

In a World of Hurt

Focused Trauma Resuscitation for Respiratory Clinicians

Hemorrhage • Airway • Ventilation • Lethal Triad

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AARC Approved for 1.5 CRCE Credit Hours

Course Objectives

Objective 1

Describe the pathophysiology of traumatic injury, including hemorrhagic shock and the impact of impaired perfusion on oxygen delivery and utilization.

Objective 2

Identify priorities in trauma resuscitation, emphasizing hemorrhage control, airway management, and ventilatory support based on current battlefield and civilian trauma practices.

Objective 3

Explain the lethal triad: coagulopathy, acidosis, and hypothermia, and its implications for respiratory care, mechanical ventilation, and trauma management.

A Simple Roadmap

Physiology

Hemorrhage creates impaired perfusion, oxygen debt, anaerobic metabolism, lactate, and acidosis.

Priorities

Stop life-threatening bleeding, protect the airway, support ventilation, and avoid interventions that worsen shock.

The Lethal Triad

Hypothermia, acidosis, and coagulopathy amplify one another unless the team actively interrupts the cycle.

Keep asking: What is killing this patient first?

Why Trauma Resuscitation Feels Different

The patient may be bleeding, hypoxemic, hypothermic, acidotic, and unstable at the same time.

Life threats compete for attention; sequence matters.

Airway and ventilation decisions affect circulation.

Small delays or “routine” interventions can have large consequences.

Working mindset

Do not ask, “What single diagnosis is this?”

Ask, “Which life threat must be addressed first, and what will my next intervention do to perfusion?”

Three Preventable Problems

Bleeding

Massive hemorrhage can kill before oxygenation problems are fully evaluated.

Breathing

Tension pneumothorax, airway obstruction, aspiration, and hypoventilation require rapid recognition.

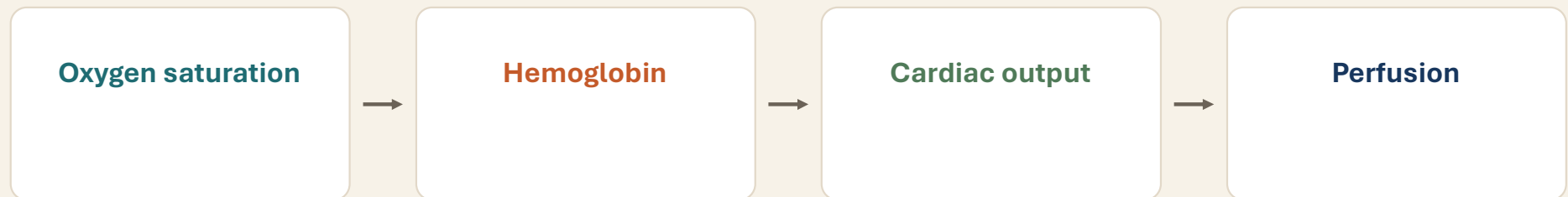
Brain

Hypoxia and hypotension create secondary injury, especially in traumatic brain injury.

The first priority is the problem most likely to kill now.

Oxygen Delivery Is More Than FiO_2

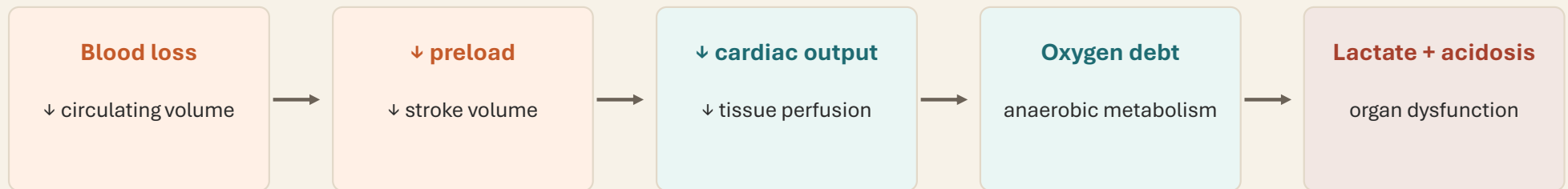
DO_2 depends on:



In hemorrhagic shock, raising FiO_2 does not restore oxygen delivery if the patient has lost volume and oxygen-carrying capacity.

RT translation: oxygenation matters — but perfusion matters too.

Hemorrhagic Shock: The Pathway



Key point

Hemorrhagic shock is a perfusion problem first. Airway and ventilation support are vital, but uncontrolled bleeding must be addressed immediately.

Oxygen Debt: What the Numbers Suggest

Lactate

Rising lactate suggests anaerobic metabolism and inadequate tissue oxygen delivery. Trend it rather than treating one value in isolation.

Base deficit

A worsening base deficit can support the clinical picture of shock and metabolic acidosis.

Clinical perfusion

Mental status, skin signs, pulse pressure, urine output, and response to resuscitation matter at the bedside.

Numbers confirm the story; they do not replace the patient.

When Perfusion Fails

Oxygen extraction increases as delivery falls.

When demand exceeds delivery, cells shift toward anaerobic metabolism.

Acidosis impairs cardiovascular performance and coagulation.

Capillary leak and inflammation can contribute to later lung injury.

Respiratory lens

The lung may be ventilated and oxygenated, but the tissues may still be starved for oxygen if perfusion is failing.

Mini-Case 1: Hemorrhage First

32-year-old after penetrating trauma to the thigh and lower abdomen

Large external bleeding; clothing soaked with blood

RR 30/min, HR 132/min, BP 82/46, SpO₂ 95% on NRB

Anxious, pale, cool skin; airway currently patent

Initial impression

The oxygen saturation is not the problem that will kill first. The bleeding and perfusion failure are.

What should happen before focusing on a definitive airway?

Mini-Case 1: Priorities

1. Control bleeding

Apply direct pressure, pack the wound if appropriate, use a tourniquet for life-threatening extremity hemorrhage, and notify the trauma team.

2. Restore perfusion

Activate institutional hemorrhage protocol. Use warmed blood products per protocol and avoid large-volume crystalloid.

3. Support breathing

Provide oxygen, monitor ventilation with EtCO₂ if available, and prepare for airway control if mental status or ventilation worsens.

Key lesson: stop the bleeding while preparing the airway.

Battlefield Lessons at the Bedside

MARCH emphasizes massive hemorrhage before airway when bleeding is immediately life-threatening.

Stop the Bleed principles brought tourniquets, pressure, and wound packing into wider civilian use.

Damage-control resuscitation shifted emphasis away from crystalloid-heavy resuscitation.

Civilian trauma care adapts these concepts through local protocols and team roles.

Keep it practical

Military concepts are useful only when translated into safe, protocol-based civilian care.

MARCH and ABCDE: Same Patient, Different Emphasis

MARCH

Massive hemorrhage
Airway
Respiration
Circulation
Hypothermia / head injury

Designed to prevent early battlefield deaths by addressing the most time-critical threats first.

ABCDE

Airway
Breathing
Circulation
Disability
Exposure

A structured trauma assessment used broadly in civilian emergency and critical care settings.

Use the framework that helps the team act in the right sequence.

Massive Hemorrhage Comes First

Compressible bleeding

Direct pressure, wound packing, hemostatic gauze, and tourniquet use may save life before the patient reaches definitive care.

Noncompressible bleeding

Internal torso, pelvic, or junctional bleeding requires rapid recognition, blood-product resuscitation, and procedural or surgical control.

RT role

Recognize shock, support oxygenation, prepare airway equipment, warm the patient, and communicate deterioration clearly.

If the patient is exsanguinating, airway perfection can wait seconds — bleeding cannot.

Hemorrhage Control: Know the Tools

Direct pressure

Sustained pressure over the bleeding source. Do not repeatedly “peek.”

Wound packing

Pack deep wounds when appropriate and maintain pressure according to training and protocol.

Tourniquet

For life-threatening extremity bleeding; place correctly and reassess per protocol.

Hemorrhage protocol

Call for help early: trauma team, blood bank, warming devices, and definitive control.

Bleeding control is a resuscitation intervention.

Damage-Control Resuscitation

Stop the dying

Control hemorrhage and restore circulating volume with the right resuscitation strategy.

Fix physiology

Prevent hypothermia, correct acidosis as perfusion improves, and monitor calcium and coagulation per protocol.

Definitive care

Move toward procedural or surgical hemorrhage control; ICU care continues physiologic correction.

Damage control is a strategy, not a single procedure.

Why “More Fluid” Can Be Harmful

Large-volume crystalloid can dilute clotting factors and platelets.

Cold fluids can worsen hypothermia.

Chloride-rich fluids may contribute to metabolic acidosis.

Excess fluid can worsen tissue edema and lung water after resuscitation.

Better question

Is this patient bleeding?

If yes, resuscitation should move quickly toward blood products and definitive hemorrhage control according to protocol.

Airway in the Shocked Trauma Patient

Prepare

Suction, oxygenation, backup devices, skilled help, and a surgical-airway plan when needed.

Resuscitate

If time allows, address severe hypotension and ongoing hemorrhage before induction.

Confirm

Use waveform capnography, tube depth, chest rise, breath sounds, and ongoing reassessment.

First-pass success matters — but so does surviving induction.

How Intubation Can Worsen Shock

Sedation / paralysis

loss of sympathetic tone

Positive pressure

↓ venous return

High PEEP / auto-PEEP

↑ intrathoracic pressure

Hypoventilation or hyperventilation

changes CO₂, pH, and cerebral blood flow

After intubation, ventilator settings are hemodynamic settings.

The Ventilator Is a Hemodynamic Device

Use lung-protective tidal volumes when mechanical ventilation is required.

Avoid excessive plateau pressure and driving pressure.

Avoid breath stacking and auto-PEEP, especially in shock.

Use enough PEEP to support oxygenation, but reassess blood pressure and perfusion after changes.

Trend EtCO₂, SpO₂, airway pressures, waveforms, and the patient.

Bedside check

When hypotension worsens after intubation or a vent change, reassess: volume status, obstruction, auto-PEEP, pneumothorax, and sedation effects.

Chest Trauma: Tension Pneumothorax

Suspect it when respiratory distress and hemodynamic compromise occur with unilateral absent or markedly reduced breath sounds.

Tracheal deviation is a late and unreliable sign.

Positive pressure can worsen obstructive shock.

An unstable patient with a convincing clinical picture should not wait for imaging.

RT actions

Call it out early.

Support oxygenation.

Prepare for decompression
/ chest tube according to
protocol.

Reassess after
intervention.

Pulmonary Contusion and Flail Chest

Pulmonary contusion

Alveolar hemorrhage and edema can worsen over hours. Oxygenation may decline after the initial assessment.

Flail physiology

Pain, chest-wall instability, and underlying contusion increase work of breathing and can lead to hypoventilation.

Respiratory strategy

Pain control, pulmonary hygiene, oxygen support, NIV or intubation when appropriate, and lung-protective ventilation if invasive ventilation is needed.

Do not underestimate the contusion just because the first film looks acceptable.

Mini-Case 2: Deteriorating Chest Trauma

Motorcycle crash with blunt chest trauma

Initially awake, now increasingly distressed

RR 34/min, HR 128/min, BP 86/52, SpO₂ 88% on NRB

Left chest moves poorly; breath sounds markedly decreased on the left

Neck veins difficult to assess; trachea appears midline

Decision point

Is this primarily an oxygen problem, a ventilation problem, a perfusion problem, or an obstructive shock problem?

What should be called out immediately?

Mini-Case 2: Teaching Point

Pattern

Respiratory distress + hypotension + unilateral reduced breath sounds after trauma is dangerous.

Action

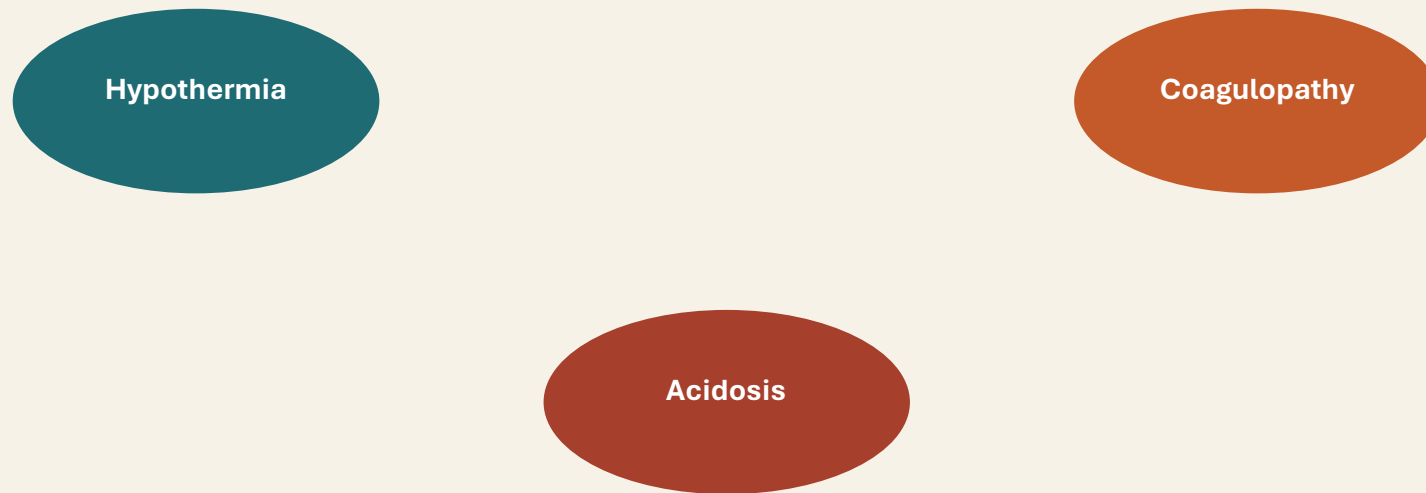
Notify the team, support oxygenation, prepare for immediate decompression and chest tube according to protocol.

Avoid

Do not wait for tracheal deviation. Do not assume increasing PEEP is the answer before obstruction is addressed.

Treat the physiology before chasing the perfect image.

The Lethal Triad



Core concept

Each element makes the others worse. Trauma management must interrupt the cycle early.

Hypothermia: The Quiet Accelerator

Trauma patients lose heat through exposure, blood loss, cold fluids, environmental conditions, and procedures.

Hypothermia impairs platelet function and enzymatic coagulation.

It increases oxygen consumption through shivering unless the patient is deeply impaired or sedated.

Warming is an active resuscitation intervention, not comfort care.

RT contribution

Warm gases when appropriate, minimize exposure, support active warming, and help prevent cold transport or cold resuscitation fluids.

Acidosis: A Sign of Failed Perfusion

Why it happens

Shock reduces oxygen delivery. Cells use anaerobic metabolism, lactate rises, and metabolic acidosis develops.

Why it matters

Acidosis reduces cardiovascular performance and interferes with coagulation.

RT implications

Ventilation can influence pH, but restoring perfusion and hemorrhage control are the main fixes for shock acidosis.

Do not try to “ventilate away” a perfusion problem.

Coagulopathy: Bleeding Feeds Bleeding

Coagulopathy may result from tissue injury, shock, dilution, hypothermia, acidosis, and consumption of clotting factors.

Large-volume crystalloid can worsen dilutional coagulopathy.

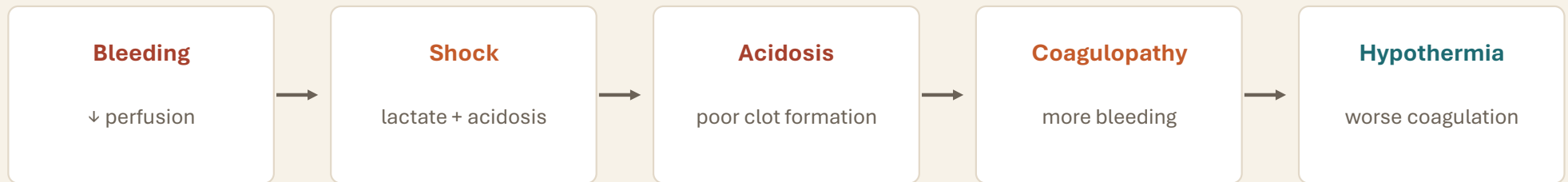
Balanced blood-product resuscitation and lab- or viscoelastic-guided therapy may be used by trauma teams.

Ongoing bleeding plus worsening coagulopathy accelerates shock.

RT lens

Prevent hypothermia, avoid unnecessary high pressures, and communicate signs of worsening perfusion or oxygen debt.

How the Triad Reinforces Itself



Breaking the cycle

Control hemorrhage, restore perfusion with appropriate blood products, keep the patient warm, avoid harmful ventilation, and reassess continuously.

What About the “Lethal Diamond”?

Some trauma discussions add hypocalcemia to the lethal triad, creating the “lethal diamond.”

Citrate in blood products can bind calcium during large-volume transfusion.

Low ionized calcium can worsen hypotension and impair coagulation. The practical point: monitor and replace calcium according to trauma protocol.

Keep focus

Teach the triad as required, then mention calcium briefly as a modern resuscitation consideration.

Respiratory Care Implications

Mechanical ventilation

Use lung-protective ventilation, avoid excessive intrathoracic pressure, and prevent auto-PEEP.

Oxygenation

Correct hypoxemia but avoid assuming that normal SpO_2 means oxygen delivery is adequate.

Temperature & trends

Support active warming and trend EtCO_2 , SpO_2 , ABG/VBG data, lactate, temperature, and clinical appearance.

RTs help protect the lung without forgetting the circulation.

Mini-Case 3: The Spiral Begins

44-year-old after high-speed MVC with abdominal and pelvic injuries
Ongoing transfusion; temperature 34.8°C
pH 7.19, lactate rising, increasing vasopressor need
Diffuse oozing from IV sites and wounds
Ventilator: increasing airway pressures after several fluid boluses

What is happening?

This is no longer just
“low blood pressure.”
The patient is entering
the lethal triad cycle.

Which findings point to hypothermia, acidosis, and coagulopathy?

Mini-Case 3: Break the Cycle

Warm

Active warming, warmed fluids/blood when available, minimize exposure, and monitor temperature.

Perfuse

Hemorrhage control and appropriate blood-product resuscitation are central to correcting shock acidosis.

Ventilate wisely

Avoid hypoxemia, avoid extreme hyperventilation, monitor pressures and waveforms, and reassess hemodynamics after changes.

The RT action plan should support physiology — not just improve one number.

RT Priorities in the First Minutes

Look at the patient before the monitor: work of breathing, skin signs, mentation, bleeding, and trajectory.

Call out life threats clearly: massive bleeding, obstructed airway, tension physiology, severe hypoxemia, or worsening shock.

Prepare airway and suction while hemorrhage control and resuscitation begin.

Use waveform capnography when an airway is placed and trend EtCO₂ continuously.

Reassess after every intervention: airway, breath sounds, chest rise, pressures, SpO₂, BP, and perfusion.

Mantra

Stop bleeding.
Support oxygenation.
Protect ventilation.
Preserve perfusion.
Prevent the triad.

Common Pitfalls to Avoid

Pitfall 1

Treating SpO₂ as proof that oxygen delivery is adequate.

Pitfall 2

Delaying hemorrhage control while preparing an airway that is not yet failing.

Pitfall 3

Increasing PEEP before considering tension physiology or obstructive shock.

Pitfall 4

Assuming lower work of breathing always means improvement; the patient may be tiring.

Pitfall 5

Letting the patient become cold during exposure, procedures, or transport.

Pitfall 6

Using ventilator settings that improve oxygenation but worsen venous return.

In trauma, the wrong “routine” intervention can worsen physiology.

Key Takeaways

1

Oxygen delivery in trauma depends on perfusion and hemoglobin, not FiO_2 alone.

2

When massive bleeding is present, hemorrhage control is the first resuscitation priority.

3

Airway and ventilation support must be planned around the patient's hemodynamics.

4

Hypothermia, acidosis, and coagulopathy form a self-reinforcing lethal triad.

5

Respiratory clinicians protect the lung while helping the team preserve perfusion.

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The End

Questions & Discussion