

## D02: Bleeding

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### Introduction

Hemorrhage can result from a number of causes including trauma, medical conditions, or medications that affect the coagulation pathway. In the context of trauma, loss of circulating blood volume from hemorrhage is the most common cause of shock. Hemorrhagic shock is a common and frequently treatable cause of death in injured patients and is second only to traumatic brain injury as the leading cause of death from trauma. Timely recognition, appropriate resources, and appropriate responses are critical for preventing death.

### Essentials

- Obtain rapid control of external hemorrhage.
- Control compressible and extremity bleeding with direct pressure.
- Recognize serious occult bleeding.
- Strive to mitigate the lethal triad of trauma (hypothermia, acidosis, and coagulopathy).
- Initiate rapid conveyance to an appropriate lead trauma hospital.

### Referral Information

Select clinical pathway in accordance with the [Out-of-hospital triage and conveyance guidelines](#) for adult and pediatric major trauma in British Columbia.

### General Information

- Assessment and stabilization should follow the CABCDE pattern:
  - Catastrophic hemorrhage
  - Airway
  - Breathing
  - Circulation
  - Disability (neurologic status)
  - Exposure
- The Advanced Trauma Life Support (ATLS) manual produced by the American College of Surgeons describes four classes of hemorrhage to emphasize the early signs of the shock state. Clinicians should note that significant drops in blood pressure are generally not manifested until Class III hemorrhage develops and up to 30% of a patient's blood volume can be lost before this occurs.
  - Class I hemorrhage involves a blood volume loss of up to 15%. The heart rate is minimally elevated or normal and there is no change in blood pressure, pulse pressure, or respiratory rate.
  - Class II hemorrhage occurs when there is a 15-30% blood volume loss and is manifested clinically as tachycardia (heart rate of 100-120 beats/minute), tachypnea (respiratory rate of 20-24 breaths/minute), and a decreased pulse pressure. Systolic blood pressure (SBP) changes may be minimal, if at all. The skin may be cool and clammy, and capillary refill may be delayed. This can be considered moderate hemorrhage.
  - Class III hemorrhage involves a 30-40% blood volume loss, resulting in a significant drop in blood pressure and changes in mental status. Any hypotension (SBP < 90 mmHg) or a drop in blood pressure greater than 20-30% of the measurement at initial presentation is cause for concern. While diminished anxiety or pain may contribute to such a drop, the clinician must assume it is due to hemorrhage until proven otherwise. Heart rate ( $\geq 120$  beats/minute and thready) and respiratory rate are markedly elevated, while urine output is diminished. Capillary refill is delayed. Both class III and class IV should be considered severe hemorrhage.
  - Class IV hemorrhage involves > 40% blood volume loss leading to significant depression in blood pressure and mental status. Most patients in Class IV shock are hypotensive (SBP < 90 mmHg). Pulse pressure is narrowed ( $\leq 25$  mmHg) and tachycardia is marked ( $> 120$  beats/minute). Urine output is minimal or absent.

The skin is cold and pale, and capillary refill is delayed.

## Interventions

### First Responder

- Supplemental oxygen as required
  - → [A07: Oxygen Administration](#)
- Apply tourniquets if clinically indicated
  - → [PR03: Tourniquets](#)
- Splint pelvis/fractures if clinically indicated and trained
  - → [PR02: Pelvic Binders](#)
- Pack wounds if clinically indicated and trained
  - → [PR04: Wound Packing](#)
- Position patient based on comfort and tolerance
- Consider spinal motion restriction if clinically indicated
- Apply direct pressure to control external hemorrhage
- Prevent heat loss

### Emergency Medical Responder – All FR interventions, plus:

- Activate [AutoLaunch/Early Fixed Wing Launch](#) if appropriate

### Primary Care Paramedic – All FR and EMR interventions, plus:

- Establish IV access
  - → [D03: Vascular Access](#)
- Fluid resuscitation to mentation and/or central pulses:
  - Consider permissive hypotension in select patients; minimize the use of crystalloid
- [Tranexamic acid](#) in cases of occult bleeding and/or hypovolemic shock
  - TXA is not indicated for gastrointestinal bleeding
- Provide analgesia as needed
  - → [E08: Pain Management](#)

### Critical Care Paramedic – All FR, EMR, PCP, and ACP interventions, plus:

- Advanced assessment techniques including point of care ultrasound (POCUS)
- **If clinically indicated:**
- Large-bore, single-lumen central cordis
  - IO access if unable to obtain IV access
- [Balanced blood product resuscitation](#)
  - pRBC
  - FFP
  - Platelets
  - [Cryoprecipitate](#)
  - Calcium (CaCL or Calcium Gluconate)
- Reversal of anticoagulation
  - [Vitamin K](#)
    - 10 mg IV given over 10 minutes
  - [Octaplex](#)
    - Pre-treatment INR: 2 to < 4: Administer 25 units/kg IV; maximum dose: 2,500 units.
    - Pre-treatment INR: 4 to 6: Administer 35 units/kg IV; maximum dose: 3,500 units.
    - Pre-treatment INR: > 6: Administer 50 units/kg IV; maximum dose: 5,000 units.

- Protamine sulfate
  - 1 mg of protamine neutralizes 100 units of Heparin slow IV injection 10 minutes to a max of 50 mg.
- Idarucizumab
  - 5 g IV (administered as 2 separate 2.5 g doses no more than 15 minutes apart).
- Andexanet alfa
  - Low dose: 400 mg IV bolus administered at a rate of ~30 mg/minute, followed within 2 minutes by an IV infusion of 4 mg/minute for up to 120 minutes.
  - High dose: 800 mg IV bolus administered at a rate of ~30 mg/minute, followed within 2 minutes by an IV infusion of 8 mg/minute for up to 120 minutes.
- Hemodynamic support
  - Fluid resuscitation
    - Ringers or Plasmalyte has been shown to be more beneficial than saline.
    - Consider starting 10-20 ml/kg
  - Vasoconstrictors
    - Does not improve blood flow and may exacerbate bleeding. Fluid resuscitation must be initiated first. Morbidity and mortality is not improved with vasoconstrictor use.
    - Contraindicated for patients with a non-compressible uncontrolled hemorrhage. The exception being with a concomitant TBI.
    - Potentially beneficial for stress volume acquisition as a peri arrest last resort.
    - [Phenylephrine](#)
    - [Epinephrine](#)
    - [Norepinephrine](#)
- Consider balloon tamponade device for variceal hemorrhage.
- **Call ETP prior to Blakemore insertion**
  - [Blakemore](#)
- GI and esophageal bleeding consider
  - [Octreotide](#)
  - [Pantoloc](#)
  - [Vasopressin](#)

## Evidence Based Practice

Hemorrhagic Shock

### Supportive

- [Plasma infusion](#)
- [Restricted Crystalloids](#)
- [Tranexamic Acid](#)
- [Mechanical Intraosseous Insertion](#)
- [Shock Prediction Tool](#)

### Neutral

- [Colloid Infusion](#)
- [Hypertonic Saline](#)
- [Trendelenburg](#)
- [Blood transfusion](#)
- [Manual Intraosseous Insertion](#)

### Against

- [Aggressive Crystalloids](#)
- [MAST](#)
- [Pressors](#)

Limb Amputation/Mangled/Major Hemorrhage

### Supportive

- [Hemostatic dressing](#)
- [Pre-alert \(massive transfusion protocol\)](#)
- [Tourniquet \(limb\)](#)

### Neutral

- [Direct Pressure](#)
- [Tourniquet \(junctional\)](#)

### Against

## References

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