EC MICROBIOLOGY
Review Article

Acute Blood Loss in Emergency Setting

Muhammad Ali Alkholy[1]*, Laila Ismail Buarish[2], Meshari Awadh Almutairi[3], Amer Hamoud Al Harbi[4], Mays Nawaf Alharbi[5], Saif Mohammed Alharbi[6], Zuhair Hamdan Alsuhaymi[7], Abdulaziz Salem Bafaraj[8], Maktoom Madies Almalki[9], Abdulaziz Zakaria Alsaegh[10], Razan Nasser Alghamdi[11] and Mohammed Saeed Alalawi[12]

[1]*Emergency Medicine Consultant, East Jeddah General Hospital, Jeddah, Saudi Arabia*
[2]*Alfarabi College of Medicine, Riyadh, Saudi Arabia*
[3]*King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia*
[4]*King Fahd Specialist Hospital, Qassim, Saudi Arabia*
[5]*Arabian Gulf University, Manama, Bahrain*
[6]*Qassim University, Qassim, Saudi Arabia*
[7]*Al Mikhwah General Hospital, Mecca, Saudi Arabia*
[8]*East Jeddah General Hospital, Jeddah, Saudi Arabia*
[9]*King Abdulaziz University, Jeddah, Saudi Arabia*
[10]*King Abdulaziz University, Rabigh, Saudi Arabia*
[11]*Princess Nourah University, Riyadh, Saudi Arabia*
[12]*Anak General Hospital, Anak, Saudi Arabia*

***Corresponding Author:** Muhammad Ali Alkholy, Emergency Medicine Consultant, East Jeddah General Hospital, Jeddah, Saudi Arabia.

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Abstract

Introduction: Blood loss in trauma patient is the most common cause of hypovolemic shock that threatening their life. Blood loss severe enough to cause shock is treatable cause of death. It is the second leading cause of death following traumatic brain injury in patient with trauma.

Aim of Work: In this review, we will discuss the initial approach to acute blood loss of adult patients in emergency setting.

Methodology: A comprehensive and systematic search was conducted regarding acute blood loss, hemorrhage, and trauma management in ED. PubMed and Google Scholar search engine were the mainly used database.

Conclusion: The first life-saving measure of hemorrhage management is controlling external bleeding; all efforts should be directed toward it. This should be attempted as early and rapidly as possible. The usage of fluid in trauma patient with excessive bleeding including the optimal type and volume remains the subject of considerable debate. Blood and blood products are best methods for resuscitation, red blood cells, plasma, and platelets are best given in equivalent amount (1:1:1 ratio). Noninvasive measures to assess the adequacy of resuscitation appear to be feasible, inexpensive, and equivalent to invasive monitoring. Such measures include MAP, heart rate, pulse oximetry, carbon dioxide tension and urine output

Keywords: *Blood Loss; Trauma*

Introduction

In the emergency department, blood loss in trauma patient is the most common cause of hypovolemic shock that threatening their life. Other cause of shock in these patients include mechanical obstruction that may present as cardiac tamponade or tension pneumothorax. In addition, neurologic dysfunction as in spinal cord injury may be considered as a potential or contributing factor to shock [1]. Blood loss severe enough to cause shock is treatable cause of death. It is the second leading cause of death following traumatic brain injury in patients with trauma [2,3].

In this review, we will discuss the initial approach to acute blood loss of adult patient in emergency setting. Other aspects of management of adult trauma patients including pathophysiology, non-hemorrhagic shock or subsequent management of trauma-related hemorrhage are dedicated another review.

Methodology

A comprehensive and systematic search was conducted regarding acute blood loss, hemorrhage, and trauma management in emergency setting. PubMed search engine (http://www.ncbi.nlm.nih.gov/) and Google Scholar search engine (https://scholar.google.com) were the mainly used database. All relevant available and accessible articles of all types were reviewed and included. The terms used in search were: blood loss, hemorrhage, trauma, hypovolemic shock, and resuscitation.

Classification of hemorrhage

The American College of Surgeons (ACS) has described 4 classes of hemorrhage in their Advanced Trauma Life Support (ATLS) manual [3]. It is worth mentioning that significant decline in patients' blood pressure are not considered an early sign of shock. Such drop in blood pressure (BP) may not appear until the development of Class III hemorrhage and patients losing up to 30 percent of their blood volume.

The first class of hemorrhage involves loss of up to 15 percent of blood volume. During this time, the heart rate (HR) could be normal of slightly elevated. Hence, changes in blood pressure, pulse pressure, or respiratory rate are not usually present. When the percent of lost blood ranges between 15 to 30 percent, this is considered as a class II hemorrhage. In this class, clinical changes usually start by increasing hear rate to 100 - 120 (tachycardia), respiratory rate of 20 to 24 (tachypnea), and a decreased pulse pressure. However, systolic blood pressure (SBP) may change slightly or may not change at all. The skin may be cool and clammy, and capillary refill may be noticed. In class III hemorrhage, patients lose 30 to 40 percent of their blood volume. Here, a significant drop in blood pressure is seen with the possibility of changes in mental status. A drop in BP below 90 mmHg causing a hypotension should raise concern and should be considered due to hemorrhage until proven the otherwise. In this class, the HR is usually above 120, respiratory rate are markedly elevated, and Capillary refill is notably delayed. In class IV hemorrhage, the blood loss is more than 40 percent of blood volume which cause a significant drop in BP and severe changes in mental status. Most patients are hypotensive (SBP less than 90 mmHg) with low pulse pressure narrowed and marked tachycardia. Urine output could be absent and the patient appears cold and pale with marked delay in capillary refill.

Initial management of acute blood loss

The first life-saving measure of hemorrhage management is controlling external bleeding and all efforts should be directed toward it. This should be attempted as early and rapidly as possible. The primary methods to control external bleeding is by applying a direct pressure. A tourniquet for extremity and clips for scalp lacerations are also possible methods that control such bleeding.

Once attempts to stop external bleeding have success, subsequent approaches are guided by the injuries, vital signs, volume of blood loss, as well as the availability of resources and if there is a need for transfer. However, some key principles that apply to all trauma patients with bleeding (the application and the details of management may slightly vary according to the clinical scenario) include: (a) intravenous (IV) fluids should be used only if hypotension has developed and then only until blood is available; (b) once the need for transfusion has been decided, blood should be given as soon as possible; (c) other blood products such packed red blood cells, plasma, and platelets should be given in equivalent amounts; (d) assessment of coagulation profile should be used as soon as possible to guide resuscitation.

The usage of crystalloid fluids in the treatment of hemorrhage increases the risk of further bleeding by the dilution of clotting factors and platelets. In addition, excess use of such fluids may lead to hypothermia. Thus, as stated before, IV fluids in early management should be avoided as possible and only resorted to when blood products are not readily available. When there is a need to start IV fluid, physicians should start with the smallest volumes necessary. The choice of fluid will be discussed later in this review.

In the emergency setting, patients with severe hemorrhage need blood. To minimize the risk and the adverse effects of massive transfusion, blood products (red blood cells, plasma, and platelets) are best given in equivalent amount (ratio of 1:1:1). However, mortality reduction in patients with severe blood loss has been observed to be possible by administrating a higher ratio of plasma and platelets to packed red blood cells (PRBCs). Hence, the so-called "Damage Control Resuscitation" (DCR) has been developed and often used in combination with Damage Control Surgery. The main goals of DCR is the rapid control of hemorrhage and prevent coagulopathy by minimizing crystalloid use. This principle relies on using a high ratio of plasma and platelets to red blood cells [4,5]. Meanwhile, this approach may entail permissive hypotension which is allowing patients to remain relatively hypotensive for some duration during the resuscitation. These are guiding principles apply to all adult trauma patients, although their application and the details of management will vary according to the clinical

Intravenous (IV) fluids

The usage of fluid in trauma patient with excessive bleeding including the optimal type and volume remains the subject of considerable debate. However, IV fluids should be started only when hypotension is developing and blood products are not readily available. The experts recommend initial IV fluid for patients with hemorrhagic shock to consist of 500 mL of isotonic crystalloid given in bolus as rapid as possible. This is done through short, large gauge peripheral IV access and should be repeated by the same way until blood products are available or until systolic blood pressure (SBP) is 90 mmHg or more. Central venous catheters could be used when peripheral IVs are not available. If the emergency departments have ready to use blood products, immediate transfusion of blood products should be done rather than fluid resuscitation.

In one study, the researchers have observed that infusions of more than 500 mL of isotonic crystalloid were associated with harmful outcomes in patients without hypotension, but not in patients with hypotension. Thus, they concluded that resuscitation should be directed based on patients systolic blood pressure measurement of less than 90 mmHg [6]. Hence, the physicians' goal is to minimize the administration of IV fluid as possible, but with care of avoiding hypotension. Once blood or blood products are available, a transition from crystalloid should be carried. Based on observational data, a ratio of crystalloid fluid to blood more than 1.5:1 was associated with worse outcomes in patients with severe hemorrhage [7,8].

The optimal type of IV fluid is of continuing debate, one systematic review of prehospital fluid resuscitation found insufficient evidence to support the superiority of any particular fluid type [9]. Giving large volumes of normal saline (NS) can cause a non-anion gap hyperchloremic metabolic acidosis. Lactated ringers (LR), on the other hand, may lead to metabolic alkalosis due to metabolism of lactate to bicarbonate. However, within the typical volume of either type of these fluids, NS and LR do not appear to have significant clinical consequences. The described adverse outcomes of these fluids may occur in case of excessive volume being used especially in patient at increased risk (as in patient with acute renal injury caused by hemorrhagic shock). Ringer lactate fluid should be infused in a separate line from blood due to the risk of clotting. In one retrospective study of records founds no negative effect in patients given 1L or less of isotonic crystalloid, however, the study found two-fold increase in mortality rate when patients were received 1.5L or more [10]. Some researchers believe that Lactated ringer is superior to isotonic normal saline in case of uncontrolled hemorrhagic shock; other researchers argue just the opposite [11,12]. The end-point for fluid therapy remain unclear [13]. Further use of IV resuscitation should be based on the patient's response to initial IV fluids and overall assessment and condition. A mean arterial pressure (MAP) around 65 mmHg or an SBP around 90 mmHg is considered adequate in case of blood loss caused by penetrating trauma. In patients with hemorrhage due to blunt trauma, higher MAP and SBP (85 mmHg and above 120 mmHg respectively) appear to be more adequate. This goal should be furtherly increased if the patient is known to have uncontrolled hypertension. Nevertheless, other conditions such as heart failure, pulmonary hypertension should be considered carefully and continual monitoring of these patients is crucial. As a conclusion, there is no consensus on the ideal MAP or SBP for the severely injured patient. Yet, limiting the amount of IV fluid used for trauma resuscitation in the absence of hypotension is still recommended by most experts [14].

Regarding hypertonic saline, many studies have evaluated its use. Hypertonic saline may provide benefit through osmotic movement of interstitial fluid into the vascular compartment and reduce the inflammatory response to injury [15]. While some trials have shown favorable outcomes [16] others did not do so [17,18]. Further study is needed to fully understand its role.

The role of colloids (albumin solution, dextran) in resuscitation of traumatic shock is unproven [19,20]. Although colloids are better than crystalloid in increasing intravascular volume and maintaining oncotic plasma, a systematic review of randomized trials found that use of colloids did not yield any benefits on mortality or morbidity rate in trauma patients [19]. Recently, many studies are conducted to examine oxygen-carrying resuscitation fluids that may act as alternatives to PRBCs. This could be very promising in the near future.

Blood and blood products

The critical cut-off to start blood transfusion remains among the most important and yet unanswered question in trauma research. The decision is usually depends of clinical scenario and physicians' judgment. In one case, immediate transfusion of PRBCs, plasma, and platelets is needed in patient with over two L of blood loss from inserted chest tube. In another case of self-inflicted wrist laceration, the need of blood product transfusion may not be necessary even if the patient is hypotensive, because hemorrhage in such case could be promptly controlled, the wound is easily repaired, and co-morbidities are absent.

Typed and cross-matched packed red blood cells (PRBCs) are the best, but it may require considerable time (at least 20 minutes in most cases) to be prepared. If patients condition is critical, immediate transfusion of type O Rh-positive or type O Rh-negative for males and type O Rh-negative for girls and women in child-bearing age. Trauma centers should always store type O blood in the ED refrigerator. Blood transfusion is becoming safer with the development of testing tools. Although rare, some risks of blood-borne infection still persist.

Assessment and upholding resuscitation

The Best end-point for fluid therapy remain unclear [13]. In addition to continual blood pressure monitoring, thromboelastography (TEG) or other useful rapid test of coagulation status should be used to guide trauma resuscitation. However, these resources may not be available in many community hospitals. Hence, a mean arterial pressure (MAP) and systolic blood pressure (SBP) could be a reasonable measure of assessment. The adequate values of MAP and SBP are 65 mmHg and 90 mmHg, 85 mmHg and 120 mmHg for bleeding caused by penetrating or blunt injuries respectively.

While some experts advocate strictly limiting the use of intravenous (IV) fluid for trauma resuscitation in the absence of hypotension [14] others have doubted the clinical importance of this approach [21]. It is safe to recommend the minimizing crystalloid administration as hypotension in avoidable until blood availability. Packed red blood cells (PRBCs), fresh frozen plasma (FFP), and platelets are transfused if the goal blood pressure is not maintained by IV boluses of isotonic crystalloid.

In some community hospitals and primary care units, traumatic patients with blood loss may need to be managed for prolonged time until surgical resources or transportation become available. In these patients, itis unclear which endpoints are most useful for guiding such resuscitations. In such poor-resources setting, emergency clinicians must rely on standard physiologic and laboratory measurements to determine whether resuscitation is adequate. Parameters that may be used to guide prolonged resuscitation of traumatic shock include [22,23]: (a) Blood pressure and MAP above 65 mmHg for penetrating trauma, and above 85 mmHg for blunt trauma; (b) Heart rate (HR) to be between 60 and 100 beats per minute; (c) Oxygen saturation above 94 percent; (d) Urine output above 0.5 mL/kg per hour; (e) lactate and base deficit every 4 hours to ensure adequate or improved end-organ perfusion, serum lactate < 2 mmol/L and normal base status are reasonable goal; (f) mixed central venous oxygen saturation every 4 hours to ensure to ensure adequate or improved end-organ perfusion, maintained above 70 percent.

In traumatic patients with less severe hemorrhage, the transfusion of blood or blood product in ED could be conducted and guided by many criteria and parameters. If hemoglobin falls below 8 g/dL 2 units of PRBCs should be administered. If the patient is at risk of acute coronary syndrome (ACS), the hemoglobin value should be 10 g/dL [24]. Emergency physician should give one unit of apheresis platelets or 6 units of random donor platelets if the serum concentration falls below 50,000/microL. Additionally, 2 units of fresh frozen plasma (FFP) should be given if the International normalized ratio (INR) rises above 2. Fibrinogen is another factor that may aid the assessment if transfusion needs, 10 units of cryoprecipitate if its concentration falls below 100 mg/dL. On the other hand, laboratory measurements can be inaccurate in case of massive and ongoing bleeding. Empiric transfusion of blood products in this setting and rapid control of bleeding is paramount.

Some researchers recommend using lactate concentration to assess the adequacy of management of blood loss in the emergency department [25-27]. Other authors acknowledge the prognostic value of metabolic acidosis and hence they believe that admission base deficit may be superior to plasma lactate in predicting injury severity and death [28]. Both parameters may provide useful feedback about the status of tissue oxygen and the adequacy of resuscitation [29,30].

Noninvasive and invasive (as pulmonary artery catheter) monitoring have been compared in many studies in evaluating patients with trauma and bleeding in ER. Recent noninvasive measures appear to be feasible, inexpensive, and equivalent to invasive monitoring [23,31]. Noninvasive monitoring in these studies included some advanced technologies in addition to standard measures as MAP, heart rate, pulse oximetry, and carbon dioxide tension.

Conclusion

Blood loss in trauma patient is the most common cause of shock that threatening their life. The American College of Surgeons (ACS) has described 4 classes of hemorrhage according the volume of blood loss and changes in clinical signs. The first life-saving measure of hemorrhage management is controlling external bleeding and all efforts should be directed toward it. This should be attempted as early and rapidly as possible. The usage of fluid in trauma patient with excessive bleeding including the optimal type and volume remains the subject of considerable debate. Blood and blood products are best methods for resuscitation, red blood cells, plasma, and platelets are best given in equivalent amount (1:1:1 ratio). Noninvasive measures to assess the adequacy of resuscitation appear to be feasible, inexpensive, and equivalent to invasive monitoring. Such measures include MAP, heart rate, pulse oximetry, and carbon dioxide tension.

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