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Michael C. Scott

Sepsis is a heterogeneous clinical syndrome that encompasses infections of many different types and severity. Not surprisingly, it has confounded most attempts to apply a single definition, which has also limited the ability to develop a set of reliable diagnostic criteria. It is perhaps best defined as the different clinical syndromes produced by an immune response to infection that causes harm to the body beyond that of the local effects of the infection.

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Jared Radbel and Daniel Boutsikaris

Recent literature continues to refine which components of the early goal-directed therapy (EGDT) algorithm are necessary. Given it utilizes central venous pressure, continuous central venous oxygen saturation, routine blood transfusions, and inotropic medications, this algorithm can be timely, invasive, costly, and potentially harmful. New trials highlight early recognition, early fluid resuscitation, appropriate antibiotic treatment, source control, and the application of a multidisciplinary evidence-based approach as essential components of current sepsis management. This article discusses the landmark sepsis trials that have been published over the past several decades and offers recommendations on what should currently be considered 'usual care'.

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Michael G. Allison, Emily L. Heil, and Bryan D. Hayes

Prescribing antibiotics is an essential component of initial therapy in sepsis. Early antibiotics are an important component of therapy, but speed of administration should not overshadow the patient-specific characteristics that determine the optimal breadth of antimicrobial therapy. Cultures should be drawn before antibiotic therapy if it does not significantly delay administration. Combination antibiotic therapy against gram-negative infections is not routinely required, and combination therapy involving vancomycin and piperacillin/tazobactam is associated with an increase in acute kidney injury. Emergency practitioners should be aware of special considerations in the administration and dosing of antibiotics in order to deliver optimal care to septic patients.

Source Identification and Source Control

Zeke P. Oliver and Jack Perkins

Identifying sources of infection and establishing source control is an essential component of the workup and treatment of sepsis. Investigation with history, physical examination, laboratory tests, and imaging can in identifying sources of infection. All organ systems have the potential to develop sources of infection. However, there are inherent difficulties presented by some that require additional diligence, namely, urinalysis, chest radiographs, and intraabdominal infections. Interventions include administration of antibiotics and may require surgical or other specialist intervention. This is highlighted by the Surviving Sepsis Campaign with specific recommendations for time to antibiotics and expeditious time to surgical source control.

Fluid Resuscitation in Severe Sepsis

Rob Loflin and Michael E. Winters

Since its original description in 1832, fluid resuscitation has become the cornerstone of early and aggressive treatment of severe sepsis and septic shock. However, questions remain about optimal fluid composition, dose, and rate of administration for critically ill patients. This article reviews pertinent physiology of the circulatory system, pathogenesis of septic shock, and phases of sepsis resuscitation, and then focuses on the type, rate, and amount of fluid administration for severe sepsis and septic shock, so providers can choose the right fluid, for the right patient, at the right time.

Vasopressors and Inotropes in Sepsis

Leeanne Stratton, David A. Berlin, and John E. Arbo

Vasopressor and inotropes are beneficial in shock states. Norepinephrine is considered the first-line vasopressor for patients with sepsis-associated hypotension. Dobutamine is considered the first-line inotrope in sepsis, and should be considered for patients with evidence of myocardial dysfunction or ongoing signs of hypoperfusion. Vasopressor and inotrope therapy has complex effects that are often difficult to predict; emergency providers should consider the physiology and clinical trial data. It is essential to continually reevaluate the patient to determine if the selected treatment is having the intended result.

End Points of Sepsis Resuscitation

John C. Greenwood and Clinton J. Orloski

Resuscitation goals for the patient with sepsis and septic shock are to return the patient to a physiologic state that promotes adequate end-organ perfusion along with matching metabolic supply and demand. Ideal resuscitation end points should assess the adequacy of tissue oxygen delivery and oxygen consumption, and be quantifiable and reproducible. Despite years of research, a single resuscitation end point to assess adequacy of resuscitation has yet to be found. Thus, the clinician must rely on multiple end points to assess the patient's overall response to therapy. This review will discuss the role and limitations of central venous pressure (CVP), mean arterial pressure (MAP), and cardiac output/index as macro-circulatory resuscitation targets along with lactate, central venous oxygen

saturation (ScvO₂), central venous-arterial CO₂ gradient, urine output, and capillary refill time as microcirculatory resuscitation endpoints in patients with sepsis.

Ready for Prime Time? Biomarkers in Sepsis

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Brit Long and Alex Koyfman

Sepsis is a common condition managed in the emergency department. Current diagnosis relies on physiologic criteria and suspicion of a source of infection using history, physical examination, laboratory studies, and imaging studies. The infection triggers a host response with the aim to destroy the pathogen, and this response can be measured. A reliable biomarker for sepsis should assist with earlier diagnosis, improve risk stratification, or improve clinical decision making. Current biomarkers for sepsis include lactate, troponin, and procalcitonin. This article discusses the use of lactate, procalcitonin, troponin, and novel biomarkers for use in sepsis.

Pediatric Sepsis

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Melanie K. Prusakowski and Audrey P. Chen

Pediatric sepsis is distinct from adult sepsis in its definitions, clinical presentations, and management. Recognition of pediatric sepsis is complicated by the various pediatric-specific comorbidities that contribute to its mortality and the age- and development-specific vital sign and clinical parameters that obscure its recognition. This article outlines the clinical presentation and management of sepsis in neonates, infants, and children, and highlights some key populations who require specialized care.

Sepsis in Special Populations

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Matthew P. Borloz and Khalief E. Hamden

Sepsis is recognized by the presence of physiologic and laboratory changes that reflect the inflammatory response to infection on cellular and systemic levels. Comorbid conditions, such as cirrhosis, end-stage renal disease, and obesity, alter patients' susceptibility to infection and their response to it once present. Baseline changes in vital signs and chronic medications often mask clues to the severity of illness. The physiologic, hematologic, and biochemical adjustments that accompany pregnancy and the puerperium introduce similar challenges. Emergency providers must remain vigilant for subtle alterations in the expected baseline for these conditions to arrive at appropriate management decisions.

Sepsis Resuscitation in Resource-Limited Settings

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Brian Meier and Catherine Staton

Our evolving understanding of the physiologic processes that lead to sepsis has led to updated consensus guidelines outlining priorities in the recognition and treatment of septic patients. However, an enormous question remains when considering how to best implement these guidelines in settings with limited resources, which include rural US emergency departments and low- and middle-income countries. The core principles of sepsis management should be a priority in community emergency

departments. Similarly, cost-effective interventions are key priorities in low- and middle-income countries; however, consideration must be given to the unique challenges associated with such settings.

Prehospital Sepsis Care

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Jerrilyn Jones and Benjamin J. Lawner

Prehospital care providers are tasked with the delivery of time-sensitive care, and emergency medical services (EMS) systems must match patients to appropriate clinical resources. Modern systems are uniquely positioned to recognize and treat patients with sepsis. Interventions such as administration of intravenous fluid and transporting patients to the appropriate level of definitive care are linked to improved patient outcomes. As EMS systems refine their protocols for the recognition and stabilization of patients with suspected or presumed sepsis, EMS providers need to be educated about the spectrum of sepsis-related presentations and treatment strategies need to be standardized.

Pitfalls in the Treatment of Sepsis

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Lars-Kristofer N. Peterson and Karin Chase

Sepsis is a challenging, dynamic, pathophysiology requiring expertise in diagnosis and management. Controversy exists as to the most sensitive early indicators of sepsis and sepsis severity. Patients presenting to the emergency department often lack complete history or clinical data that would point to optimal management. Awareness of these potential knowledge gaps is important for the emergency provider managing the septic patient. Specific areas of management including the initiation and management of mechanical ventilation, the appropriate disposition of the patient, and consideration of transfer to higher levels of care are reviewed.

Antimicrobial Stewardship in the Management of Sepsis

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Michael S. Pulia, Robert Redwood, and Brian Sharp

Sepsis represents a unique clinical dilemma with regard to antimicrobial stewardship. The standard approach to suspected sepsis in the emergency department centers on fluid resuscitation and timely broad-spectrum antimicrobials. The lack of gold standard diagnostics and evolving definitions for sepsis introduce a significant degree of diagnostic uncertainty that may raise the potential for inappropriate antimicrobial prescribing. Intervention bundles that combine traditional quality improvement strategies with emerging electronic health record-based clinical decision support tools and rapid molecular diagnostics represent the most promising approach to enhancing antimicrobial stewardship in the management of suspected sepsis in the emergency department.

The Past, Present, and Future of the Centers for Medicare and Medicaid Services Quality Measure SEP-1: The Early Management Bundle for Severe Sepsis/Septic Shock

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Jeremy S. Faust and Scott D. Weingart

SEP-1, the new national quality measure on sepsis, resulted from an undertaking to standardize care for severe sepsis and septic shock

regardless of the size of the emergency department where the patient is being treated. SEP-1 does not necessarily follow the best current evidence available. Nevertheless, a thorough understanding of SEP-1 is crucial because all hospitals and emergency providers will be accountable for meeting the requirements of this measure. SEP-1 is the first national quality measure on early management of sepsis care. This article provides a review of SEP-1 and all its potential implications on sepsis care in the United States.

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