Consider Autotransfusion in the Field

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ABSTRACT Massive hemothorax is a life-threatening condition that can present as hemorrhagic shock, cardiogenic shock, or elements of both. It is described by the American College of Surgeons, in the 9th Edition of Advanced Trauma Life Support, as a rapid accumulation of more than 1,500 mL of blood or one-third or more of the patient's blood volume. The use of autotransfusion systems has been implemented for the treatment of hemothorax in hospital settings. The implementation of autotransfusion has been documented in situations where an extended period can elapse before definitive treatment can occur. This article is the first described case where an autotransfusion system has been implemented in a prehospital setting, at a Role 1 medical facility, for massive hemothorax in Afghanistan.

INTRODUCTION

A medical doctor or physician assistant along with a staff of Corpsmen or Medics typically operates a Role 1 medical treatment facility (MTF). It serves the purpose of triage, treatment, and evacuation. The facilities of a Role 1 MTF have vital sign monitors, suction devices, and basic surgical instruments. There is limited access to laboratory or formal radiology, and has inconsistent access to blood products. They can be located in remote settings requiring helicopter transport for patients, which can take up to a half hour to arrive and a half hour to deliver the patient to a surgeon, located at Role 2 or 3 MTF. The Joint Trauma System has recommended an expansion in capabilities in administering blood products because of uncontrollable delays in patients receiving definitive care.[1]

Penetrating injuries to the chest are potentially life threatening. When occurring outside of the mediastinum, life-threatening injuries can manifest as open pneumothorax, tension pneumothorax, hemothorax, or hemopneumothorax. Injuries to the great vessels, lung parenchyma, or intercostal arteries are the typical causes of massive hemothorax. It has been clinically defined as initial bloody output of 1,500 mL or more than one-third of the patient's blood volume (calculated by $\geq$20 mL/kg).[2] This condition usually presents as a hemorrhagic shock and, less frequently, as an obstructive shock. Traumatic injuries to the thorax may require interventions before arrival to a higher echelon of care, including placement of an occlusive dressing, needle decompression, and if time allows, a chest tube in an effort to combat shock.

Treatment in the hospital setting most often consists of placement of a chest tube to evacuate a hemothorax or pneumothorax. Drainage of 1,500 mL or more of blood during any 24-hour period or physiologic instability in the presence of hemothorax should prompt consideration for surgical intervention.[3]

Autotransfusion devices drain and collect hemothoraces and are used to transfuse unstable patients. The commercially available systems operate in series with chest drain systems, use internal negative pressure to collect blood from a precollected source, or are capable of either method. Anticoagulation using citrate solutions is used; however, it may cause citrate toxicity[4] and is not always necessary.[5] Many manufacturers of autotransfusion devices recommend the use of an in-line filter of 50 microns.

Autotransfusion of blood collected from a hemothorax is a common practice in many trauma centers; however, its role in the prehospital setting is still somewhat unclear. To date, there have been no case reports of the implementation of autotransfusion devices in a Role 1 setting. It is worth recognizing that autotransfusion has seen successes in austere environments, using readily available materials[6] and in cases of extended transport times from point of injury.[7] This present report describes the diagnosis of massive hemothorax followed by autotransfusion in the field.

CASE REPORT

The patient, a male in his mid-20s with close to average mass for an Afghan male of 55 to 60 kg, was a member of the Afghan National Army's Mobile Strike Force who sustained a gunshot wound to the right chest (Fig. 1). He was ground evacuated to a local Afghan Aid Station. The anterior wound received an occlusive dressing and the posterior wound had bandages placed on it, 20-gauge IV access at the left median cubital vein was established, and needle decompression was attempted. The needle decompression was ineffective at releasing positive pressure, based on the report of no release of air or improvement of vital signs.

Ground transportation then delivered the patient to the Role 1 MTF, one-eighth of a mile away. By initial evaluation by the trauma team, the patient had a patent airway and a SpO_2 of 100%. Also noted was bilateral jugular venous distention. Breath sounds were normal on the left; diminished breath and fluid sounds were present on the right. The observed blood pressure was 89/43 mm Hg with a heart rate

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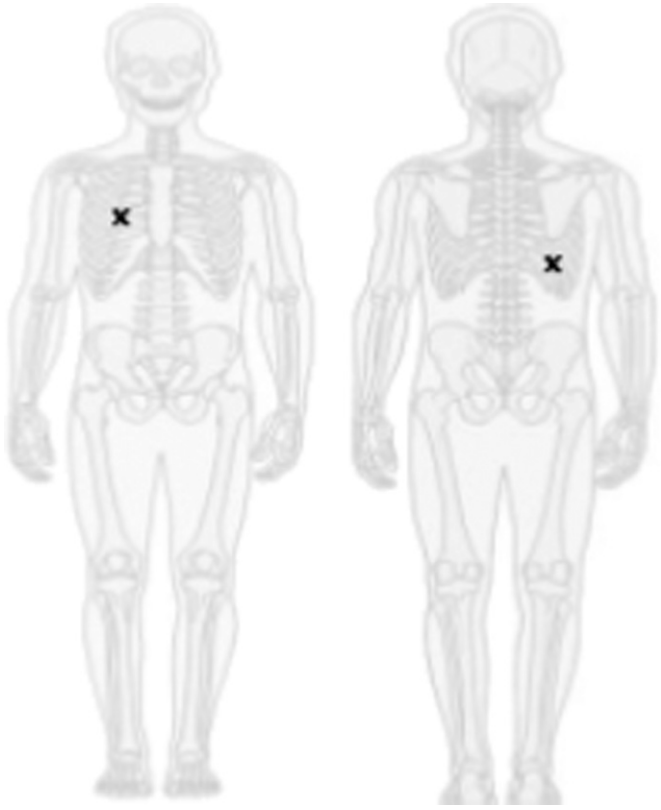

FIGURE 1. Our patient suffered from a gunshot wound to the right chest. One wound was found on the anterior chest and on the posterior, which gave the impression that both wounds resulted from the same bullet.

of 110 beats per minute. The patient had an altered mental status. Conducted concurrently with auscultation of the chest, ultrasonography confirmed hemothorax on the right with a positive sinusoid sign[8] (Fig. 2).

Seeking temporary stabilization, an additional attempt at needle decompression occurred with the same result as previously reported. In the usual fashion, the right thorax had a chest tube placed, resulting in the evacuation of approximately 50 mL of uncollected blood as the pleural space was entered. Also placed at this time was an interosseous device into the right tibia. Blood immediately drained into a clamped 40-Fr chest tube (Atrium RFN 8040; Atrium Medical Corporation, Hudson, New Hampshire) on insertion. The autotransfusion system (PLEUR-EVAC RFN S-100-08; Teleflex Incorporated, Wayne, Pennsylvania) was used, which collected 800 mL, and the pleurevac device (PLEUR-EVAC RFN S-1100-08; Teleflex Incorporated) collected 600 mL. A total of 1,400 mL was collected and was autotransfused via intraosseous catheter (Fig. 3).

The patient required intubation before his air evacuation to a Role 3 MTF. Final vital signs before departure were 133 beats per minute, 144/89 mm Hg, 20 respirations per minute, SpO_2 100%. The accepting hospital received notification, by phone, regarding the status of the patient. The total time spent at our Role 1 MTF was approximately 18 minutes.

The patient proceeded to the operating room for a right thoracotomy, after an initial assessment. The operating surgeon found injury to the right middle lobe causing an arterial bleed as well as an injury through the right lower lobe. The surgeon accomplished hemorrhage control via a nonanatomical resection of the right middle lobe; repair of the lower lobe occurred before transferring the patient to intensive care.

The patient remained in intensive care for 2 days and then he transferred to the ward. The remainder of his hospital stay was uneventful. On postoperative day 5, his providers transferred him to Kabul, Afghanistan, for continued treatment in the National Healthcare System.

DISCUSSION

This patient was clearly suffering from a massive hemothorax as indicated by physical examination, brief imaging, and contents of his pleural evacuation. Questionably, a patient who has jugular venous distention and experiences an increase of blood pressure after evacuating the pleural space, tension physiology could have been simultaneously occurring. Use of ketamine or mechanical error could have attributed to the perception of increased blood pressure. Hemorrhagic shock was a clear indication to transfuse. This condition requires emergent surgical evaluation,

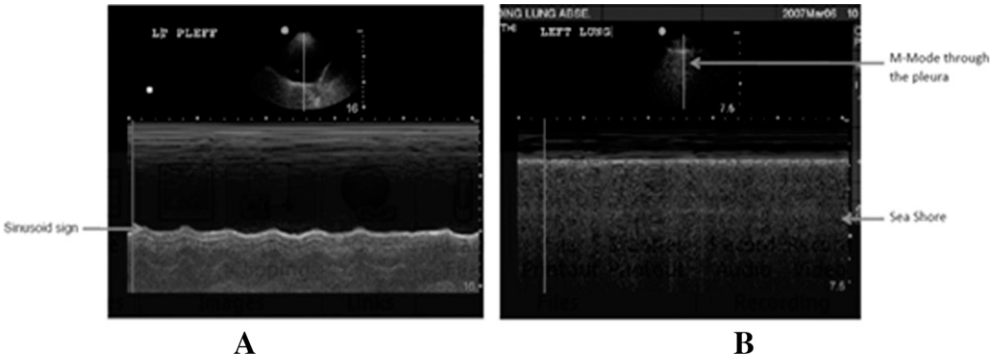

FIGURE 2. Ultrasonography on M-mode. (A) Sinusoid sign representing a pleural effusion. (B) Seashore sign representing normal pleural sliding.

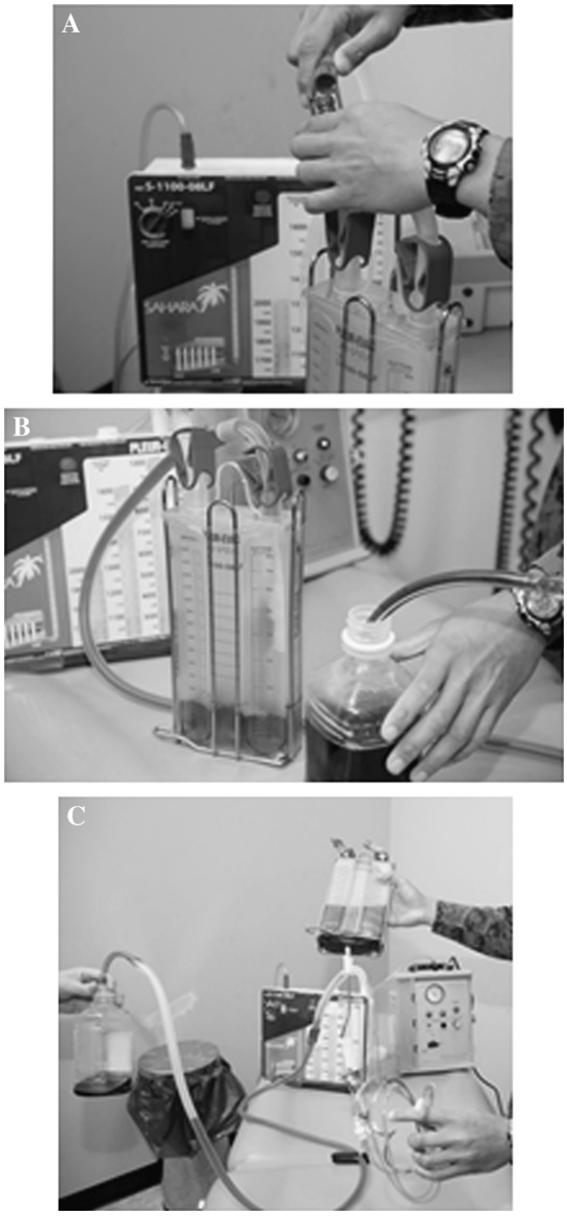

FIGURE 3. Demonstration of autotransfusion being set up. Iodine was added to normal saline for contrast. (A) Connecting autotransfusion system to plurevac and suction. (B) Draining fluid into autotransfusion system. (C) Line is connected to the bottom of the autotransfusion system, making it ready for administration.

which should not be delayed by keeping a patient at a Role 1 MTF longer than necessary.

With injuries sustained on the battlefield, there may be little option of starting an immediate transfusion. The presentation of a patient with hemothorax allows autotransfusion to be a viable option. The storage requirements of autotransfusion systems, which are identical to the requirements of storing a pleurevac device, do not interfere with the mission of a Role 1 MTF. Therefore, medical personnel with adequate knowledge of placing a chest tube and operative knowledge of an autotransfusion system can initiate transfusion and possibly improve chances of survival. In addition, with projections from Department of Defense's Quadrennial Defense Review, which suggest that future military operations will no longer be conducted as large-scale stability operations,[9] there will be a decreased probability for early definitive care. In order to maintain the lowest mortality from potentially survivable injuries, any life-extending procedure, including performing an autotransfusion or developing more field expedient devices to do so, must be investigated. A multicenter study should be initiated to test the viability of the use of autotransfusion systems in the prehospital setting.

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