Chapter 61
Approach to Shock in the ICU

61.1 Introduction

Shock is a life-threatening condition frequently encountered in the intensive care unit (ICU), characterized by inadequate tissue perfusion and oxygenation. Early recognition and prompt management are crucial to prevent progression to multi-organ dysfunction and death. Patients often present with undifferentiated shock, where the cause is not immediately apparent. To address this challenge, systematic assessment protocols like the "MINUTES" bundle have been developed to streamline initial management [1]. The MINUTES acronym stands for:

- Maintain ABCs (airway, breathing and circulation).
- Infuse vasopressors/fluids.
- Investigate.
- Ultrasound.
- Treat etiology.
- Evaluate for stabilization.

Understanding the progressive stages of shock—pre-shock, shock, and end-organ dysfunction—is essential. Early-stage shock is often reversible with timely intervention, highlighting the importance of rapid diagnosis and treatment [Ref: Algorithm 61.1].

S. B. Mishra et al., *Mastering ICU Care*,
https://doi.org/10.1007/978-981-95-0179-3_61

61.2 Step-by-Step Explanation of the Algorithm

61.2.1 Initial Assessment: Hypotension Criteria

The first step in approaching a patient suspected of being in shock is the assessment of hypotension. Hypotension is defined by a mean arterial pressure (MAP) of less than 65 mmHg or a systolic blood pressure below 90 mmHg. Recognizing hypotension is crucial, as it is a hallmark of shock and indicates inadequate perfusion pressure. Immediate recognition prompts further evaluation and intervention to prevent deterioration.

61.2.2 Evaluate for Signs of Shock

After identifying hypotension, clinicians should evaluate the patient for signs of shock, which include tachycardia, altered mental status, decreased urine output, cold, clammy skin, reduced capillary perfusion, and skin mottling. If these signs are absent, the patient should be monitored closely for any changes (see next section). However, if signs of shock are present, immediate stabilization is necessary. Early detection of these clinical signs allows for prompt intervention before irreversible organ damage occurs.

Capillary perfusion/refill time (CRT) steps:

1. Moderate pressure is applied to the nail bed until it turns white (usually 5–10 seconds), then pressure is removed and the time it takes for the nail to return to pink is measured.
2. Ideally, measure at room temperature (20–25 °C).
3. Capillary refill time > 5 seconds is said to be abnormal.

61.2.3 If no Shock Signs: Monitor

In patients without overt signs of shock but with hypotension, continuous monitoring is essential. Key parameters to monitor include urine output, mental status, and skin temperature and perfusion. Monitoring these parameters helps detect subtle changes that may indicate deterioration, allowing for timely intervention if the patient's condition worsens.

61.2.4 If Shock Signs Present: Stabilization (MINUTES BUNDLE)

61.2.4.1 M (Maintain ABCs)

For patients exhibiting signs of shock, immediate stabilization is imperative. This involves maintaining airway, breathing, and circulation—the "M" in the MINUTES bundle. Ensure the airway is patent and consider intubation if necessary. Provide supplemental oxygen and monitor oxygen saturation to support breathing. Establish intravenous access to manage circulation effectively.

61.2.4.2 IN (Infuse)

Next, infuse vasopressors and fluids—the "IN" in MINUTES. Administer 1 liter of crystalloid fluids rapidly and initiate a norepinephrine infusion, even through a peripheral line if central access is not yet established. Norepinephrine is considered the first-line vasopressor for septic and distributive shock due to its efficacy and safety profile. Immediate stabilization supports circulatory function and maintains perfusion while further assessments are conducted [2].

IN (Investigate)
The "IN" in MINUTES stands for investigate, emphasizing the need for prompt diagnostic evaluations. Laboratory tests should include blood gas analysis to assess oxygenation, ventilation, and acid-base status, as well as serum lactate levels, which serve as a marker of tissue hypoperfusion. A complete blood count, electrolytes, and renal and liver function tests provide additional information about the patient's physiological state. If cardiogenic shock is suspected, cardiac enzymes should be measured.

Imaging studies are also crucial. A chest X-ray should be performed within the first 10 minutes to identify potential causes such as pneumothorax, pulmonary edema, or a widened mediastinum. Early investigations provide critical insights into the underlying etiology of the shock, guiding further management.

61.2.4.3 U (ultrasound)

The "U" in MINUTES stands for ultrasound, highlighting the role of point-of-care ultrasound (POCUS) in the rapid assessment of patients in shock. Cardiac ultrasound can assess for pericardial effusion, evaluate ventricular function, and detect signs of cardiac tamponade. Lung ultrasound is useful for detecting pneumothorax, pleural effusions, or pulmonary edema. Assessment of the inferior vena cava (IVC) collapsibility can help estimate the patient's volume status.

Critical care echocardiography (CCE) further enhances hemodynamic assessment by measuring parameters such as the left ventricular outflow tract velocity time integral (LVOT VTI) to estimate cardiac output and assessing right atrial

pressure to evaluate preload status. Ultrasound aids in rapidly differentiating shock types and identifying conditions that require immediate intervention.

61.2.4.4 TE (Treat Etiology/underlying cause)

Based on the findings from investigations and ultrasound, targeted management should be initiated—the "T" in MINUTES. The treatment approach varies depending on the type of shock identified.

S (Stabilize organ perfusion) - see later section.

Diagnosis involves obtaining a history of recent bleeding, vomiting, diarrhea, or other fluid losses. Physical examination may reveal signs of dehydration. A positive Passive Leg Raise (PLR) test indicates fluid responsiveness. Management focuses on restoring circulating volume by continuing crystalloid infusion and considering blood products if hemorrhage is present. Controlling fluid loss is essential, requiring surgical or medical intervention to address bleeding sources. Caution must be exercised to avoid over-resuscitation and prevent fluid overload.

Steps of Passive Leg Raise Test:

1. Start from the semi-recumbent position with their head at a 45° angle.
2. Lower the patient's upper body until it's horizontal.
3. Passively raise the patient's legs to a 45° angle (by tilting bed, not the legs directly).
4. Direct measurement of cardiac output is to be done and not by the simple measurement of blood pressure. The technique used to measure cardiac output during PLR must be able to detect short-term and transient changes since the PLR effects may vanish after 1 minute.
5. Cardiac output must be measured not only before and during PLR but also after PLR when the patient has been moved back to the semi-recumbent position, in order to check that it returns to its baseline.
6. Avoid confounding factors (pain, cough, discomfort, and awakening could provoke adrenergic stimulation).

Diagnosis is based on electrocardiogram (ECG) findings of ischemic changes or arrhythmias, echocardiography revealing reduced ejection fraction or regional wall motion abnormalities, and elevated cardiac biomarkers such as troponin levels. Management includes initiating inotropic agents like dobutamine to improve cardiac output and consulting cardiology for potential revascularization procedures, such as percutaneous coronary intervention or thrombolysis. Fluids should be used cautiously to avoid exacerbating pulmonary edema. Monitoring for arrhythmias and worsening heart failure is critical. Target a MAP of 65 mm Hg and a urine output of 0.5 ml/kg/hr. Avoid higher doses of noradrenaline and MAP as they lead to increased afterload and oxygen consumption by the failing myocardium. Milrinone can also be used in specific cases.

Diagnosis relies on POCUS findings. In tension pneumothorax, absent lung sliding is observed; pericardial tamponade presents with pericardial effusion and diastolic collapse of the right heart chambers; pulmonary embolism may show right ventricular dilation. Management involves relieving the mechanical obstruction to

restore circulation. Tension pneumothorax requires immediate needle decompression followed by chest tube placement. Pericardial tamponade necessitates urgent pericardiocentesis. Pulmonary embolism is treated with thrombolytics or surgical embolectomy.

Diagnosis includes a history of infections, allergic reactions, or spinal injury, and physical examination may reveal warm, flushed skin and low systemic vascular resistance. Management depends on the specific cause:

- Septic Shock: Administer broad-spectrum antibiotics within the first hour after drawing necessary culture and continue norepinephrine infusion, adding vasopressin if needed. Fluid resuscitation should be guided by PLR and hemodynamic monitoring. Source control should be achieved.
- Anaphylactic Shock: Immediate intramuscular epinephrine is essential (0.5 mg, 1:1000), with antihistamines and corticosteroids as adjunctive therapy.
- Neurogenic Shock: Requires fluids and vasopressors to maintain MAP, along with stabilization of any spinal injury.

Careful monitoring is necessary to prevent fluid overload and adjust vasopressor doses based on response.

61.2.4.5 S (Stabilize organ perfusion)

The final steps in the MINUTES bundle are to evaluate for stabilization. Assess the patient's response to treatment by continuously monitoring vital signs, including heart rate, blood pressure, respiratory rate, and oxygen saturation. Urine output should be closely observed, aiming for greater than 0.5 mL/kg/hour as an indicator of renal perfusion. Serial lactate measurements can help assess the adequacy of tissue perfusion.

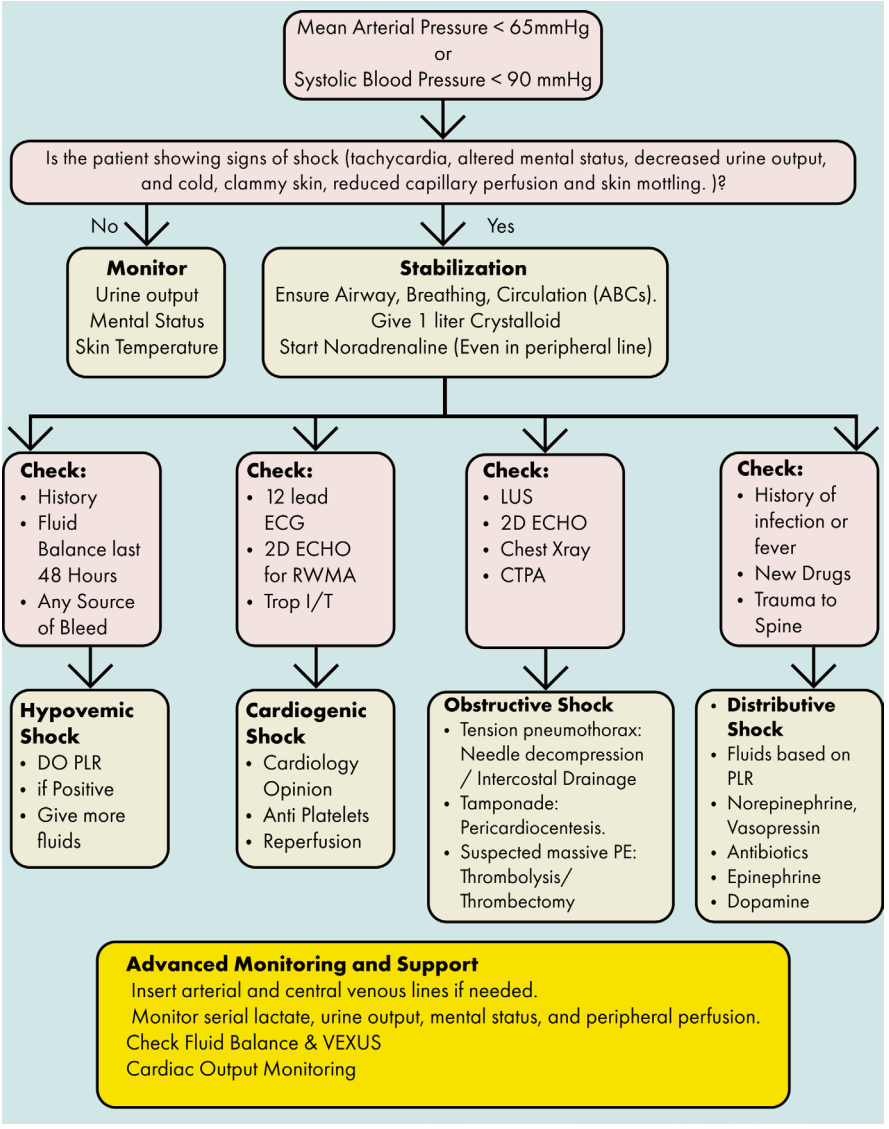
Advanced monitoring techniques may be employed to guide ongoing management. Insertion of an arterial line allows for continuous blood pressure monitoring and frequent blood gas sampling. A central venous catheter facilitates central venous pressure monitoring and administration of medications. Cardiac output monitoring, using pulse contour analysis or thermodilution techniques, provides valuable information about the patient's hemodynamic status. The venous excess ultrasound (VExUS) examination can be used to evaluate for venous congestion. These measures ensure that interventions are effective and allow for adjustments to treatment as necessary.

61.3 Conclusion

Managing shock in the ICU requires a structured and rapid approach. The MINUTES bundle provides a practical framework for early recognition and intervention, crucial in the reversible stages of shock. Incorporating point-of-care ultrasound (POCUS) and critical care echocardiography (CCE) enhances diagnostic accuracy, allowing for timely and targeted therapy. Recognizing the characteristics of each

shock type guides appropriate management while avoiding potential pitfalls, such as fluid overload in cardiogenic shock. Early and aggressive treatment of specific etiologies—like antibiotics for septic shock or decompression for tension pneumothorax—can significantly improve patient outcomes. Continuous evaluation and advanced monitoring ensure that therapy is effective and adjusted to the patient's evolving condition, ultimately reducing the risk of multi-organ failure and mortality.

Algorithm 61.1: Approach to shock in the ICU



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