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THE ROLE OF THE ANESTHESIOLOGIST IN THE MANAGEMENT OF CRITICALLY ILL SEPTIC PATIENTS: A CLINICAL LITERATURE REVIEW

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ABSTRACT

Sepsis and septic shock are acute, life threatening syndromes in which infection triggers widespread organ dysfunction and rapid clinical deterioration, demanding fast, coordinated action from multiple specialties. In patients who require surgical source control, the anesthesiologist becomes central to perioperative management, because decisions made in the operating room directly influence perfusion, oxygen delivery, and the safety of the procedure. This review focuses on the anesthesiologist's tasks before, during, and after surgery, with particular attention to how sepsis alters usual anesthetic practice. In unstable patients, careful evaluation of organ failure, cautious choice and dosing of induction drugs (often favoring ketamine or etomidate rather than propofol), advanced monitoring with individually tailored fluid therapy, lung protective ventilation, and timely escalation to vasopressor support are all essential to reduce perioperative risk. Current Surviving Sepsis Campaign recommendations underline that effective source control should be achieved as early as possible, ideally within the first 6 hours from recognizing sepsis, which places anesthesiologists in a key position to balance the urgency of surgery with the need for initial resuscitation. A solid grasp of sepsis pathophysiology and its hemodynamic consequences is therefore fundamental for anesthesiologists involved in the care of these critically ill patients.

KEYWORDS

Sepsis, Septic Shock, Anesthesia Management, Critically Ill Patients, Perioperative Care, Hemodynamic Monitoring

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Introduction

Sepsis is a severe clinical condition in which an infection triggers acute organ failure as a result of an abnormal, dysregulated host response[2]. Septic shock is regarded as the most critical form of sepsis and is characterized by persistent hypotension that, despite adequate fluid resuscitation, requires vasopressor therapy to maintain a mean arterial pressure of at least 65 mmHg, together with a serum lactate concentration above 2 mmol/L[2]. These syndromes place a substantial burden on healthcare systems worldwide; current estimates suggest roughly 48.9 million sepsis episodes each year and about 11 million deaths in which sepsis is a direct or contributing cause[3]. Around 30-day mortality remains high, affecting roughly one quarter of patients with sepsis and more than one third of those with septic shock. Among survivors, long-term complications are common and are often grouped under the term post-intensive care syndrome (PICS), which includes persistent physical disability, cognitive impairment, and psychological problems that necessitate structured rehabilitation and prolonged follow-up after discharge. Despite advances in critical care, sepsis continues to be one of the leading causes of death in intensive care units worldwide[3]. Patients with sepsis or septic shock frequently need invasive interventions aimed at removing the infectious focus, limiting further contamination, and repairing damaged structures. Typical source control procedures include surgical debridement of necrotic or infected tissue (for example in necrotizing fasciitis), drainage of collections such as abscesses, explantation of infected prostheses or devices, and closure of gastrointestinal perforations that have resulted in peritonitis[4][6]. Throughout this process, the anesthesiologist plays a central role in the care of these critically ill patients[5]. Before surgery, this involves a thorough evaluation of organ dysfunction and careful stabilization of the circulation. In the operating room, anesthesiologists must balance the hemodynamic effects of anesthetic drugs with the need to preserve sufficient organ perfusion. After the procedure, many patients with sepsis still require intensive care, including ongoing organ support in the ICU. The Surviving Sepsis Campaign (SSC) recommends that sepsis should be recognized as early as possible and treated without delay, with broad-spectrum antibiotics started within roughly the first hour, prompt efforts to control the infectious focus—ideally during the first 6 hours—and aggressive hemodynamic resuscitation[1]. Observational data indicate that achieving source control in this early time window is linked to substantially lower 90-day mortality, with about a 29% reduction in adjusted odds of death compared with later intervention[7].

Methodology

Literature Selection and Search Strategy In this review, we considered original, peer-reviewed papers examining how anesthesiologists manage critically ill patients with sepsis. We focused on clinical studies published between 2011 and 2025, including observational work, cross-sectional analyses, and interventional trials. Only studies that reported concrete clinical data on preoperative evaluation and optimization, intraoperative management, postoperative care, and patient outcomes were included.

Inclusion Criteria Studies were selected based on the following criteria: (1) inclusion of adult patients with sepsis or septic shock; (2) a clear focus on the role of the anesthesiologist in perioperative management (preoperative assessment and optimization, intraoperative management, or postoperative care); (3) provision of empirical clinical data (observational studies, cross-sectional analyses, interventional trials, or evidence-based guidelines); (4) adequate methodological quality and clarity in reporting study design, population, and outcomes.

Data Extraction and Analysis Data extraction from the selected studies focused on the following elements:

1. Study design, population, and setting
2. Specific anesthetic interventions and techniques
3. Hemodynamic monitoring approaches
4. Fluid resuscitation strategies
5. Vasopressor and inotrope use
6. Mechanical ventilation parameters
7. Clinical outcomes (mortality, length of stay, complications)
8. Guideline recommendations and consensus statements

The evidence was synthesized narratively, organizing findings according to the phases of perioperative care: preoperative assessment and optimization, intraoperative management, and postoperative considerations.

Quality Assessment The quality of included studies was assessed based on study design, sample size, methodological rigor, and consistency with current clinical practice guidelines. Particular emphasis was placed on the 2021 Surviving Sepsis Campaign guidelines[1], which represent the current international consensus for sepsis management.

Results

Part I - Preoperative Assessment and Optimization

Comprehensive Organ Dysfunction Evaluation Preoperative evaluation of a patient with sepsis has to be done quickly, but at the same time cannot be superficial[5]. It should include an early judgement of whether urgent source control is needed, alongside a systematic search for organ dysfunction and its targeted treatment. In daily practice, many teams use scoring systems such as the Sequential Organ Failure Assessment (SOFA) to quantify the severity of organ failure[2].; this score incorporates, among others, the Glasgow Coma Scale, the PaO_2/FiO_2 ratio, blood pressure and vasopressor use, platelet count, bilirubin, creatinine, and urine output[2]. Because patients with sepsis often require emergency surgery, there is usually little time to stabilize them before the procedure, and the window for effective source control is inherently short[6][7].

Hemodynamic Optimization Hemodynamic optimization must be initiated before anesthesia induction and continued throughout surgery[5]. The 2021 Surviving Sepsis Campaign guidelines recommend administering at least 30 mL/kg of intravenous crystalloid fluid within the first 3 hours of resuscitation for patients with sepsis-induced hypoperfusion or septic shock[1]. The fluid challenge technique is increasingly used and recognized as an individualized approach[8]. A fluid challenge involves infusing 3-4 mL/kg of crystalloid over 5 minutes while monitoring stroke volume (SV) or cardiac output (CO)[8]. An increase in SV >10-15% defines a fluid-responsive patient, and the test may be repeated until responsiveness ceases[8]. Recent evidence from 2025 demonstrated that patients receiving 40-45 mL/kg fluid resuscitation volume within 3 hours had a higher probability of successful outcomes compared to those receiving 20-25 mL/kg, with the optimal timing being ≤3 hours from sepsis recognition[9]. Advanced hemodynamic monitoring plays a crucial role in the preoperative phase. The SSC 2021 guidelines suggest using dynamic measures including passive leg raise or fluid bolus response, assessed through stroke volume variation (SVV), pulse pressure variation (PPV), or echocardiography where available[1][10]. Transpulmonary thermodilution should be considered in patients with severe septic shock, as it allows continuous real-time monitoring of cardiac output and provides estimates of end-diastolic volume, systolic function, extravascular lung water (EVLW), and pulmonary vascular permeability[5].

Vasopressor Therapy Vasopressor therapy should be initiated early if hypotension persists during fluid resuscitation, while volume optimization continues[1]. Norepinephrine is the vasopressor of first choice[1]. The 2021 SSC guidelines introduced a new recommendation supporting peripheral initiation of vasopressors[1][10]. Vasopressor administration should not be delayed in order to obtain central venous access. This recommendation is based on mounting evidence that peripheral administration via antecubital veins is safe when used for short periods (<6 hours), particularly if smaller distal veins are avoided[10]. The target MAP should be ≥65 mmHg initially, as higher MAP does not improve survival and may increase complications such as atrial fibrillation[1]. A 2023 randomized controlled trial demonstrated that permissive hypotension (MAP 60-65 mmHg) in elderly patients (≥65 years) with septic shock achieved similar 90-day mortality to usual care targeting higher MAP, with reduced use of vasopressor agents.

Cardiac Function Assessment Cardiac dysfunction occurs in 10-70% of patients with sepsis[5]. Evaluation should include identification of arrhythmias or septic cardiomyopathy, as these conditions contribute to hemodynamic instability[5]. Echocardiography has a pivotal role in assessing left ventricular systolic/diastolic function and right ventricular function[5]. Troponin and BNP are biomarkers that become elevated in the course of sepsis and reflect severity of illness and multiple organ dysfunction rather than exclusively myocardial cell death[5].

Respiratory Assessment Patients may present with dyspnea and hypoxia[5]. Increased work of breathing and tachypnea may represent a compensatory response to metabolic acidosis. Hypoxia may indicate coexisting acute respiratory distress syndrome (ARDS)[5]. Physical examination, pulse oximetry (SpO_2), arterial blood gas analysis, and chest imaging form the basis for diagnosing lung injury[5].

Renal Function and Coagulopathy Assessment of renal function is essential, as sepsis often leads to acute kidney injury[5]. Urea, creatinine, electrolytes, and urine output should be monitored. Coagulopathy is a major clinical problem in the course of sepsis[5]. It may manifest as mild or moderate abnormalities in coagulation tests and thrombocytopenia, whereas in more severe cases it may progress to disseminated intravascular coagulation (DIC)[5]. The International Society on Thrombosis and Haemostasis (ISTH) criteria for overt DIC and sepsis-induced coagulopathy (SIC) should be applied[5]. In patients with DIC and active bleeding or a high risk of bleeding, fresh frozen plasma (10-15 mL/kg) or prothrombin complex concentrate should be administered[5]. Platelet concentrate transfusion should be considered when the platelet count falls below 50×10^9/L in patients with active bleeding or before planned invasive procedures[5].

Antimicrobial Therapy Antibiotic treatment with a broad-spectrum regimen should be started as early as possible, ideally within about an hour from the moment sepsis or septic shock is suspected, after blood and other cultures have been obtained for microbiological testing[1]. Current SSC 2021 recommendations distinguish two main situations: in patients with probable septic shock or a high likelihood of sepsis, antimicrobial therapy ought to begin immediately, aiming for administration within the first hour; in patients with suspected sepsis but without shock, a short, focused diagnostic work-up is advised, with antibiotics given within up to 3 hours if the suspicion of infection persists[1].

Part II - Intraoperative Management

Anesthetic Induction Rapid sequence induction is generally preferred when general anesthesia is required for urgent or emergency surgery in patients with sepsis, because it minimizes the time between loss of consciousness and airway protection[5][14]. In the setting of shock, both the cardiovascular and central nervous systems tend to respond more strongly to anesthetic agents, so usual induction doses are often too high and should be reduced[14]. The induction phase itself can provoke pronounced hypotension through vasodilation and depression of myocardial contractility[5][14]. Therefore, as far as the clinical situation allows, circulation should be stabilized before induction, including invasive arterial blood pressure monitoring, consideration of central venous access, and careful optimization of intravascular volume[5]. Vasopressor agents ought to be prepared for immediate use and, in particularly unstable patients, may be started even before induction of anesthesia[5].

Selection of Induction Agents

Table 1. Comparison of induction agents for septic patients undergoing anesthesia[11][12][13]

Induction Agent	Hemodynamic Stability	Advantages	Disadvantages
Ketamine	High	Sympathomimetic effects, anti-inflammatory properties	May cause tachycardia, hallucinations
Etomidate	High	Minimal cardiovascular effects, rapid onset	Transient adrenal suppression
Propofol	Low	Smooth induction, anti-emetic effects	Significant vasodilation, myocardial depression
Ketamine + Lidocaine	High	Reduced hypotension, fewer adverse effects	Requires two agents, more complex dosing

Opioids Short-acting opioids (fentanyl, alfentanil, remifentanil) allow reduction of hypnotic agent doses, potentially minimizing hemodynamic perturbations[5][14].

Maintenance of Anesthesia Current evidence does not clearly show that either volatile or intravenous techniques are superior for maintaining general anesthesia in patients with sepsis[14]. Sepsis and septic shock tend to lower the minimum alveolar concentration of inhaled agents, so effective anesthesia is usually achieved at lower doses[14]. When lung function is severely impaired, achieving a stable brain concentration of volatile anesthetics can be challenging because of disturbed gas exchange and ventilation. In this context, monitoring anesthetic depth with processed EEG can help avoid both excessive dosing and the risk of intraoperative awareness[5][14].

Hemodynamic Monitoring and Management If hemodynamic monitoring has not been used in the preoperative period, it should be instituted[5]. The use of minimally invasive systems based on pulse contour analysis to estimate cardiac output is recommended[5]. The choice between calibrated and uncalibrated systems depends on the severity of shock[5]. The reliability of uncalibrated systems is limited in patients receiving high doses of vasopressors or experiencing rapid fluctuations in vasomotor tone[5]. Central venous pressure (CVP) has limited utility for guiding fluid administration[1][5]. Dynamic indices of fluid responsiveness (PPV and SVV) can be considered when predicting the response to fluid boluses[1][5]. However, limitations include arrhythmias, tidal volumes <8 mL/kg, low pulmonary compliance, intra-abdominal hypertension, and right ventricular dysfunction[5]. A tidal volume challenge may be performed when protective ventilation with 6 mL/kg is employed: temporarily increasing tidal volume to 8 mL/kg for several breaths, with increases in PPV or SVV of 3.5% and 2.5%, respectively, indicating fluid responsiveness[5]. Alternatively, an end-expiratory occlusion test for 15-20 seconds indicates responsiveness if cardiac output increases ≥5%[5]. Albumin should be considered when large volumes of fluids are required[1]. Other colloids, such as gelatins and hydroxyethyl starch, are contraindicated[1]. In cases of refractory hypotension despite fluid resuscitation and high-dose norepinephrine, vasopressin may be added[15]. A 2021 study demonstrated that while vasopressin adjunct to norepinephrine may not provide mortality benefit overall, it enables more rapid achievement of target MAP >65 mmHg and may benefit patients with less severe shock[15]. Low-dose hydrocortisone (200 mg/day intravenously) should be considered in septic shock patients with ongoing vasopressor requirements[1]. Dobutamine is the preferred inotrope in the presence of low cardiac output with hypoperfusion despite adequate fluid resuscitation and optimization of afterload[1]. Central venous oxygen saturation ($ScvO_2$), arterial lactate, and venous-to-arterial CO_2 difference ($Pv\text{-}aCO_2$) are useful for assessing tissue perfusion adequacy[1][5]. Values indicating hypoperfusion include lactate >2 mmol/L, $ScvO_2$ <70%, and $Pv\text{-}aCO_2$ >6 mmHg[5].

Mechanical Ventilation

Table 2. Lung-protective mechanical ventilation parameters for septic patients[1][16]

Parameter	Recommended Value	Rationale
Tidal Volume	6-8 mL/kg PBW	Reduces VILI and improves survival in ARDS
PEEP	Individualized (5-15 cmH_2O typical)	Prevents atelectasis, maintains alveolar recruitment
Driving Pressure	Minimize (<15 cmH_2O target)	Lower driving pressure associated with better outcomes
FiO_2	Lowest to achieve SpO_2 ≥94%	Avoids oxygen toxicity while ensuring adequate oxygenation
Plateau Pressure	<30 cmH_2O	Limits barotrauma and ventilator-induced injury
Respiratory Rate	Adjusted to maintain pH 7.30-7.45	Prevents hypercapnia and respiratory acidosis

Special Considerations Patient positioning and surgical technique impact hemodynamics[5]. Laparoscopic surgery with pneumoperitoneum and anti-Trendelenburg positioning may severely reduce preload and cardiac output in hypovolemic patients[5]. These effects result from reduced compression of the inferior vena cava and decreased pooling of blood in capacitance veins[5]. Intraoperative bleeding may cause further hemodynamic derangement[5]. These disturbances often require blood transfusion to maintain target hemoglobin levels. In sepsis, pharmacokinetics and pharmacodynamics are altered and must be taken into account when administering repeated doses of antibiotics during prolonged procedures, as patients typically have greater volume of distribution for hydrophilic drugs and altered organ function[5][14].

Source Control Timing and Outcomes Source control timing critically affects patient outcomes[7]. A landmark 2022 cohort study of 4,962 patients across 14 hospitals demonstrated that source control within 6 hours of sepsis onset was associated with 29% reduced risk-adjusted odds of 90-day mortality compared with delayed control (adjusted OR 0.71, 95% CI 0.63-0.80)[7]. Early source control was also associated with 24% and 34% reductions in in-hospital and 365-day mortality, respectively[7]. Each hour of delay was associated with increased 90-day mortality, with the greatest risk reduction observed for gastrointestinal, abdominal, and soft tissue interventions[7]. Timely and adequate source control is a key component of sepsis treatment, alongside early recognition, antimicrobial therapy, and hemodynamic support[6][7].

Part III - Postoperative Care and Outcomes

ICU Admission and Continued Support ICU admission is often required after source control in patients with sepsis or septic shock[5][17]. Patients after sepsis may remain hypoperfused and hemodynamically unstable. Such conditions may require organ support or repeat abdominal operations for open abdomen management as well as daily necrosectomy in cases of necrotizing fasciitis[5]. Postoperatively, patients may require organ support, including mechanical ventilation and renal replacement therapy[17]. A 2025 prospective observational study of postoperative ICU patients found that sepsis in the postoperative period is associated with prolonged mechanical ventilation, increased need for renal replacement therapy, higher steroid and sedation requirements, increased blood product use, cardiac complications, and significantly higher ICU and hospital mortality[17].

Perioperative Mortality A retrospective cohort study published in 2018 examined 11,562 anesthetic procedures and found that anesthesia-related perioperative deaths occured predominantly in the early postoperative period, within the first 48 hours[18].. In this cohort, the incidence of deaths directly attributed to anesthesia was 1.72 per 10,000 anesthetics, whereas deaths in which anesthesia was considered a contributing factor occurred at a rate of 10.37 per 10,000[18].. Early mortality was independently associated with intraoperative vasopressor use, extreme patient age, and procedures performed outside regular working hours.

Most late postoperative deaths (50.7%) were judged unavoidable and were attributed to severe pre-existing comorbid conditions[18]..

Long-term Outcomes Sepsis survivors often face substantial long-term morbidity, collectively described as post-intensive care syndrome (PICS), as shown in recent narrative reviews. This syndrome encompasses physical, cognitive, and psychological impairments that necessitate structured rehabilitation and coordinated follow-up after hospital discharge. A 2024 comparative study including 673 critically ill patients with sepsis demonstrated significant differences in long-term functional outcomes and survival[19]. The importance of comprehensive post-discharge assessment and rehabilitation programs aimed at improving the quality of life of sepsis survivors was emphasized[19].

Discussion

Integration of Evidence Anesthesiologists occupy a critical position in the multidisciplinary management of critically ill septic patients[5]. The evidence consistently supports several key principles:

1. **Time-sensitive intervention**: Early detection and source control, performed within 6 hours of sepsis recognition, reduce mortality[7]. This aspect places anesthesiologists at the forefront of the fight for the lives of patients with sepsis.
2. **Comprehensive preoperative assessment**: Rapid yet thorough assessment of organ dysfunction enables targeted optimization[2][5]. For this purpose, standardized tools such as the SOFA score are used[2].
3. **Hemodynamic optimization**: Goal-directed fluid therapy using dynamic measures of fluid responsiveness, early vasopressor initiation (including peripheral administration when appropriate), and advanced hemodynamic monitoring improve outcomes[1][8][9][10].
4. **Judicious anesthetic selection**: Ketamine and etomidate offer hemodynamic advantages over propofol in unstable patients[11][12][13].
5. **Lung-protective ventilation**: Low tidal volume ventilation (6-8 mL/kg), PEEP optimization, and driving pressure minimization reduce VILI and improve survival[1][16].

Pathophysiological Considerations Sepsis most often manifests as a vasodilatory distributive form of shock, characterized by markedly reduced systemic vascular resistance and, in the hyperdynamic phase, relatively increased cardiac output with progressive organ dysfunction[2][5]. Energy metabolism is profoundly disturbed, with cells losing the ability to utilize substrates efficiently, and this, together with immune dysfunction, increases vulnerability to secondary infections[4]. These extensive pharmacokinetic and pharmacodynamic changes highlight the need for cautious dose titration and close monitoring of drug effects[14]. The reduced MAC for volatile anesthetics in septic patients indicates altered central nervous system sensitivity, while an increased volume of distribution for hydrophilic agents necessitates appropriate dose adjustments[14].

Hemodynamic Management Controversies Although the 2021 Surviving Sepsis Campaign recommends an initial crystalloid bolus of about 30 mL/kg[1], emerging data support a more individualized, context-dependent strategy. A large multicenter cohort published in 2025 reported the best outcomes in patients who received roughly 40–45 mL/kg within the first 3 hours of recognition, underscoring that the optimal fluid dose and timing are still being refined[9].

Anesthetic Agent Selection Current practice promotes ketamine or etomidate as first-line agents for hemodynamically unstable septic patients, with propofol reserved for more stable individuals when carefully titrated[11][12][13]. Randomized studies support the addition of lidocaine to ketamine to reduce adverse effects[13].

Mechanical Ventilation Strategies Intraoperative lung-protective ventilation in septic patients largely adapts strategies that were first validated for ARDS management in the ICU[16]. Recent evidence syntheses support the use of low tidal volumes and minimizing driving pressure, which is consistent with current intraoperative recommendations[16]. For anesthesiologists, a key challenge is reconciling lung-protective settings with the hemodynamic impact of PEEP, particularly in patients who are relatively hypovolemic[5]. The so-called tidal volume challenge, in which tidal volume is briefly increased from about 6 to 8 mL/kg to test fluid responsiveness, offers a practical way to obtain dynamic hemodynamic information while overall maintaining a lung-protective approach[5].

Source Control Urgency Observational data suggest that every additional hour before achieving effective source control is linked to a measurable rise in mortality[7]. The anesthesiologist must therefore work to accelerate access to surgical intervention while at the same time maintaining an acceptable level of safety in the hemodynamically unstable septic patient[6][7]. This dual objective is demanding, because it requires

parallel efforts to optimize the patient's condition and to avoid unnecessary delays to the operating room. In practice, core resuscitation steps (initial fluid administration, starting vasopressors, administering antibiotics) should begin without delay, but should not postpone surgical source control beyond roughly 6 hours, with further optimization continuing during the procedure[1][6][7]..

Clinical Implications Practical recommendations for anesthesiologists:

1. **Preoperative optimization should be rapid but comprehensive**, focusing on hemodynamic stabilization with goal-directed fluid therapy, early vasopressor support, and assessment of organ dysfunction severity[1][5][8][9].
2. **Ketamine or etomidate should be considered first-line induction agents** for hemodynamically unstable septic patients, with careful titration and consideration of adjuvant lidocaine[11][12][13].
3. **Advanced hemodynamic monitoring with dynamic assessment of fluid responsiveness** should guide intraoperative fluid management, avoiding both hypovolemia and fluid overload[1][5][8].
4. **Lung-protective ventilation strategies** should be implemented from the start of mechanical ventilation, with awareness of hemodynamic consequences requiring optimization of intravascular volume before recruitment maneuvers[1][16].
5. **Communication with the surgical team regarding source control urgency** is essential, with target intervention within 6 hours of sepsis recognition when feasible[6][7].
6. **Postoperative planning should anticipate ICU admission** for most septic patients, with clear handover regarding intraoperative management and ongoing resuscitation needs[5][17].

Multidisciplinary Collaboration Optimal outcomes in sepsis care depend on close, well-coordinated collaboration between anesthesiologists, surgeons, intensivists, infectious disease specialists, and nursing staff[4][5]. Because anesthesiologists are involved in preoperative resuscitation, intraoperative stabilization, and postoperative intensive care, they naturally assume a central coordinating role in the perioperative management of septic patients[5].

Education and Future Directions for Anesthesiologists The translation of evidence-based recommendations into daily clinical practice requires not only the availability of protocols but also targeted education and structured implementation strategies for anesthesiologists caring for septic patients. In many institutions, the perioperative management of sepsis is still heterogeneous, with substantial variation in fluid resuscitation practices, vasopressor use, and timing of source control. Standardized pathways that integrate Surviving Sepsis Campaign bundles with local perioperative workflows may reduce this variability and support more consistent, guideline-concordant care[1][4]. Simulation-based training has emerged as a particularly valuable tool for improving team performance in time-critical situations such as septic shock requiring emergency surgery. High-fidelity scenarios allow anesthesiologists, surgeons, and ICU staff to rehearse early recognition of sepsis, rapid hemodynamic stabilization, and coordinated transfer to the operating room. Such training, in addition to teaching patient management, also develops communication and task delegation skills under stressful conditions. Repeated simulation sessions have been associated with faster initiation of antibiotics, earlier vasopressor titration, and fewer delays in source control in observational studies, although robust randomized data remain limited. Another key element of successful implementation is the integration of decision-support tools into electronic medical records. Automated alerts based on vital signs, laboratory data, and SOFA score trajectories can prompt clinicians to reassess patients for possible sepsis and trigger predefined escalation pathways[2]. For anesthesiologists, perioperative checklists that include verification of lactate trends, vasopressor requirements, and fluid balance before induction may help identify patients at particularly high risk of decompensation. Embedding these tools into everyday practice can lower cognitive load and facilitate adherence to complex bundles of care. Continuous professional development is essential, as sepsis management is a rapidly evolving field. Regular multidisciplinary morbidity and mortality conferences focused on septic patients undergoing surgery provide an opportunity to review borderline cases, discuss controversial decisions (e.g., the balance between fluid restriction and hemodynamic optimization), and update local protocols in light of new evidence. Including anesthesiology residents and fellows in these discussions fosters a culture of shared responsibility and early familiarity with sepsis-specific challenges. From a research perspective, anesthesiologists can contribute to closing existing knowledge gaps by participating in perioperative sepsis registries and pragmatic trials. Many pivotal studies in sepsis have focused on ICU populations, whereas high-quality data specifically addressing intraoperative management, choice of anesthetic agents, and detailed hemodynamic targets during emergency surgery remain scarce[4][5]. Collaborative networks that systematically collect perioperative data on fluid strategies, vasopressor dosing, ventilation parameters, and outcomes could support the development of more refined, individualized

recommendations for different phenotypes of septic shock. Finally, the concept of patient- and family-centered care should extend into the perioperative management of sepsis. Although many septic procedures are urgent and allow little time for detailed discussion, whenever feasible, anesthesiologists should briefly explain the increased risk associated with sepsis, the need for postoperative ICU admission, and the potential for long-term functional impairment[3][19]. Clear communication regarding prognosis and expected recovery trajectories helps to align treatment goals, reduces misunderstandings, and may facilitate earlier engagement of rehabilitation and psychological support services after discharge. By combining evidence-based clinical strategies with structured education, simulation, digital decision support, and active participation in research and quality-improvement initiatives, anesthesiologists can further strengthen their central role in the multidisciplinary management of sepsis[4][5]. Such an integrated approach offers the greatest potential to narrow the gap between guidelines and real-world practice, ultimately improving survival and long-term outcomes for critically ill septic patients who require anesthetic care.

Conclusions

Sepsis and septic shock represent medical emergencies requiring immediate, multidisciplinary intervention[2][3]. The anesthesiologist plays an indispensable role in managing critically ill septic patients undergoing source control procedures[5]. Key findings demonstrate that optimal outcomes require:

1. Comprehensive preoperative assessment using standardized tools like SOFA score to quantify organ dysfunction[2][5]
2. Rapid hemodynamic optimization with goal-directed fluid therapy, targeting at least 30-45 mL/kg within 3 hours, guided by dynamic measures of fluid responsiveness[1][8][9]
3. Early vasopressor support with norepinephrine, including peripheral initiation when central access is not immediately available[1][10]
4. Judicious selection of anesthetic agents, favoring ketamine or etomidate over propofol in hemodynamically unstable patients[11][12][13]
5. Advanced hemodynamic monitoring integrating pulse contour analysis, echocardiography, and assessment of tissue perfusion markers (lactate, $ScvO_2$, $Pv\text{-}aCO_2$)[1][5]
6. Lung-protective mechanical ventilation with low tidal volumes (6-8 mL/kg), optimized PEEP, and minimized driving pressure[1][16]
7. Timely source control within 6 hours of sepsis recognition, which reduces 90-day mortality by 29%[6][7]
8. Anticipation of postoperative ICU admission with continued organ support[5][17]

The evidence emphasizes that anesthetic agents significantly impact hemodynamic stability, with experimental and clinical studies demonstrating differential effects on cardiac function[11][12][13][14]. Sepsis-induced alterations in pharmacokinetics and pharmacodynamics, including reduced MAC for volatile anesthetics and increased volume of distribution for hydrophilic drugs, necessitate careful titration and monitoring[14].

Despite advances, sepsis mortality remains substantial, with 30-day mortality rates of 24.4% for sepsis and 34.7% for septic shock[3]. Survivors face long-term sequelae including post-intensive care syndrome, underscoring the importance of optimizing acute management to improve both survival and quality of life[3][19]. Future research should focus on randomized controlled trials comparing anesthetic techniques specifically in septic populations, investigation of individualized hemodynamic targets, development of predictive models, and studies in resource-limited settings[4]. Precision medicine approaches integrating molecular diagnostics and individualized therapy hold promise for further improving outcomes. For anesthesiologists managing critically ill septic patients, this review provides a comprehensive evidence base supporting current best practices. Understanding sepsis pathophysiology, implementing appropriate anesthetic techniques, utilizing advanced hemodynamic monitoring, and collaborating within multidisciplinary teams are essential competencies[5]. By adhering to evidence-based principles while individualizing care to each patient's unique physiology, anesthesiologists can significantly improve outcomes in this high-risk population. The challenge ahead lies not only in further refining our evidence base but in ensuring equitable implementation of best practices across diverse healthcare settings globally, where the burden of sepsis remains highest. Only through continued research, education, and commitment to quality improvement can we reduce the substantial mortality and morbidity associated with sepsis in critically ill patients requiring anesthetic care.

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