cycle system. After completing a three-year undergraduate program, they obtain a bachelor's degree and are qualified to work in emergency ambulance teams, which enables administration of 47 medications without additional authorization (e.g., TXA, fentanyl, norepinephrine, amiodarone, adenosine, diazepam, clonazepam, midazolam). Since 2026, paramedics have also had the opportunity to continue their education through an additional two-year graduate program leading to a master's degree (Dick, 2003; Polish Central Statistical Office, 2026). Additionally, paramedics may pursue four-year, full-time doctoral studies leading to the academic degree of Doctor of Philosophy, as exemplified by the author of this manuscript. However, obtaining a doctoral degree currently does not result in an extension of professional competencies or the scope of emergency medical procedures that paramedics are authorized to perform.

Since the Polish NEMS is quite young compared to other European or global systems, it is still searching for the best organizational and clinical solutions to implement in the country. At the same time, the system trains highly skilled professionals, regarded as some of the most competent and independent paramedics worldwide.

EVIDENCE-BASED PRACTICE GUIDELINES FOR FLUID RESUSCITATION & TXA ADMINISTRATION

Traumatic injury remains one of the leading causes of death globally, with the majority due to massive hemorrhage and head injury. Evidence-based practice guidelines have been developed for fluid management in prehospital care with an emphasis on penetrating traumatic injuries (Campbell & Alson, 2020; NAEMT, 2023; Polish Central Statistical Office, 2026). Polish emergency medicine guidelines have adopted the combined ITLS and Advanced Life Support Guidelines approach in the management of trauma, indicating the administration of a crystalloid fluid bolus (as soon as possible replaced

with blood or blood products) and hemorrhage control (Soar et al., 2021). Moreover, guidelines indicate the need to limit fluid administration to the level at which peripheral perfusion is restored, defined as sufficient fluid amounts (optimally administered in the form of 250 mL boluses of 0.9% NaCl) to restore a radial pulse or systolic blood pressure of approximately 80-90 mmHg (permissive hypotension) (Kudo et al., 2017; NAEMT, 2023). Despite structured recommendations for IV fluid resuscitation for trauma within the context of fluid type, administered volume, and clinical presentation, it should be emphasized that excessive fluid resuscitation with crystalloids can lead to acidosis and dilution of clotting factors, leading to coagulopathy and deterioration of the patient's condition (Kudo et al., 2017).

On the other hand, TXA, with its antifibrinolytic, anti-inflammatory, and anti-angiogenic properties, has been widely used in multiple clinical conditions to reduce or control bleeding, including perioperative bleeding control, postpartum hemorrhage, acute upper gastrointestinal bleeding, cardiac surgery, and orthopedic surgery. Additionally, this synthetic lysine-based fibrinolytic inhibitor has now been shown to be associated with reduced mortality after traumatic injury by reducing blood loss and transfusion rates (Barrett et al., 2025; Neeki et al., 2017). This medication is also used to stop severe bleeding on the battlefield, according to TCCC guidelines (Committee on Tactical Combat Casualty Care [CoTCCC], 2026).

TXA is generally well-tolerated. Most of its adverse effects are considered mild, such as nausea and vomiting and blurred vision, or moderate, although it is shown that high doses of TXA could lead to seizures, hypotension (occurred with rapid IV bolus administration), and may affect a theoretical risk of a significant increase in thrombotic complications (Barrett et al., 2025; Neeki et al., 2017; Soar et al., 2021). Therefore, we conducted a detailed analysis of available sources.

Studies and clinical trials on the use of TXA in emergent settings have demonstrated the life-saving effects of TXA in trauma; hence, the prehospital use of TXA has grown exponentially. In recent decades, guidelines on the prehospital use of TXA in major trauma have been published by several authoritative bodies, including the United States' National Association of EMS Physicians (Barrett et al., 2025) and the United Kingdom's National Institute for Health and Care Excellence (2023). However, the formulated dose, rate, and route of administration of TXA in hemorrhagic trauma have yet to be established.

Current guidelines suggest that TXA could be given: (1) 1g intravenous/intra-osseous (IV/IO) in the prehospital settings by EMS, followed by 1g infusion over the next 8 hours in the hospital, or (2) 2g IV/IO as infusion or slow push. It is noteworthy that prehospital TXA administration is recommended to be given within a 3-hour window since the injury for hemorrhagic shock. This time frame, derived from the Clinical Randomization of an Antifibrinolytic in Significant Hemorrhage (CRASH-2) trial, has not been replaced or challenged (Shakur et al., 2010). A randomized controlled trial conducted by Ali et al. (2026) in 2025 showed that the risk of 28-day mortality increases with increasing time to the first dose of TXA, with the benefit being most pronounced within 90 minutes. Another clinical trial by Mazzei et al. (2024) demonstrated that prehospital use of TXA reduces mortality by 22% when administered at 1 g. Furthermore, a 2024 meta-analysis by Fouche et al. (2024) on the use of TXA for traumatic injury found that, in addition to

a significant reduction in mortality, there is no evidence of adverse vascular occlusive events attributable to TXA.

Various doses and regimens have been proposed in clinical trials, including single bolus, repeated bolus, and bolus plus infusion; however, the optimal dosing recommendation proposed by ITLS and PHTLS committees in the prehospital context is 1 g of TXA in 100 mL 0.9% NaCl given IV over approximately 10 minutes (slow infusion to reduce risk of hypotension) (Campbell & Alson, 2020; NAEMT, 2023). Based on the existing literature, there is insufficient evidence to support improvement in clinical outcomes from the first dose of TXA administered beyond the 3-hour window recommended by guidance.

Consistent with adult trauma principles, in pediatric trauma patients with suspected significant hemorrhage or signs of hemorrhagic shock, early administration of ideally within 3 hours of injury is emphasized. The recommended pediatric dosing is 15-20 mg/kg IV (maximum 1 g), administered slowly to minimize the risk of hypotension (Gendler et al., 2023). Although high-quality randomized pediatric trauma trials remain limited, available observational data and extrapolation from adult studies support the safety of TXA in children, with no demonstrated increase in thromboembolic complications at standard trauma dosing. Consequently, current PHTLS & ITLS guidance supports weight-based TXA administration in both groups of patients when clinically indicated, as part of early damage-control resuscitation strategies (Campbell & Alson, 2020; NAEMT, 2023). For this reason, local institutions responsible for medical supervision should familiarize themselves with the current literature and incorporate the principles of appropriate TXA use into prehospital protocols as it was done in Polish NEMS. Tranexamic acid was introduced locally into clinical use in 2023. Initially, before administering the medication, paramedics were required to contact the medical director (emergency medicine physician) of their ambulance service, describe the patient's condition, and obtain approval from a specialist available on call 24/7. After several months of successful nationwide use of TXA without reported complications, the government decided to formally expand paramedic competencies, allowing independent administration of TXA (norepinephrine administration via infusion pump was added as a second medication within the same decision) without additional authorization starting in March 2024.

LIMITATIONS

This study has several limitations. Only one case was evaluated, therefore general conclusions cannot be drawn based on the conducted study. The absence of an ultrasound device in the EMS equipment prevented the extension of diagnostics with imaging (POCUS/FAST). The lack of a dedicated method for immobilizing foreign bodies in the abdominal cavity prolonged and complicated patient management at the scene. The lack of blood products in the standard ambulance equipment forces the administration of synthetic fluids. Measuring lactate levels to assess the development of shock in Polish NEMS is not available. Additionally, lack of any feedback from the hospital treatment or further outcomes is a substantial weakness of the paper that makes the story incomplete.

CONCLUSION

Despite its many strengths, the Polish NEMS still requires further organizational improvements to better respond to evolving conditions, and technological advancements.

The introduction of clear standards and a more efficient organizational framework will enhance operational effectiveness and contribute to improving the overall quality of EMS. Even though in our case study the administration of TXA turned out to be successful, further research or clinical trials are needed to evaluate and address this clinical context.

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