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SHOCK: EVALUATION AND INITIAL MANAGEMENT

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Abstract:
Shock is characterized by inadequate oxygen supply to cells and tissues. A Patient experiencing shock may have high blood pressure, normal blood pressure, or low blood pressure. At the beginning, the consequences of shock can be reversed, but if not managed promptly and effectively, they can result in irreversible failure of multiple organs and ultimately lead to death. This review will explore the most recent evidence regarding the optimal initial approach for managing a patient experiencing suspected undifferentiated shock.

Key words: Shock, management, assessment, IV fluids.

Introduction:
Oxygen is a crucial element for meeting the metabolic needs of cells and tissues. When cells and tissues do not receive enough oxygen due to circulatory failure, it is known as shock. Shock is a dangerous condition of tissue hypoxia, regardless of its cause. Cellular hypoxia can occur from a lack of oxygen delivery, inadequate oxygen utilization, or failure to meet an increased oxygen demand, or a combination of these factors. These situations often arise when circulatory failure leads to low blood pressure. It is important to note that patients in shock may have high, normal, or low blood pressure. Timely and appropriate responses can reverse the effects of shock, but delayed or inadequate treatment could result in irreversible failure of multiple organs and death. The key focus in managing shock is to prevent multiorgan failure. Shock is divided into four main categories: distributive, cardiogenic, hypovolemic, and obstructive. Various conditions can lead to each of these types. However, the distinction between these categories is not always clear, and many patients experiencing circulatory failure may have a combination of different types of shock, known as multifactorial shock. Among patients in the intensive care unit (ICU), septic shock is the most common type, followed by cardiogenic and hypovolemic shock; obstructive shock is rarely observed.[1,2] The proportion of different types of shock in the emergency department is influenced by the population that the department serves. In urban trauma centers, there is a greater prevalence of hemorrhagic shock.[3,4]

Clinical Presentation:

Patients suspected of being in shock may exhibit various clinical manifestations. These manifestations can differ based on the underlying cause and the stage of presentation, whether it is pre-shock, shock, or end-organ failure. The undifferentiated shock might show symptoms like rapid heart rate, fast breathing, low blood pressure, reduced urine output, altered level of consciousness, cold and clammy cyanotic extremities, metabolic acidosis, and elevated lactate levels. It is important to note that individuals in the early phases of shock may have normal or high blood pressure, meaning that low blood pressure is not a necessary indicator for diagnosis.[5,6]

Oliguria may occur due to diverting renal blood flow to other essential organs or as a direct kidney injury. The cool and clammy skin responds to peripheral vasoconstriction, which helps redirect blood to vital organs. A bluish, mottled skin is a concerning sign seen in severe shock. However, cool, clammy, or bluish skin can also be linked to underlying peripheral arterial vascular disease. It is important to note that warm, reddened skin does not rule out shock, as it can be present in patients with early distributive or terminal shock. Detecting a high anion gap metabolic acidosis should prompt suspicion of shock. It is crucial to recognize that metabolic acidosis in shock states is not exclusive and could also indicate acute kidney injury or toxin exposure. A higher serum lactate level is associated with worse outcomes, whether in combination with metabolic acidosis or on its own, in cases of shock or other conditions.[7]

Most clinical signs and symptoms are not particularly reliable for identifying shock. Nevertheless, they can offer hints about the underlying cause of shock and help narrow down possible diagnoses, enabling the start of empirical treatment.

Initial management

The first steps in treating undifferentiated shock involve starting with an initial approach, carrying out an initial assessment, using initial diagnostic methods, and providing hemodynamic support. It is preferable to use a multidisciplinary, team-based approach whenever possible, as it enables both the evaluation and treatment to be done simultaneously.

Initial Assessment

The initial step in proper management involves quickly evaluating and securing the airway, breathing, and circulation. Ensuring a stable airway and providing oxygen for proper breathing is essential. Patients experiencing respiratory distress or significant hemodynamic instability should generally be intubated. The only exception is in cases of suspected tension pneumothorax, where promptly draining air from the pleural space can rapidly improve shock and avoid intubation. The recommended method is rapid sequence intubation, usually using medications like etomidate or ketamine, along with fast-acting neuromuscular blockers such as succinylcholine or rocuronium. Agents like propofol or midazolam, which may worsen low blood pressure, should be avoided. Circulation should be supported with sufficient intravenous access, allowing immediate treatment with fluids to restore proper tissue perfusion. It is important not to delay resuscitative efforts for a detailed clinical assessment, nor should clinicians be hesitant to provide fluids to patients with a history of heart failure or kidney injury. Studies have shown that generous fluid resuscitation can be life-saving for patients in septic shock with moderate serum lactate levels.[8]

In many patients with undifferentiated shock and hypotension, peripheral venous or intraosseous access is sufficient for initial management. Vasoactive medications can be safely administered for hours to days in peripheral intravenous access, obviating the need for central venous catheterization in some patients.[9] Central venous access is necessary if peripheral access cannot be obtained, or if patients require large volumes or prolonged infusion, or if they need vasopressors for an extended period. It is important to evaluate patients for the possibility of immediate or early intervention, such as surgical intervention. In cases where patients become hemodynamically unstable during evaluation and early treatment, it is crucial to shift focus to lifesaving management quickly.

A concise medical history is crucial for guiding the initial approach and proper management of life-threatening conditions. Valuable information can be gathered from various sources such as prehospital providers, hospital personnel, family members, and the patient themselves. Signs like low blood pressure, noisy breathing, swelling of the face and mouth, skin rash, and recent exposure to common allergens strongly indicate shock caused by severe allergic reaction. Swift administration of epinephrine via injection into the thigh can save lives. Patients on ventilators may experience a sudden rise in breathing pressures. The standard adult dosage is 0.3 mg injected into the mid-outer thigh, repeatable every 5 to 15 minutes as necessary. If tension pneumothorax shock is suspected, look for fast breathing, chest pain on one side, reduced breath sounds, swollen neck veins, deviation of the windpipe, and risk factors like trauma history or recent medical procedures. In such cases, skip the chest X-ray and proceed with needle decompression or an emergency chest tube insertion, ideally guided by ultrasound. Symptoms like difficulty breathing, rapid heart rate, low blood pressure, visible neck vein pulsation, faint heart sounds, weakened pulse, and risk factors like trauma could indicate a pericardial tamponade. Use point-of-care ultrasonography or bedside echocardiography before attempting pericardiocentesis. Ultrasound also helps in guiding needle or catheter insertion and assessing fluid drainage from the pericardial sac. In rare instances where catheter drainage is not an option or if cardiac arrest occurs during resuscitation, emergency thoracotomy may be necessary. Note that pericardiocentesis is not suitable for patients with a pericardial effusion due to aortic dissection or heart muscle rupture, as it could worsen bleeding. These individuals need immediate surgical care.

Shock suspected to result from hemorrhage needs to determine if it stems from traumatic or non-traumatic causes. Individuals with a history of blunt or penetrating trauma may benefit from a rapid multiorgan bedside ultrasonography known as focused assessment with sonography for trauma (FAST) to detect abdominal bleeding. Positive results suggest the requirement for immediate surgical exploration to locate and manage the bleeding source. In cases where hemorrhagic shock is suspected without a trauma history, a ruptured aorta should be considered. Patients with a ruptured aorta typically exhibit hypotension, along with abdominal, chest, or back pain, and may have a known aneurysm or dissection history. Due to instability, contrast-enhanced computed tomography (CT) may not be safe for these patients. Before treatment, diagnostic options like transesophageal echocardiography (for thoracic aorta) and abdominal ultrasound (for abdominal aorta) are utilized to identify perioaortic hematoma or aneurysmal disorders. For patients showing signs of upper or lower gastrointestinal bleeding, interventions such as endoscopy, embolization, or surgery may be considered. Hemorrhage-induced shock often necessitates significant blood product transfusions, while vasopressors are best avoided. Physicians should ensure adequate peripheral access or a large-bore, single-lumen central line for patients suspected of hemorrhage. It is essential to conduct a type and crossmatch, complete blood count, and coagulation studies for proper management.

Initial assessment might show the existence of arrhythmia leading to shock. Atropine or vasoactive agents can be used to cardiovert tachyarrhythmia, while bradyarrhythmias can be treated with temporary or permanent pacemaker placement. Arrhythmias could be the main reason for shock or a contributing factor; immediate intervention could be life-saving. However, arrhythmias might also be caused by shock-related metabolic issues like acidosis, or by the underlying conditions such as sepsis, pulmonary embolism, or myocardial infarction. Therefore, the detection of arrhythmias should trigger further investigations.[10]

Therefore, further investigations should be carried out due to their presence. Symptoms like fever, hypotension, and a suspected septic origin indicate septic shock. These individuals should receive prompt intravenous antibiotics and intravenous fluid resuscitation. The choice of antibiotic depends on the suspected source. In cases where the source is unidentified and the presence of Pseudomonas is unlikely, initial management can involve combining vancomycin with a third- or fourth-generation cephalosporin, a beta-lactam/beta-lactamase inhibitor, or a carbapenem. However, if Pseudomonas is anticipated, vancomycin should be paired with two antipseudomonal agents like fluoroquinolone, aminoglycoside, piperacillin-tazobactam, cefepime, or ceftazidime. Signs such as leukocytosis, especially with bandemia, along with supportive laboratory and imaging results indicating a source, confirm sepsis as the underlying cause of shock. It is crucial to obtain blood and other relevant body fluid cultures before administering antibiotics, as well as conducting imaging studies as needed to enable timely management of the source. Monitoring serial vital signs and serum lactate levels is recommended for follow-up care in patients with septic shock.

Cardiogenic shock should be considered in patients experiencing low blood pressure along with severe chest pain, breathing difficulties, and ECG changes indicative of a heart attack. Elevated levels of troponin or creatine phosphokinase in the blood, as well as signs of fluid in the lungs on chest X-rays, further support this suspicion. Treatment involves giving medications to prevent blood clotting or using heparin, performing procedures to restore blood flow to the heart, and possibly inserting a balloon pump into the aorta. Patients who do not have ST elevation on their ECG may also benefit from receiving glycoprotein IIb/IIIa inhibitors. Cardiogenic shock can be caused by sudden leakage of the aortic or mitral valves. Symptoms suggesting aortic valve leakage include chest pain, low blood pressure, and a new type of heart murmur. These patients should have point-of-care ultrasonography or an echocardiogram before considering surgery. More tests may be needed to determine the cause. Patients who develop breathing difficulties and a new heart murmur after a heart attack should promptly undergo an echocardiogram to check for mitral valve leakage or a hole in the heart wall, which often require urgent surgery. Aortic dissection typically causes sharp chest or back pain. Unlike those with a dissection in the lower part of the aorta, patients with a dissection in the upper part are more likely to have low blood pressure and shock due to sudden valve leakage, fluid around the heart, or a heart attack. Urgent consultation with a heart surgeon is crucial in cases of ascending aortic dissection. A patient who is in shock, has sudden difficulty breathing, and low oxygen levels, along with low blood pressure, is likely to have a blood clot in the lungs. Using clot-busting drugs can be life-saving. High levels of D-dimer, troponin, and certain hormones support this diagnosis; chest X-rays typically appear normal. A CT scan of the lungs is the best way to confirm the diagnosis. If this is not possible, point-of-care ultrasonography or an echocardiogram can provide clues, such as an enlarged right ventricle or a clot, which may warrant starting clot-busting medication if no contraindications are present.

A past of having low levels of glucocorticoids or stopping their use in patients with low blood pressure and reduced fluid levels indicates the possibility of an adrenal crisis. The initial approach should involve giving fluids and administering 4 mg of dexamethasone intravenously. The choice of dexamethasone is made considering the ability to analyze blood cortisol levels during the assessment. Patients might develop shock after being bitten by certain insects or animals, and in such cases, they will need antivenom to treat shock, along with standard resuscitation measures.

Initial diagnostic evaluation

After the initial assessment, the focus should be on conducting a comprehensive diagnostic evaluation. This may involve various tests such as laboratory work and imaging studies. In cases of undifferentiated hypotension and shock, bedside telemetry and/or electrocardiogram (ECG) can help identify the cause and should be done for all patients. Signs like arrhythmia and ST segment changes indicating ischemia or pericarditis might be present. A low-voltage ECG could be a sign of pericardial effusion. Additionally, classic indicators of pulmonary embolism (S1, Q3, T3) or right ventricular strain might also be observable.

Laboratory tests should be conducted early in patients with undifferentiated shock. Elevated serum lactate (>2 mmol/L) is an early sign of shock and can be a valuable parameter, particularly in normotensive or hypertensive patients. Other crucial laboratory tests to consider are Complete blood count and differential (CBC), arterial blood gases (ABG), cardiac enzymes, renal and liver function tests, Coagulation studies, and D-dimer levels. The Complete blood count can provide insight into the type of shock. For instance, anemia in the presence of bleeding can indicate hemorrhagic shock, while thrombocytopenia may suggest a cause for bleeding. A high eosinophil count might point towards anaphylaxis shock. While leukocytosis could indicate septic shock, it is not definitive and may be a stress response. A low white blood cell count, especially with the pandemic, is more concerning for sepsis in cases of undifferentiated shock.[11] Lactate levels in shock indicate tissue perfusion status and result from higher production through anaerobic and aerobic metabolism, as well as reduced clearance by the liver, kidneys, and skeletal muscle.[7,12] Nevertheless, while elevated lactate is a useful indicator for detecting shock (a normal level can rule out the diagnosis), it lacks specificity. It may be present in other conditions, such as metformin toxicity, diabetic ketoacidosis, and alcoholism. A lactate level exceeding 4 mmol/L is particularly linked to higher mortality, regardless of organ dysfunction or low blood pressure. Elevated lactate from other causes is also connected to increased mortality.[13] Elevated levels of cardiac enzymes like troponin-I or -T, along with brain natriuretic peptide, could suggest cardiogenic shock caused by ischemia but might also be a result of demand ischemia or a pulmonary embolism (PE).

Imaging techniques can help indicate the cause of shock. In cases of suspected shock, a portable chest X-ray is commonly used to identify prevalent causes like pneumonia (septic shock). Point-of-care ultrasonography (POC) is frequently utilized in patients experiencing undifferentiated shock and hypotension.[14-17] This comprises rapid ultrasound in shock (RUSH), focused cardiac ultrasound (FOCUS), or abdominal and cardiac evaluation with sonography in shock (ACES). These serve as convenient, point-of-care diagnostic instruments. RUSH and ACES involve examining multiple organs through ultrasound, starting with the heart, then moving on to the chest, abdomen, and major blood vessels. Focused cardiac ultrasound (FOCUS) focuses solely on the heart. The application of these methods in patients experiencing undifferentiated shock is akin to the use of focused assessment with sonography for trauma (FAST) in trauma cases. Portable and cost-effective, point-of-care ultrasonography poses no risks. Its primary benefit lies in swiftly assessing various organs, especially the heart, aiding in narrowing down potential causes of shock. Quick, empirical diagnoses can be made within minutes, unlike traditional imaging techniques, as indicated by observational research.

Ultrasonography has a higher level of sensitivity compared to portable chest radiography when it comes to identifying pneumothorax, showing a high sensitivity (86 to 100 percent) and specificity (92 to 100 percent).[18-21] Nevertheless, POC has limited effectiveness in detecting various causes of shock compared to advanced imaging techniques done by well-trained professionals. One reason for this limitation could be the absence of established guidelines related to the education, proficiency, and appropriate use of bedside ultrasound. A prime illustration of this restriction is seen in identifying pericardial effusion. Even though POC ultrasound is known for its accuracy, a comprehensive echocardiogram with additional perspectives might be necessary for a conclusive diagnosis in cases of complex, localized, or small effusions.[22,23] Furthermore, some abnormalities are not easily identified through limited bedside views such as regional wall motion abnormalities, valvular dysfunction, ventricular septal wall perforation, ruptured aortic aneurysms, and aortic dissection. A meta-analysis of nine studies found that using FOCUS to assist in clinical assessment showed higher sensitivity in examining the left ventricle and mitral valve compared to clinical assessment alone while maintaining similar specificity.[24] No data supports the benefits of pulmonary arterial catheterization (PAC) on important outcomes. Hence, the routine insertion of Swan-Ganz catheters has largely declined.[25-27] Hemodynamic measurements acquired through PAC can be very useful in cases where the diagnosis or type of shock is uncertain or a combination of types. Patients who may also benefit from PAC are those with unclear volume status after receiving enough fluids, those experiencing severe cardiogenic shock, or those suspected of having serious underlying conditions like pulmonary artery hypertension or cardiac tamponade.

The primary hemodynamic parameters assessed with a pulmonary artery catheter include cardiac output, systemic vascular resistance, pulmonary artery wedge pressure, right atrial pressure, and mixed venous oxygen saturation (SvO_2). These values are valuable for diagnosis and can also assist in managing fluid replacement, adjusting vasopressor doses, and evaluating the impact of altering mechanical ventilator parameters.[28]

Hemodynamic support

There is no agreement on the specific level at which hemodynamic support should be given to patients with undifferentiated shock because shock can occur in patients with low, high, or normal blood pressure. Typically, when shock is suspected based on initial evaluation or lab tests, treatment should begin with intravenous fluids (IVFs), followed by vasopressors if IVFs do not improve tissue perfusion. While the ideal blood pressure to perfuse organs is uncertain, experts generally recommend maintaining a mean arterial pressure of at least 65 to 70 mmHg, as higher targets do not seem to reduce mortality and may increase the risk of heart rhythm problems. [29] The amount of fluid needed depends on the cause of shock. Patients with obstructive shock due to pulmonary embolism or cardiogenic shock from left ventricular myocardial infarction usually require small amounts of IV fluid (500-1000 mL), while those with right ventricular infarction or sepsis often need 2 to 5 liters, and those with hemorrhagic shock often need more than 3 to 5 liters. Though the best fluid choice is uncertain, most patients with septic shock receive crystalloids like Ringer's lactate or normal saline, while those with hemorrhagic shock should ideally get blood products. Vasopressors are often needed to help patients with undifferentiated shock by improving tissue perfusion. It is important to note that vasopressors can be harmful for patients with hemorrhagic or hypovolemic shock. Therefore, vasopressors should only be used as an additional method of hemodynamic support when aggressive resuscitation fails to improve tissue perfusion, or as a last resort for critically ill patients. The most effective initial vasopressor and the ideal target mean arterial pressure are not known. [30] Nevertheless, the most frequently utilized agent is intravenous norepinephrine (Levophed). When drugs with excessive beta-adrenergic activity cannot be used due to tachyarrhythmia, phenylephrine (Neo-synephrine) is typically given intravenously instead. Dobutamine is commonly used as an inotropic agent for patients experiencing cardiogenic shock. It is often combined with norepinephrine to counteract the drop in peripheral vascular resistance that occurs with low dobutamine doses. The administration of vasopressor support should be adjusted based on the patient's response to minimize side effects. Typically, the goal is to achieve a mean arterial pressure of 65 or higher based on personalized care. While targeting higher mean arterial pressures in patients with chronic hypertension led to an increase in arrhythmias, this issue was balanced out by a reduced need for renal replacement therapy.[31]

Conclusion

An inadequate supply of oxygen to cells and tissues leading to circulatory failure defines shock. Shock can occur in patients with high blood pressure, normal blood pressure, or low blood pressure. Early intervention can reverse the effects of shock, but delayed treatment may result in irreversible failure of multiple organs and death. The clinical symptoms vary based on the cause and timing of shock presentation, whether it is in the early stages, during shock, or when organ failure has already occurred. Undifferentiated shock may show symptoms such as rapid heartbeat, fast breathing, and low blood pressure. The first step in effective treatment is a quick evaluation and ensuring proper airway, breathing, and circulation. After the initial assessment, focus should shift to a comprehensive diagnostic examination through laboratory tests and imaging. If shock is suspected based on the initial assessment or lab results, administering intravenous fluids should be the first step, followed by vasopressors if fluids are ineffective.

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