CONSENSUS MUST BE FOUND ON INTRAVENOUS FLUID THERAPY MANAGEMENT IN TRAUMA PATIENTS

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Abstract

Introduction: Trauma is an important cause of death among young people and 30-40% of this mortality rate is due to hypovolemic shock, intensified by trauma's lethal triad: Hypothermia, Acidosis, and Coagulopathy. Nurses are responsible for managing fluid therapy administration in trauma victims. The purpose of this study is to analyse the reasons why intravenous fluid therapy is recommended for trauma patients' hemodynamic stabilization.

Methods: This narrative literature review included published and unpublished studies in English, Spanish or Portuguese between 1994 and January 2019. The search results were analyzed by two independent reviewers. Inclusion criteria encompasses quantitative studies involving trauma victims aged over 18 who underwent fluid therapy in a prehospital assessment context.

Results& Discussion: 11 quantitative studies were included. 9 involved the use of fluid therapy for hypotension treatment and 2 of the studies analyzed involved the use of warmed fluid therapy for hypothermia treatment. The analysis performed reveals that the administration of aggressive fluid therapy seems to be responsible for the worsening of the lethal triad. In the presence of traumatic brain injury, permissive hypotension is not allowed due to the negative impact on cerebral perfusion pressure. Used as warming measure, warmed fluid therapy does not seem to have a significant impact on body temperature.

Conclusions: There is no consensus regarding the administration of fluid therapy to trauma patients. This conclusion clearly supports the need to develop more randomized controlled trials in order to understand the effectiveness of such measure when it comes to control hypovolemia and hypothermia.

KEYWORDS: **"TRAUMA"; "FLUID THERAPY"; "HYPOTHERMIA"; "HYPOTENSION"**

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INTRODUCTION

Trauma is responsible for high mortality and morbidity rates and is the leading cause of death among people under the age of 40[1]. This mortality and disability are a major concern among medical and paramedical teams and, as 30 to 40% of trauma deaths are caused by a potentially preventable hemorrhagic shock[2], the need for rapid and effective intervention in the prehospital setting is essential.

Metabolic derangement resulting from trauma and decreased oxygen perfusion is responsible for physiological exhaustion which will lead the patient to a vicious cycle called the Lethal Triad: metabolic acidosis, hypothermia, and coagulopathy[3].

Once the insufficiency of tissue oxygen supply is detected, anaerobic metabolism will take place[1], ending up in metabolic acidosis[4].

The reduction in oxygen supply that affects the tissues during shock will result in lactic metabolic acidosis, which in turn will lead to decreased coagulation factors and platelets activity which plays a major role in causing coagulopathy in trauma patients[5].

Hypothermia, defined when body temperature is below 35 ° C, may be categorized as mild (when the temperature ranges from 32 to 35 ° C), moderate (from 28 to 32 °C), and severe, when the temperature is below 28 ° C[6]. In trauma patients, hypothermia results essentially from blood loss, patient exposure, unheated fluids administration and loss of thermoregulation capacity[4].

Hypothermia is responsible for the decrease in the interaction of von Willebrand factor with platelet glycoproteins causing platelet dysfunction, but also for inactivating the temperature-dependent coagulation factors and inducing changes in the fibrinolytic system, thus causing endothelial abnormalities[4]. Prehospital interventions are important to promote hemodynamic stability, bleeding control and patient's rewarming[7]. That way, rewarming measures should be carried out in prehospital context and include the use of passive and active measures[8].

Intravenous fluid therapy is a therapeutic option available in pre or in-hospital medical team protocols and that can be applied to these victims. It can be used for hypovolemic correction and as a warm-up measure for hypothermia prevention and treatment[9,10]. However, there has been little consensus among scientific community as to whether this kind of approach should be adopted, considering that it leads to higher blood pressures and, when implemented prior to surgical hemorrhage control, may cause the rupture of blood clots formed in the injured blood vessels that might, in turn, cause rebleeding[11]; it is also responsible for the development of hyperchloremic metabolic acidosis that will worsen the victims' health condition[5]; it is also considered an important cause of coagulopathy, due to hemodilution caused by the administration of saline or other crystalloids fluids[4].

This review intends to summarize knowledge currently available about the importance of intravenous fluid therapy in a prehospital setting, particularly when hypovolaemia and hypothermia correction in trauma victims are concerned.

METHODS

To answer the research question "When is the administration of fluid therapy recommended to control hypotension and hypothermia in trauma victims?", a narrative review was performed in order to produce a comprehensive narrative synthesis of the previously published information on this research problem[12]. A narrative review was the methodological option chosen, since the purpose of this study was to provide insight into the available literature rather than provide guidance.

A preliminary search was carried out using Pubmed and CINAHL in order to understand the main keywords used to describe the problem. The review included studies published in English, Spanish or Portuguese that have been published between 1994, the year that witnessed the publication of the first and most important RCT on the impact of fluid therapy on hypotension control[13], and January 2019.

Inclusion criteria included trauma victims aged over 18 submitted to fluid therapy in a context of prehospital assessment, emergency rooms and/or trauma centers. Sources of information included the following databases: CINAHL Plus, PubMed, Cochrane Central Register of Controlled Trials, Scopus, PsycINFO, The JBI Database of Systematic Reviews and Implementation Reports, Cochrane Database of Systematic Reviews, RCAAP – Repositório Científico de AcessoAberto de Portugal, OpenGrey – System for Information on Grey Literature in Europe. Initial MeSH terms and delimiters used were: ("trauma" AND "Prehospital Care") AND ("fluid therapy" OR "rewarming") AND ("hypotension" OR "hypothermia").

Published and unpublished quantitative studies were included in this search strategy. Analysis of the included literature was, during this initial phase, conducted by two in-

dependent reviewers who analyzed a wide range of titles and abstracts for inclusion in the review. A third reviewer was also involved in the event of disagreement.

RESULTS & DISCUSSION

After duplicates were removed, a total of 2775 citations were identified from searches of electronic databases and article references review. Based on the title and abstract, 2598 were excluded, with 177 full-text articles to be retrieved and assessed for eligibility. Of these, 166 were excluded for the following reasons: 130 did not directly study the main topic, 22 included children or adolescents, 9 studies were not in defined languages. We excluded 5 studies because we were unable to retrieve them.

A total of eleven quantitative studies were included, nine of them involved the use of fluid therapy for hypotension treatment and two of the studies analysed involved the use of warmed fluid therapy for hypothermia treatment.

Prehospital Fluid Resuscitation Strategy

Use of fluid therapy in trauma patients is a widely used clinical option for prehospital correction/management of low blood pressure due to hypovolemia[10, 14, 15]. Vascular compliance allows for the maintenance of normal blood pressure for a lower blood volume[16]. As such, blood pressure and circulating volume are proportional and have equal meaning when other pressure determinants, such as compliance, remain constant[17]. Systolic blood pressure, due to vascular compliance, decreases only when in the presence of hemorrhagic loss over 30% of the blood volume, a situation that will entail a worse prognostic[18].

According to the physiopathology described, many authors believe that volemic reposition after trauma improves tissue perfusion[19]. In contrast, effects of this aggressive volemic reposition are acute respiratory distress syndrome, abdominal compartment syndrome, cerebral edema, and cardiac dysfunction[20, 21].

In a study that involved 593 adults with penetrating torso injuries and with systolic blood pressure of less than 90 mmHg, was proven that the group with delayed fluid resuscitation, who receive only 92ml of Ringer's acetate solution, presented shorter length of hospital stay and higher survival rates compared to the group with immediate fluid resuscitation, who received 870 ml of Ringer's acetate solution[13]. The same study showed that for hypotensive victims with penetrating torso injury, delay of aggressive fluid resuscitation improves the outcomes.

Another study involved 1399 trauma victims divided into two groups. One of those groups received fluids right where the accident had occurred and the other only when they got to the hospital. There were no significant differences for six-month mortality and no difference was found as far as complications were concerned[22]. A research that assessed hypotensive trauma patients presenting to an Emergency Department found out that prehospital fluid resuscitation may reverse shock. However, the infusion of more than one litre of volume was associated with an increased likelihood of receiving blood transfusion[23].

Increased blood pressure can only be achieved when increase in cardiac output occurs first. As such, fluid reposition is not, on its own, sufficient[24].

A study with 192 patients with hypotension after trauma, dividing them into two groups: one of them, the "Controlled Resuscitation group", received 250 ml (and additional 250ml as needed) to achieve a systolic blood pressure of 70mmHg, and the other group, the "Standard Resuscitation group" received 2L (and additional fluid as needed) to maintain a systolic blood pressure of 110mmHg[25]. Among patients with blunt trauma, 24-hour mortality was 3% among the first group and 18% among the Standard Resuscitation group.

A multicenter prospective study of blunt injured adults transported from the incident scene to the hospital with Injury Severity Score being greater than15, showed that prehospital fluid resuscitation in severely injury blunt trauma patients, who received more than 500 mL, was associated with worse outcomes in patients without prehospital hypotension, namely an increase in the risk of mortality and acute coagulopathy. These results were not verified in prehospital hypotension patients. Instead, each 1 mm Hg increase in emergency department systolic blood pressures was associated with a 2% increase in survival in subjects who belonged to that prehospital hypotension group[26].

Aggressive fluid therapy may not present immediate complications. Studies conducted report, in Intensive Care and after adjustment of other risk factors, an increase in mortality rates of 10% for each litre of positive fluid balance[27].

Observational studies seeking to identify the impact of fluid reposition on trauma victims also showed that, a decrease in the aggressive fluid infusion will cause a decrease in hemodilution by the time of arrival in emergency department and to a decrease in coagulopathy and mortality[14]. These authors understand that permissive hypotension and restricted fluid reposition is the best approach for prehospital assistance.

Fluid administration therapy in trauma victims is far from being consensual. However, results provided by quantitative studies, randomized controlled trials and observational studies support that

TABLE 1

STUDY HIGHLIGHTS

What is already known on this topic
Hypovolemia and hypothermia are common and potentially preventable complications in trauma patients Little or no consensus exist in the scientific community regarding the best approach for hypovolemic correction and hypothermia prevention and treatment
What this study adds
Permissive hypotension appears to be the best approach for prehospital fluid administration protocols Protocols for hypothermia correction with two different purposes (heat loss reduction and temperature increase) need to be developed

this kind of therapy leads to less complications and mortality than aggressive fluid resuscitation and consider permissive hypotension as the most viable therapeutic option[28].

The challenge imposed is to develop the most appropriate algorithmic strategy that will have to take into account the hemodynamic parameters for the implementation of resuscitation through permissive hypotension[29].

The European guideline on management of major bleeding and coagulopathy following trauma[30] leaves three major recommendations: a target systolic blood pressure of 80 to 90 mmHg until major bleeding has been stopped in the initial phase following trauma without cerebral injury. In patients with severe traumatic brain injury (GCS ≤8), mean blood pressure ≥80 mmHg is recommended[1, 28]; also recommended is the use of a restricted volume replacement strategy and the administration of vasopressors in addition to fluids to maintain target blood pressure in patients with life threatening hypotension.

Fluid therapy as a rewarming measure

Hypothermia can be caused by many diseases or conditions that will decrease thermoregulatory responses or even by environmental exposure, but can also be caused by trauma, sepsis or by any other disease that can cause a decrease in the production of metabolic heat or may affect thermoregulation[31].

Hypothermia is present in two-thirds of trauma victims with severe body injuries, so body temperature control should be a priority in early treatment[8]. Thus, early application of measures to reduce heat loss and warm hypothermic patients has been highly recommended in order to achieve and maintain normothermia[32].

The administration of heated fluid therapy is one of the most common measures implemented in prehospital care to achieve hypothermia prevention[9, 10],however, other authors demonstrated that warmed crystalloid solution cannot reheat a hypothermic victim since one would need 14 litters of infused fluids at 60ºC, the highest temperature possible for infusion, to achieve that purpose. This total volume is well above the tolerated limit because of the risk of developing abdominal compartmental syndrome and acute respiratory problems[33].

Although many authors consider heated fluid administration as an active warming measure[8], other authors have demonstrated that heated fluid therapy does not provide active warming, instead, and assuming that fluid infusion in trauma victims is really necessary, heated fluid administration plays but a passive role in warming up the victims, which means that it only avoid further heat loss[33]. Other authors have also verified that heated fluid therapy administration did not have positive results in rising core temperature[34]. Administration of heated bolus at 38-42ºC will, therefore, prevent further heat loss and will not help as an effective active warming measure[35].

The European guideline on management of major bleeding and coagulopathy following trauma[30] recommends the early application of measures to avoid heat loss and heating measures to maintain and promote normothermia that include the removal of wet clothing, covering the patient to avoid additional heat loss, increasing ambient temperature, forced air warming, warm fluid therapy, and, if necessary, extracorporeal re-warming devices. It is important to note, however, that in a cold prehospital environment, intravenous fluids cool rapidly which can worsen hypothermia[35].

Thus, it is important to reflect on the need to develop intervention protocols that would include heating measures with two different purposes: heat loss reduction and temperature increase, with protocols designed to achieve each of these objectives **(Table 1).**

CONCLUSION

The administration of prehospital intravenous fluid therapy is a commonly used measure for trauma victims in order to promote hemodynamic stability that had been compromised by low blood pressure consequent to hypovolemic shock. On the other hand, the administration of heated boluses

is also an important therapeutic measure to correct hypothermia. These two premises are far from being consensual among scientific community and among medical and paramedical professionals who are part of the prehospital teams. Intravenous fluid therapy seems to offer no benefit for the hemodynamic stability of trauma victims and this measure is often associated with an increased risk of mortality.

The option that seems safer for the patient is the permissive hypotensive resuscitation with a target systolic blood pressure of 80 to 90 mmHg until bleeding stops. However, victims suffering from severe traumatic brain injury should be excluded from this approach, since this fluid administration process should lead to mean blood pressure values ≥80 mmHg. Systematic reviews conducted show that permissive hypotensive resuscitation is feasible and safe as a fluid resuscitation strategy to control hemorrhagic shock in prehospital and hospital settings.

Regarding the correction of hypothermia in trauma patients, literature continues to present heated intravenous fluid therapy as an important measure to allow the victims' rewarming. However, observational studies and randomized clinical trials showed that it is not effective at all. To achieve normal body temperature values, using exclusively heated fluid therapy, the total volume of fluids would compromise the patient's own survival and would cause acute respiratory distress syndrome, abdominal compartment syndrome, cerebral edema, cardiac dysfunction and others complications.

Further studies should be conducted with larger samples and a more appropriate randomization methodology. Accurate methodologies used to define limited volume strategy for correction of hypotension and the ideal temperature of this volume for the prevention of hypothermia are also necessary.

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