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Review Article

Management of Hemorrhage and Hemorrhagic Shock in Emergency Room

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Abstract

Background: Traumatic hemorrhage is a serious condition as severe trauma contributes to 1 in 10 deaths, resulting in an annual death of more than 5.8 million individuals. Around 40% of traumatic mortalities are attributed to severe hemorrhage and its consequences. Appropriate management of hemorrhage and hemorrhagic shock in the emergency room will represent a hurdle in controlling the cause-specific death rates of trauma. Damage control resuscitation involves hemostatic resuscitation, permissive hypotension and damage control operations and further studies are needed to examine the influence of these approaches on different types of patients and traumas.

Aim: In this review, we will look into management of hemorrhage and hemorrhagic shock in emergency room.

Methodology: The review is comprehensive research of PUBMED since the year 1997 to 2019.

Conclusion: Focusing research on the development of new innovative techniques to control bleeding while avoiding the lethal triad of trauma- and resuscitation coagulopathy, acidosis and hypothermia will represent a hurdled in controlling deaths resulting from traumas.

Keywords: *Hemorrhage; Injury; Trauma; Mortality*

Introduction

Hemorrhage is defined as the acute loss of blood from a damaged blood vessel [1]. The amount of blood lost can be minor or significant leading to ambiguous chain of symptoms that rapidly alter the subject's vital signs as well as mental status [2]. Hemorrhage is a symptom of a wide variety of incidents and conditions that can lead to vascular insult and blood loss. Traumatic hemorrhage is a serious condition as severe trauma contributes to 1 in 10 deaths, resulting in an annual death of more than 5.8 million individuals, globally making it a major public health issue [3,4]. Uncontrolled post-traumatic bleeding can be lethal or disabling. Around 40% of traumatic mortalities are caused by hemorrhage or its consequences, making hemorrhage the most common factor leading to preventable death among traumatized patients [5].

Severe loss of blood leads to inadequate tissue perfusion and hypoxia taking the body to the manifestations of shock. Shock is defined as the inadequate perfusion of body tissues as a result from an imbalance between the tissue needs of oxygen and the body's ability to supply it [6]. Hypovolemic shock is the category of shock characterized by a significant decrease in the intravascular volume causing malfunction. A subset of hypovolemic shock is hemorrhagic shock which can result from many conditions. The most common cause of hemorrhagic shock is blunt or penetrating trauma, followed by gastrointestinal bleeding. Many other factors have been described and reported to result in hemorrhagic shock including obstetrical, vascular, iatrogenic and more [7].

Pathophysiology

Severe hemorrhage leads to the inability to match the body demand for oxygen. Mitochondria are no longer able to maintain aerobic metabolism and production of energy and in order to meet the cellular oxygen demand for ATP, they switch to anaerobic metabolism which, in a short time, leads to accumulation of lactic acid to be utilized in other biochemical pathways to maintain function in an anaerobic conditions [8,9].

Series of responses are achieved once the body is losing significant amount of blood that result in increased heart rate and cardiac contractility, as well as increased sympathetic activity through activation in baroreceptors, which results in peripheral vasoconstriction leading to diversion of blood from noncritical sites towards vital organs to maintain their perfusion. While diverting the blood to vital organs due to sympathetic activation, the noncritical organs and sites suffer even further hypoxia and lactic acid production leading to acidosis. If left uncontrolled, acidosis and hypoxia can lead to loss of the vasoconstriction, reversing the hemodynamic mechanism to save the vital organs and leading to death [10,11].

Trauma-induced coagulopathy (TIC)

Among other factors that worsen the state of a hemorrhagic shock patient is the development of coagulopathy. It is a clinical syndrome featuring failure of blood coagulation in the early stages of trauma due to various factors, such as bleeding and tissue injury [12]. Severe bleeding causes loss of coagulation factors and resuscitation fluids lead to dilution of blood. This, along with acidosis and hypothermia, lead to failure of the coagulation cascade. However, it is now believed that TIC is not associated with resuscitation-induced coagulopathy since literature reported that TIC begins before the initiation of resuscitation in 25% of patients.

The activity of the coagulation pathway is affected by acidosis. In addition, entering the state of hypothermia (below 34C) resembles an independent risk for mortality in cases of hemorrhagic shock [13,14].

Evaluation of blood loss

Four different classes of hemorrhagic shock have been identified by the American College of Surgeons Advanced Trauma Life Support (ATLS) predicting the physiologic response of a healthy 70 kg patient to different amounts of blood loss. A healthy 70 kg patient has about 5 Liters of blood as the average amount of circulating blood is approximately 7% of the total body weight.

The first class is the loss of up to 15% of total circulating blood. The heart rate is normal or with minimal elevation. Respiratory rate, blood pressure as well as pulse pressure remain normal.

The second class is the loss from 15% to 30% of total circulating blood. Heart rate is increased (100 - 120 BMP) and respiratory rate is increased (20 - 24 RR). Systolic blood pressure remains normal or decreases slightly, and pulse pressure slightly narrows.

The third class is the loss from 30% to 40% of total circulating blood. Changes of the mental status occur at this stage, and the blood pressure drops significantly. Respiration and heart rate significantly increase (more than 120 BPM) and there is a delay in the capillary refill.

The forth class is the loss of over 40% of total circulating blood. Mental status and hypotension deteriorate and heart rate is more pronounced. Pulse pressure is narrow (less than 25 mmHg) and urine output is minimal [15,16].

Examination

Locating the type and source of bleeding is a crucial step in the management of hemorrhagic emergencies. History taking includes mechanism of injury, in cases of trauma, and history of present illness may give the health care provider an insight of where the source of blood. There are five areas in the external body that can have a life-threatening bleeding: thorax and neck, abdomen, pelvis, retroperitoneum, and the thighs. The evaluation might include assessment along with attempting to control any significant bleeding. It is important to know if the bleeding is associated with use of any antiplatelet or anticoagulant medication [17,18].

Physical examination along with radiological evaluation are important to localize all the sources of hemorrhage. A Focused Assessment with Sonography for Trauma (FAST) is a bedside ultrasound examination performed to detect free blood around the heart or abdominal viscera after trauma [19].

FAST has been a valuable diagnostic approach recommended by the American Institute of Ultrasound in Medicine (AIUM) and American College of Emergency Physicians (ACEP) and it is now replacing the use of diagnostic peritoneal lavage (DPL) and computer topography (CT) [20].

Benefits of FAST examination include decreasing the time of diagnosis of acute abdominal hemorrhage and assessing the level of severity in blunt abdominal trauma, noninvasiveness, can be used for serial examinations, safe for pregnancy and it can be performed quickly, without removing patients from the emergency room [21].

Management

When managing an emergency of hemorrhage, the health care provider should be focused on the lethal triad of coagulopathy, acidosis and hypothermia. Controlling and stoppage of bleeding is the main primary management when handling severe hemorrhage in the emergency room. European guidelines recommend [22] the minimization of the time elapsed between the trauma and the urgent surgical bleeding control by local compression to limit life-threatening bleeding as well as the pre-operative use of tourniquet in cases of open extremity traumas with life-threatening bleeding and the pre-operative use of pelvic binder in suspected pelvic fractures with life-threatening bleeding [23].

Resuscitation with IV fluids is necessary if the patient presents signs with severe hypovolemia. For hemorrhagic shock patients without head trauma, hypotensive resuscitation has been recommended to achieve a systolic blood pressure of 90 mmHg to maintain an adequate tissue perfusion without the opening of recently clotted vessels. Achieving balance between end-organ perfusion and stoppage of bleeding is critical in patients with severe trauma [24]. Permissive hypotension is the restriction of resuscitation fluids and accepting a suboptimal level of end-organ perfusion until bleeding is controlled. This approach may avoid the side effects of high dose fluid resuscitation including resuscitation-induced coagulopathy and acceleration of hemorrhage.

Current guidelines recommend the use of permissive hypotension and controlled resuscitation. Studies are conflicting on which treatment is better for which type of trauma. Studies performed on animals suggest that hypotensive resuscitation has better outcomes in subjects with penetrating injury as the blood has a limited exit from the body whereas the hypotensive resuscitation can worsen the

outcomes of cases with blunt trauma due to tissue hypoperfusion. Further studies are needed to sufficiently examine the influence of these approaches on different types of patients and traumas [25]. The effectiveness of hypotensive resuscitation/permission hypotension and restricted/controlled resuscitation is still debatable and more clinical trials are recommended for elucidating the best outcomes. Damage control resuscitation (DCR) involves hemostatic resuscitation, permissive hypotension and damage control surgery [26]. DCR is to be conjugated with adequate intervention to control the source of bleeding. In management of hemorrhage, fluid resuscitation includes the IV infusion of normal saline or lactated ringer. Blood products should be given in equal amounts (1:1:1) for packed red blood cells, fresh frozen plasma, and platelets. In hemorrhagic shock, normal saline causes a non-anionic gap hyperchloremic metabolic acidosis as it has high amounts of chloride. On the other hand, lactated ringers can cause metabolic alkalosis due to the regeneration of lactate into bicarbonate [27].

Target mean arterial blood pressure (MAP) is more than 65 mmHg. For brain traumas, the target MAP is 105 mmHg or more and systolic blood pressure more than 120 mmHg. When the patient has penetrating trauma, the goal systolic blood pressure should be more than 90 mmHg [23].

Conclusion

Focusing research on the development of new innovative techniques to control bleeding while avoiding the lethal triad of trauma- and resuscitation coagulopathy, acidosis and hypothermia will represent a hurdled in controlling deaths resulting from traumas.

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