D01: Shock

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Introduction

Shock is a life-threatening condition of circulatory failure that is defined as a state of cellular and tissue hypoxia resulting from reduced oxygen delivery, increased oxygen consumption, or inadequate oxygen use. Four types of shock are recognized:

- Distributive shock, including: septic shock; neurogenic shock; anaphylactic shock; endocrine shock; toxic shock syndrome; systemic inflammatory response syndrome; and end-stage liver disease.
- Cardiogenic shock, resulting from: myocardial infarction; atrial or ventricular dysrhythmias; and valvular or ventricular septal rupture.
- Hypovolemic shock, due largely to hemorrhagic and nonhemorrhagic fluid losses.
- Obstructive shock, due to: pulmonary embolism; pulmonary hypertension; tension pneumothorax; constrictive pericarditis; and restrictive cardiomyopathy.

These should not, however, be considered exclusive. Many patients with circulatory failure have more than one form of shock. 'Undifferentiated shock' refers to a situation where shock is recognized, but the cause is unclear.

Paramedics and EMRs/FRs should suspect shock when confronted with hypotension, altered mental status, tachypnea, cool and clammy skin, oliguria, and metabolic acidosis (usually from hyperlactatemia). Most of these clinical features are not specific or sensitive for the diagnosis of shock and should be used primarily to narrow the differential diagnosis so that empiric therapies can be delivered in a timely fashion.

Essentials

- Control obvious bleeding in accordance with CPG D02: Bleeding.
- Identify shock states as early as possible.
- Attempt to identify possible causes and types of shock.
- Initiate treatment expeditiously, primarily fluid resuscitation and hemodynamic stabilization.
- Consider CliniCall consultation to discuss treatment plan and/or early conveyance options.

Additional Treatment Information

- Prompt identification of shock state is essential to ensure early and aggressive management of the intended shock state.
- When possible, treatment should include specific correction of the cause of shock.
- Clinicians may consider hemodynamic stabilization primarily through fluid resuscitation and administration of vasoactive agents when appropriate.
- Appropriate and expedient treatment should be based on a good understanding of the possible underlying pathophysiology.

General Information

- The effects of shock are initially reversible but rapidly become irreversible, resulting in multi-organ failure and death.
- Patients who present with undifferentiated shock should have immediate therapy initiated while rapidly identifying the cause and type of shock.
- IV fluids should be used judiciously in cases of suspected cardiogenic shock. Consultation with CliniCall is encouraged in these cases prior to beginning treatment (1-833-829-4099).

Interventions

First Responder

- Control external hemorrhage
  - → PR03: Tourniquets
  - → PR04: Wound packing
- Splint pelvis/fractures, if clinically indicated
  - → PR02: Pelvic Binders
- Position the patient supine to support blood pressure
- Keep the patient warm and protect from further heat loss
- Consider spinal motion restriction where required
- Provide airway management as indicated:
  - → B01: Airway Management
- Provide supplemental oxygen as required:
  - → A07: Oxygen Administration
- Conduct ongoing assessment and gather collateral information, such as medications and identifying documents
- Establish ingress and egress routes from the patient's location
- Communicate patient deterioration to follow-on responders

Emergency Medical Responder – All FR interventions, plus:

- Administer supplemental oxygen to maintain SpO_2 ≥ 94%
  - → A07: Oxygen Administration
- Convey and consider intercept with additional resources
- CliniCall consultation recommended to discuss treatment plan and/or early conveyance options.

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

- Obtain vascular access
  - → D03: Vascular Acccess & Fluid Administration
- Consider fluid bolus to correct hypoperfusion or hypotension if clinically indicated
  - CliniCall consultation recommended prior to treatment to discuss care planning options in cases of suspected cardiogenic shock.
  - Consider tranexamic acid in cases of shock secondary to blood loss and hypovolemia secondary to occult bleeding

Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

- Consider needle thoracostomy
  - → PR21: Needle Thoracentesis
- Consider an appropriate airway adjunct
  - → B01: Airway Management
- Consider Epinephrine if refractory to fluid resuscitation
- Consider cardiac arrhythmia
  - → C02: Bradycardia
  - → C03: Narrow Complex Tachycardia
  - → C04: Wide Complex Tachycardia

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

- Shock differentiation is a hallmark of CCP care. The first thing when dealing with a patient in shock is to differentiate the shock state. Each shock state is specific to the presenting disease or injury pattern. As such each has a specific treatment. The overarching goal is to maintain tissue homeostasis. One of the tools used for differentiation is the use of ultrasound and the RUSH protocol. However this gives a singular data point and needs to be corroborated with history, clinical presentation, and lab data.
- Hypovolemic
  - Is loss of fluid

        - Replace fluid and electrolytes
        - Stop further fluid loss
    - Loss of blood
        - Replace blood with a balanced blood product administration.
        - Stop further blood loss.
- Cardiogenic
    - Arrhythmia
        - Bradyarrhythmias are treated as per ACLS protocols
        - Tachyarrhythmias are treated as per ACLS protocols
    - Cardiomyopathic
        - This is a failure of the muscle to contract properly and eject blood effectively. The most common cause is a STEMI. Regardless of type treat as per ACLS protocols. Determination of Killip class may be helpful.
        - Important to identify right versus left and HFrEF and HFpEF (Heart failure with reduced ejection fraction, Heart failure with preserved ejection fraction)
    - Mechanical
        - This is a failure of the mechanics of the heart. The most common is valvular issues such as regurgitation. Other examples are VSD, PFO, or septal rupture.
- Obstructive
    - Failure to fill
        - Abdominal compartment syndrome, pericardial tamponade, tension pneumothorax, and excessive PEEP are examples that lead to a reduction in blood returning to the ventricle.
        - Treatment consists of removal of the offending pressure.
    - Failure to eject
        - Pulmonary embolism, aortic stenosis, or iatrogenic levels of vasopressor support are examples that restrict the ability of forward blood flow.
        - Remove the offending pressure and support preload, afterload, or contractility.
- Distributive
    - Characterized by the loss of vascular resistance
        - Differentiation can start immediately with a pulse pressure and skin temperature.
        - Further delineation can be identified with heart rate (bradycardia) as in the case of neurogenic.
- Treatments
- Fluid replacement
    - Saline
    - Ringers lactate
    - Plasmalyte
    - Blood products
    - Electrolyte replacement
- Fluid reduction
    - Lasix
- Preload reduction
    - Nitroglycerine
    - Nitroprusside
- Vasopressor
    - Consider Norepinephrine infusion
    - Consider epinephrine infusion
    - Consider vasopressin
    - Consider phenylephrine
    - Consider Dopamine
- Inotrope support
    - Consider Dobutamine
    - Consider Milrinone
- Chronotropic support

- Consider Isopril
- Consider Atropine
- TVP

- Procedural
  - Consider needle/finger/tube thoracostomy
  - Consider pericardiocentesis
  - Consider rapid sequence induction (RSI)
  - Consider thrombolytics such as TNK
  - Consider specialty resource center
- If MAP is unachievable, attempt to maintain signs of end organ perfusion

Evidence Based Practice

Cardiogenic Shock

Supportive

- Bypass/Direct to PCI
- Dopamine
- Norepinephrine
- Epinephrine

Neutral

- Crystalloid Infusion

Against

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

Neurogenic Shock

Supportive

- Aggressive Crystalloids
- Pressors

Neutral

- Colloid Infusion

Against

References

1. Alberta Health Services. AHS Medical Control Protocols. 2020. [Link]
2. Ambulance Victoria. Clinical Practice Guidelines: Ambulance and MICA Paramedics. 2018. [Link]
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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 (≥ 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 (≤ 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

1. Alberta Health Services. AHS Medical Control Protocols. 2020. [Link]
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D03: Vascular Access and Fluid Administration

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Introduction

Peripheral venous cannulation, among the most common medical procedures, has revolutionized the practice of medicine. Peripheral intravenous (IV) catheters allow for the safe infusion of medications, hydration fluids, blood products, and nutritional supplements.

Essentials

- Vascular access should only be performed when there is an indication for use in the out-of-hospital environment.
  - See → PR26: Venipuncture - Ethical decision making for more information.
- The need to obtain vascular access should be balanced against other acute clinical needs of the patient. Conveyance of the patient must not be delayed in favor of establishing vascular access.
- Catheter and site selection varies according to the patient's condition and intended use.

General Information

- Initiation of peripheral vascular access is contraindicated when appropriate therapy can be provided through a less invasive route (e.g., intramuscularly, intranasally, or orally).
- Paramedics must make informed decisions with respect to a patient's need for vascular access, with consideration given to:
  - Current clinical status and stability.
  - Expected out-of-hospital interventions, such as the need to administer medications or fluid en route to hospital.
  - Anticipated in-hospital clinical course. Note that a general expectation that the patient may require IV access at some point during their hospital stay is not, by itself, grounds to attempt IV cannulation.
- *In general*, paramedics should limit themselves to two attempts per practitioner. After two total failed attempts, consider the clinical requirement for vascular access before making further efforts to obtain IV access. ACPs may, at their discretion, make further attempts if the clinical scenario requires access (intraosseous cannulation remains an option).
- Intravenous devices can become dislodged or pulled out during patient movement. Paramedics should consider the timing of patient movements when contemplating IV cannulation.
- Intraosseous (IO) administration is available to CCP, ACP and PCP paramedics. See below for further details on license-specific parameters regarding IO initiation and use

Interventions

First Responder

Not indicated for this license level

Emergency Medical Responder – All FR interventions, plus:

Not indicated for this license level

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

- Obtain peripheral vascular access
- Consider need for fluid or fluid replacement if signs or symptoms of hypotension, hypoperfusion, or hypovolemia are present (including based upon history):
  - **In general, give normal saline in up to 20 mL/kg increments with frequent reassessment for effect (every 500ml)**

- Target a systolic blood pressure ≥ 90 mmHg
- **Caution**: major trauma, head, and spinal cord trauma have different fluid resuscitation targets; consult appropriate CPGs for guidance
  - → H01: Principles of Major Trauma
  - → H03: Head Trauma
  - → H05: Spinal Cord Injuries

- Reassess patient after every 20 mL/kg bolus for blood pressure and presence or absence of pulmonary edema
- Do not exceed 2 L of fluid
  - ☎☐ CliniCall consultation required if additional fluid administration over 2 L is anticipated.
  - PCPs may not cannulate children < 12 years of age **via any method**
    - **In children, consider normal saline in increments of 5-10 mL/kg; do not exceed 20 mL/kg.**
- ☐☐ **Requires completion of PCP scope expansion education:**
  - Special considerations:
    - For patients in cardiac arrest with a clear clinical history of hypovolemia as a treatable cause, consider → PR12: Intraosseous Cannulation if intravenous access is unavailable.
      - **Intraosseous cannulation is prohibited in patients with perfusing rhythms or spontaneous respirations except at the direction of an ACP or higher. Children under 12 years of age may not be cannulated by PCPs under any circumstances.**
      - ☐ CliniCall consultation recommended prior to initiating intraosseous access
      - Intraosseous access is not routinely indicated in cardiac arrest. Intravenous access remains the preferred route of vascular access in these patients.
      - Attempts to obtain intraosseous access must not detract from high-quality chest compressions and cardiac arrest management

Advanced Care Paramedic – All FR, EMR, and PCP interventions, plus:

If unable to obtain peripheral vascular access:

- Consider external jugular access
  - → PR13: External Jugular Cannulation
- Consider intraosseous access
  - → PR12: Intraosseous Cannulation

Community Paramedic (CP) Interventions

→ CP 4.14: Intravenous Initiation by Community Paramedics

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

- Ultrasound-guided peripheral venous access
- Arterial line placement with or without ultrasound

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

References

1. Alberta Health Services. AHS Medical Control Protocols. 2020. [Link]
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Practice Updates

- 2023-09-29: added intraosseous cannulation to PCP interventions
- 2024-06-25: updated total access attempts