

# Acute Hemorrhagic Shock: Direct Right Atrial Transfusion

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## Abstract

Arterial bleed from major arteries can be rapidly fatal if not stopped timely. Once temporary hemostasis by external compression is achieved, establishment of proximal control should be the foremost priority.

We describe a case of acute hemorrhagic shock where a timely performed sternotomy to control the bleeding vessel proximally; open-chest cardio-pulmonary resuscitation along and a direct right-atrial blood transfusion resulted in successful resuscitation.

As in our case, a witnessed cardiac arrest; a low threshold for internal cardiac massage may yield good results. In extreme circumstances, direct transfusion of blood into the right atrium can be lifesaving. Meticulous de-airing, not to pass any air bubble through the transfusion set, should be performed with utmost care.

A prompt and timely sternotomy may provide: 1) exposure and access to control the bleeding, 2) access for internal cardiac massage; and 3) access for direct transfusion into the right atrium.

## INTRODUCTION

Arterial bleed from major arteries can be rapidly fatal if not stopped timely. Often subclavian artery injury may prove to be life threatening. Once temporary hemostasis by external compression is achieved, establishment of proximal control should be the foremost priority. We describe a case where a timely performed sternotomy to control the bleeding vessel proximally; open-chest cardio-pulmonary resuscitation along with a direct right-atrial blood transfusion resulted in successful resuscitation of acute hemorrhagic shock.

## CASE

A twelve year old female child suffering from uncontrolled type 1 diabetes mellitus presented with gangrene of the right arm. An elective disarticulation of right arm from the shoulder joint was performed. Two days later while undergoing a surgical debridement and dressing, the wound started to bleed. The bleeding was moderate in severity, bright red in color and in spurts. Hence it was presumed to be from the proximal portion of the axillary artery. Temporary hemostasis was achieved by pressure and packing. Emergency vascular repair was anticipated and a vascular surgeon called for.

The procedure was conducted under general anesthesia with ketamine, midazolam, vecuronium, isoflurane and oxygen

and air. Routine monitoring including electrocardiography (ECG), pulse oximetry (SpO<sub>2</sub>), end-tidal carbon-dioxide (ETCO<sub>2</sub>) along with a right-atrial (RA) pressure monitoring was with a triple lumen central venous catheter placed via right internal jugular vein and invasive left radial arterial blood pressure monitoring (ABP). Two peripheral intravenous cannulae (20G), one each on the left leg and left arm were placed.

After induction of anesthesia, patient was positioned supine and surgical cleaning and draping started. On removal of the packing sudden torrential bleeding started which was uncontrollable. Any amount of external pressure and local exploration failed to stop or reveal the bleeder. An attempt to clamp the subclavian artery through an infraclavicular incision also failed due to an immense bloody field. Meanwhile the systolic ABP drifted from 110mm Hg to 60-70mm Hg and RA pressure dropped from 8mm Hg to 3 mm Hg. Rapid transfusion was started through all accesses – both peripheral as well as central. Hemorrhage however was unrelenting.

As the bleeder was not identified, an immediate midline sternotomy was performed for direct visual control of the bleeding vessel. The bleeding vessel identified as the proximal subclavian artery and subsequently clamped. By

now the systolic ABP of the patient was not more than 10mm Hg with extreme bradycardia (10-15 beats/minute). Pericardiotomy was done, heart exposed and internal cardiac massage started. During this period prior to starting the internal cardiac massage a momentary cardiac asystole for three minutes was witnessed. Visually the heart appeared empty.

Estimated blood loss till that time was two liters. Total of five units of blood, two units of colloid and one unit of Ringer lactate were transfused, most of which was lost. By now immense resistance could be felt while pushing blood into the central venous line. A decision to transfuse blood directly into the right atrium was made. Purse string suture on the right atrium were placed and the distal end of a sterile blood transfusion set (Pall blood transfusion set) was passed through it and snugged. Meticulous de-airing of the transfusion set done before passing into the RA. Two units of warm blood were transfused rapidly through this line. Internal cardiac massage continued through-out. Boluses of adrenaline and atropine along with intermittent calcium were administered. After about 6 minutes, the heart gained spontaneous activity. Ice-packs were placed around the head for external cooling.

A systolic ABP of 60-70 mm Hg achieved in another ten minutes. RA pressure tracing showed a value between 4-5 mm Hg. Transfusion of blood continued through the peripheral access. Adrenaline infusion was started at the rate of 1.0 µgrams/kg/minute. The RA transfusion was stopped but the line not yet disconnected.

Meanwhile the subclavian artery was ligated and internal pacing wires were placed. One mediastinal and one right pleural chest drains were placed. By now the systolic BP was 100mm Hg, RA pressure 7mm Hg and urine output of 0.5 ml/kg/hour. The RA line was removed, pericardium closed and sternum closed with sternal wires.

The patient was shifted to the ICU with full mechanical ventilation and continued blood transfusion and inotropic support with stable hemodynamics and planned for gradual weaning.

## DISCUSSION

Gangrene and necrotizing fasciitis of upper limb in diabetic patients often need multiple surgical debridements and amputations <sup>1</sup>. Profuse arterial hemorrhage due to infection of amputated stumps have been reported <sup>2</sup>.

Demetrades D et al in their study of subclavian artery injury in 79 patients, observed that in half of the patients a standard clavicular incision was sufficient for proper exposure of the subclavian artery while in the other half a 'double surgical exposure' exposure was necessary, the second exposure being a median sternotomy or a thoracotomy <sup>3</sup>. Injuries to the proximal subclavian artery usually needed this second exposure, irrespective of the side (right/left) of injury.

Tsutsumi K et al report a case of acute bleeding in subclavian artery pseudoaneurysm which was managed with the 'double surgical exposure' <sup>4</sup>. Distal part of subclavian artery control was acquired through the clavicular incision while proximal control was accessed through a partial median sternotomy (upto 4<sup>th</sup> intercostal space).

Mc Coy DW et al in there series on subclavian artery injury established certain principles for management, the foremost being acquiring proximal and distal control prior to exposing the injury site <sup>5</sup>.

The concept and practice of emergency room thoracotomy (ERT) for resuscitation of trauma patients has always been controversial. Frezza EE et al describe a definite positive outcome of ERT in the patients who receive it within 30 minutes of pre-hospital time <sup>6</sup>. Fialka C et al in there series on open-chest cardiopulmonary resuscitation (CPR) in patients in acute hemorrhagic shock from penetrating and blunt trauma demonstrated almost similar results provided it is started at the latest within 20 minutes after initial uninterrupted closed-chest CPR <sup>7</sup>. Fujiwara K et al describe a case of traumatic right atrial rupture managed without cardiopulmonary bypass; only with surgical hemostasis, pericardiotomy and rapid transfusion <sup>8</sup>.

Through the present case we intend to emphasize the need to establish a proximal control whenever an arterial bleed is suspected in which a temporary hemostasis has been achieved. A ritual of prior surgical field cleaning and painting had unleashed a series of catastrophic events which might not have happened otherwise, had a proximal control been taken beforehand. In cases of arterial bleed, the possibility of a deep or much proximal bleeder must be kept in mind due to retraction of the severed vessel and more so in cases of infected amputated stumps.

In managing witnessed cardiac arrest due to acute hemorrhagic shock, a low threshold for internal cardiac massage can yield good results. In extreme circumstances, direct transfusion of blood into the right atrium can be helpful though we recommend it as the last resort. Extreme caution

needs to be advocated while executing such transfusion. Meticulous deairing and vigilance not to pass any air bubble through the transfusion set, cannulation of the right atrium, placement and snugging of the purse-string sutures and finally de-cannulation of the right atrium should be performed with utmost care, preferably by trained hands. As far as possible we would advice a more conservative approach, but in an extreme situation this technique may be utilized.

### **CONCLUSION**

Management of any acute hemorrhagic shock revolves around the primary principle of controlling the bleeding and simultaneous replacement (transfusion). A prior proximal control before exploring an arterial injury can prevent a catastrophic surgical mishap. In anticipation of massive bleeding, proper part preparation with readiness of cell-saver, blood warmer, preload and hypotensive anesthesia is crucial.

A prompt and timely sternotomy may prove to be lifesaving by providing: 1) exposure and access to control the bleeding,

2) access for internal cardiac massage; and 3) access for direct transfusion into the right atrium.

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