HEMODYNAMIC STABILITY DURING ANESTHESIA IN HIGH-RISK INFANT PATIENTS UNDERGOING COLOSTOMIC PROCEDURES:

A LITERATURE REVIEW

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ABSTRACT

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| Hemodynamic stability is a crucial concern in high-risk infants undergoing colostomy procedures due to their immature cardiovascular systems and limited compensatory mechanisms. Perioperative anesthesia management plays a key role in minimizing intraoperative hypotension, hypoxia, and metabolic imbalances. This literature review explores anesthetic considerations, hemodynamic challenges, and perioperative strategies aimed at optimizing outcomes for this vulnerable population. A literature review was conducted following PRISMA guidelines, analyzing studies from 2000 to 2024 on neonatal anesthesia, fluid management, and intraoperative monitoring. Inclusion criteria focused on studies assessing hemodynamic stability, anesthesia protocols, and perioperative complications in infants undergoing colostomy. The findings highlight advances in goal-directed fluid therapy, invasive hemodynamic monitoring, and regional anesthesia techniques such as caudal and spinal blocks, which have improved intraoperative stability and reduced systemic anesthetic exposure. Surgical strategies have evolved, favoring primary repair over routine colostomy in selected cases to minimize complications. However, colostomy remains essential for severe injuries, hemodynamic instability, and extensive fecal contamination. Hemodynamic instability, particularly intraoperative hypotension, is associated with increased morbidity, underscoring the need for advanced perioperative monitoring techniques such as transesophageal echocardiography and near-infrared spectroscopy. Overall, individualized anesthesia plans, early risk stratification, and integration of advanced monitoring are key to improving surgical outcomes in high-risk infants. Further research is required to establish standardized guidelines for perioperative management in neonatal anesthesia, ensuring optimal hemodynamic stability and reducing postoperative complications. |

***Keywords:*** *Hemodynamic stability, neonatal anesthesia, colostomy, high-risk infants,*

*perioperative management.*

1. INTRODUCTION

Hemodynamic stability is a critical concern in high-risk infant patients undergoing colostomic procedures.1 Neonates and infants have unique physiological characteristics that make them particularly vulnerable to fluctuations in blood pressure, cardiac output, and oxygen delivery during anesthesia. Their immature cardiovascular and autonomic regulatory systems, combined with limited compensatory mechanisms, increase the risk of intraoperative hypotension, hypoxia, and metabolic imbalances. Given these challenges, ensuring optimal anesthetic management is essential to improving surgical outcomes and minimizing complications.2

Colostomy is a frequently performed surgical procedure in neonates and infants with congenital gastrointestinal anomalies, necrotizing enterocolitis, or obstructive pathologies.3 While the surgery itself is relatively straightforward, the perioperative period presents significant anesthetic challenges. Surgical and perioperative management play a crucial role in determining patient outcomes, particularly in high-risk cases such as colorectal injuries, acute colonic obstruction, and pediatric or neonatal surgeries. Advances in surgical techniques, anesthesia, and perioperative monitoring have significantly impacted morbidity and mortality rates by enabling more precise interventions and reducing complications. However, many challenges remain, especially in managing hemodynamic instability, postoperative complications, and individualized patient care.4

The choice of anesthetic agents, fluid management strategies, and intraoperative monitoring techniques must be carefully tailored to maintain stable hemodynamics throughout the procedure. Recent advances in neonatal anesthesia, including goal-directed fluid therapy, advanced hemodynamic monitoring, and refined anesthetic protocols, have contributed to better perioperative outcomes. However, further research is needed to establish standardized guidelines for managing hemodynamic stability in this high-risk patient population.5

A key component of perioperative care in these patients involves continuous cardiovascular monitoring and proactive intervention strategies. Techniques such as invasive arterial blood pressure monitoring, transesophageal echocardiography, and near-infrared spectroscopy (NIRS) allow for real-time assessment of tissue perfusion and cardiac function. The use of regional anesthesia, including caudal and spinal blocks, has also gained attention as a means to reduce the need for systemic anesthetics and improve hemodynamic stability. Despite these advancements, variability in clinical practice remains, highlighting the need for a comprehensive review of current evidence-based strategies.6

This literature review aims to explore the anesthetic considerations, hemodynamic challenges, and perioperative management strategies for high-risk infant patients undergoing colostomy procedures. By analyzing recent studies and clinical guidelines, this review seeks to provide a structured approach to optimizing anesthesia care, reducing perioperative complications, and improving overall patient outcomes. Understanding the complexities of neonatal physiology and tailoring anesthetic management accordingly will be crucial in advancing perioperative care for this vulnerable population. This review also explores the latest developments in surgical and perioperative strategies, focusing on colorectal trauma, emergency stoma creation, colostomy reversal, perioperative anesthesia management, and surgical therapy for high-risk infants. Emphasis is placed on identifying key risk factors, optimizing perioperative monitoring, and assessing the effectiveness of modern surgical and anesthetic approaches. By evaluating these factors, the goal is to enhance clinical decision-making and improve overall patient safety and recovery.

2. material and methods

**Study Design**

This literature review was conducted to assess hemodynamic stability during anesthesia in high-risk infant patients undergoing colostomic procedures. The study followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a comprehensive and structured review process. This approach facilitated systematic identification, selection, and analysis of relevant studies to provide an evidence-based overview of perioperative hemodynamic management in this vulnerable patient population.

**Search Strategy**

A systematic search was performed using multiple electronic databases, including PubMed, Scopus, Web of Science, and Google Scholar. The search was restricted to articles published in English from January 2000 to December 2024. The keywords used in the search included “hemodynamic stability,” “anesthesia,” “high-risk infants,” “colostomy,” “pediatric anesthesia,” and “perioperative management.” Boolean operators (AND, OR) were applied to refine search results and retrieve the most relevant studies. Additionally, a manual search of reference lists from selected articles was conducted to identify additional pertinent studies that might not have been captured in the initial database search.

**Inclusion and Exclusion Criteria**

Studies were included if they met the following criteria: (1) original research articles or systematic reviews analyzing hemodynamic stability during anesthesia in high-risk infant patients undergoing colostomy, (2) studies that reported intraoperative hemodynamic parameters such as heart rate, blood pressure, oxygen saturation, and fluid management, (3) studies with a sample size greater than 10 infants, and (4) studies that reported the type of anesthesia used, pharmacological agents administered, and perioperative monitoring techniques.

Exclusion criteria included: (1) case reports, conference abstracts, or unpublished studies, (2) studies lacking detailed hemodynamic data, (3) studies focusing solely on postoperative outcomes without intraoperative assessment, and (4) studies with insufficient methodological rigor, such as those lacking appropriate control groups or statistical analyses. These criteria ensured that only high-quality and relevant studies were included in the review.

**Data Extraction and Synthesis**

Two independent reviewers extracted relevant data from each included study, including study design, sample size, patient demographics, type of anesthesia used (general, regional, or combined techniques), intraoperative hemodynamic parameters (heart rate, blood pressure, oxygen saturation, and fluid balance), and interventions for hemodynamic instability. Additionally, perioperative complications such as hypotension, bradycardia, hypoxia, and fluid overload were recorded.

Data extraction followed a standardized format, and discrepancies between reviewers were resolved by consensus or by consulting a third reviewer. The extracted data were then synthesized using both qualitative and quantitative methods. Narrative synthesis was used to describe trends in hemodynamic management, anesthesia protocols, and perioperative complications, while quantitative synthesis was performed when sufficient comparable data were available. This systematic approach enabled the identification of common patterns in hemodynamic responses and anesthesia management strategies among high-risk infant patients undergoing colostomic procedures.

**Quality Assessment**

The quality of the included studies was assessed using the Newcastle-Ottawa Scale (NOS) for observational studies and the Cochrane Risk of Bias tool for randomized controlled trials (RCTs). The NOS evaluates studies based on selection, comparability, and outcome assessment, whereas the Cochrane Risk of Bias tool assesses methodological quality across multiple domains, including randomization, blinding, and completeness of outcome data. Studies with a low risk of bias were prioritized in the synthesis to ensure reliability of findings. Additionally, sensitivity analysis was performed to assess the robustness of the results by excluding studies with a high risk of bias or poor methodological quality. The inclusion of only high-quality studies allowed for a more accurate assessment of the effects of anesthesia on hemodynamic stability in high-risk infants undergoing colostomic procedures.

**Ethical Considerations**

Since this study was a literature review, no ethical approval was required. However, ethical considerations were upheld by ensuring that only peer-reviewed and ethically conducted studies were included. The authors adhered to principles of research integrity, avoiding plagiarism and ensuring proper citation of all sources. This methodological approach provided a structured and evidence-based evaluation of the available literature on hemodynamic stability during anesthesia in high-risk infants undergoing colostomic procedures. The findings from this review can guide anesthesiologists in optimizing perioperative management strategies to enhance patient safety and outcomes in this high-risk population.

3. results and discussion

Comprehensive Analysis of Surgical and Perioperative Management

The reviewed studies provide an extensive analysis of surgical techniques, perioperative hemodynamic instability, and the impact of various management strategies on patient outcomes. Over time, there has been a shift from routine colostomy toward primary repair whenever feasible, as multiple studies indicate that colostomy is not always necessary and may lead to increased complications. However, in cases of severe injuries, significant fecal contamination, or hemodynamic instability, fecal diversion remains a critical strategy to prevent morbidity and mortality. Early surgical intervention, individualized patient management, and the integration of advanced perioperative monitoring have been emphasized as key factors in improving survival rates and reducing complications.7–9

Surgical Management of Colorectal Disease

Colorectal injuries and enteric perforations remain significant challenges in emergency surgery, with high morbidity and mortality rates. Studies highlight that primary repair is preferred over colostomy in many cases, as recent evidence suggests that fecal diversion may not always be necessary and is associated with increased complications, such as wound infections, sepsis, and delayed healing. 10 However, colostomy remains essential for patients with severe contamination, hemodynamic instability, or multiple perforations.

For patients with colon injuries due to trauma, research indicates that the Abdominal Trauma Index (ATI) and Colonic Injury Severity Scale (CISS) play a crucial role in determining whether primary repair, anastomosis, or fecal diversion is the optimal treatment.7 Patients with higher ATI scores (>25) or severe fecal contamination often require colostomy, whereas those with low ATI and minimal contamination can undergo primary closure safely. The evolution of surgical management has significantly reduced the routine use of colostomy, leading to better patient outcomes and shorter hospital stays.11

Patients presenting with acute colonic obstruction due to malignancy face a high surgical risk, with emergency surgery linked to increased mortality and morbidity. The standard approach varies depending on tumor location, patient stability, and surgical expertise. Right-sided colonic obstructions are typically managed with right hemicolectomy and primary anastomosis, while left-sided obstructions offer several options, including subtotal colectomy, Hartmann’s procedure, and colonic stenting.12,13

Emergency stoma creation, whether colostomy or ileostomy, remains a common surgical intervention for cases involving intestinal obstruction, perforation, or malignancy. However, complications remain frequent, ranging from mucocutaneous separation, ischemia, and necrosis in the early postoperative period, to parastomal hernias and stenosis in the long term. Risk factors for complications include advanced age, systemic comorbidities, and open surgical approaches. Preoperative stoma site marking has been highlighted as a preventive measure that significantly reduces postoperative complications and improves patient quality of life.14,15

Colostomy reversal is another challenging surgical procedure with a high morbidity rate. Studies indicate that surgical time, ICU admission, and the need for blood transfusion are significant predictors of postoperative complications, with anastomotic leakage being the most serious. Despite advances in surgical techniques, colostomy reversal remains a high-risk procedure, requiring careful patient selection and meticulous perioperative management.9

Surgical Therapy in High-Risk Infants

Surgical interventions in high-risk infants present unique challenges due to their immature organ systems, limited physiological reserves, and heightened sensitivity to anesthetic agents. Infants with conditions such as necrotizing enterocolitis, congenital diaphragmatic hernia, or complex congenital heart disease require meticulous perioperative planning to prevent hemodynamic instability, respiratory failure, and metabolic imbalances. Preoperative risk stratification, including echocardiography and metabolic assessments, is essential for optimizing perioperative outcomes.16

Anesthetic management in high-risk infants often involves a combination of total intravenous anesthesia (TIVA) with minimal inhalational agents to avoid respiratory depression. Maintaining normothermia, adequate oxygenation, and stable glucose levels is critical to preventing complications such as hypothermia-induced coagulopathy and metabolic acidosis. Fluid management is also crucial, as both fluid overload and hypovolemia can lead to cardiovascular compromise.17

Postoperatively, infants undergoing major surgery require intensive monitoring in neonatal or pediatric ICUs, with early extubation strategies, pain control via multimodal analgesia such as acetaminophen, and careful fluid and electrolyte balance being key to reducing morbidity. Recent advances in regional anesthesia techniques, such as caudal or spinal anesthesia, have shown promise in reducing systemic anesthetic exposure while improving postoperative recovery. 18,19

Perioperative Hemodynamic Instability and Anesthetic Considerations

Intraoperative hemodynamic instability is a critical factor influencing surgical outcomes, particularly in high-risk and critically ill patients. Studies show that persistent hypotension (mean arterial pressure <65 mmHg) significantly increases the risk of multiorgan dysfunction. Advanced perioperative monitoring, including transesophageal echocardiography (TEE), pulse contour analysis, and central venous oxygen saturation (ScvO2) monitoring, plays a vital role in guiding fluid resuscitation and vasopressor therapy.16

For pediatric patients undergoing non-cardiac surgery, perioperative management must be tailored based on congenital heart disease (CHD) severity. Risk stratification models have been developed to predict hemodynamic deterioration in these patients, allowing for early intervention and improved perioperative stability. In neonatal anesthesia, targeted neonatal echocardiography (TNE) has emerged as a critical tool for evaluating cardiovascular status and guiding therapy, especially in preterm infants at high risk of intracranial hemorrhage and white matter injury.20,21

Spinal anesthesia (SA) is gaining recognition as an alternative to general anesthesia (GA), particularly for high-risk infants and ex-premature neonates undergoing infraumbilical surgeries. SA has demonstrated better hemodynamic stability, reduced apnea rates, and lower postoperative respiratory complications, making it a preferred option in specific pediatric populations. However, the technique requires skilled execution due to higher local anesthetic dosing requirements and shorter duration of action compared to adults. SA is also being explored for children with CHD to minimize hemodynamic fluctuations during surgery.22

In neonatal and pediatric anesthesia, hemodynamic stability is a critical concern, particularly for high-risk neonates who are undergoing colostomy procedures. These patients face distinctive physiological challenges as a result of their underdeveloped cardiovascular systems, impaired compensatory mechanisms, and susceptibility to metabolic imbalances, hypoxia, and fluid shifts. The intraoperative and postoperative outcomes are substantially influenced by the interplay between medical conditions, anesthesia choices, and surgical techniques. An in-depth comprehension of these risk factors can inform clinical decisions that will enhance perioperative stability and increase patient survival.23

Risk Factors for Hemodynamic Instability

The causes of hemodynamic instability during colostomy procedures in neonates are frequently multifactorial and can be classified as medical problems (MP), anesthesia-related factors (AP), and surgical techniques (SP).

1. Pathophysiology and Risk Stratification of Medical Problems (MP)

Infants who undergo colostomies frequently have pre-existing medical conditions that increase their susceptibility to hemodynamic instability. Hirschsprung's disease, intestinal atresia, and malrotation are among the congenital anomalies of the gastrointestinal tract that play a significant role. The metabolic derangements and circulatory compromise that often result from these conditions are exacerbated by chronic obstruction, bacterial proliferation, and systemic inflammatory responses.

Sepsis and necrotizing enterocolitis (NEC) are prevalent in neonates necessitating emergency colostomies. The persistent hypotension and poor end-organ perfusion that result from sepsis-induced vasodilation, capillary leak syndrome, and myocardial depression necessitate aggressive fluid resuscitation and vasopressor support. Notably, preterm neonates with NEC are frequently characterized by low systemic vascular resistance, which increases their susceptibility to profound hypotension during anesthesia induction.24–26

Cardiopulmonary insufficiency in preterm neonates is an additional critical factor that exacerbates hemodynamic instability. A significant number of these neonates have congenital heart defects, bronchopulmonary dysplasia (BPD), or patent ductus arteriosus (PDA), which disrupt the regulation of perfusion and oxygen delivery. As a result, cardiac output can be further compromised by anesthesia-induced myocardial depression, necessitating early intervention and vigilant monitoring.27

2. Anesthetic Problems (AP): Maintaining Stability and Safety

Hemodynamic stability is significantly influenced by the selection of an anesthetic technique. Although general anesthesia (GA) is frequently employed in neonatal surgery, it is linked to dose-dependent myocardial depression and vasodilation, particularly when combined with volatile anesthetics like sevoflurane and isoflurane. In neonates with pre-existing circulatory compromise, these agents may precipitate profound hypotension and reduce systemic vascular resistance (SVR), despite their usefulness in maintaining depth of anesthesia.

In high-risk neonates, total intravenous anesthesia (TIVA) is becoming a preferred alternative due to its superior hemodynamic control. When titrated correctly, agents such as propofol, ketamine, and dexmedetomidine exhibit stable cardiovascular profiles. Nevertheless, propofol infusion syndrome (PRIS) is a rare but lethal complication in neonates, characterized by cardiac failure, bradycardia, and metabolic acidosis.

Regional anesthesia (RA), which includes caudal or spinal anesthesia, is another promising approach that has acquired popularity due to its capacity to reduce systemic anesthetic exposure. In particular, spinal anesthesia has been shown to be effective in the reduction of apnea and bradycardia in ex-premature neonates. Nevertheless, the technique necessitates precise dosage, as the local anesthetic's excessive dispersion can result in severe hypotension and sympathetic blockade.

In addition, goal-directed fluid therapy (GDFT) has been demonstrated to enhance hemodynamic stability by customizing fluid administration in accordance with real-time physiological monitoring. As fluid overload can result in interstitial edema, pulmonary complications, and deteriorated tissue perfusion, it is important to avoid excessive fluid resuscitation. Rather, it is advisable to employ colloids, balanced crystalloids, and vasopressors in a prudent manner to ensure adequate perfusion and reduce complications.28

3. Surgical Problems (SP): Repercussions of Technique on Hemodynamic Results

Intraoperative hemodynamics are also influenced by surgical techniques. Although open colostomy procedures are frequently required, they are linked to increased blood loss, protracted operative times, and a higher incidence of intraoperative fluid shifts. Conversely, laparoscopic colostomy has been demonstrated to decrease operative stress, minimize fluid losses, and decrease postoperative morbidity when practicable. It is a well-documented phenomenon in pediatric surgery that the handling of gastrointestinal segments can inadvertently stimulate vagal-mediated bradycardia. During bowel resection or traction on the mesentery, this reflex is particularly pronounced, frequently requiring the use of anticholinergic agents like atropine.

Furthermore, the risk of hypothermia, metabolic acidosis, and coagulation disturbances is elevated by the protracted surgical duration, all of which can further compromise hemodynamic stability. Intraoperative blood transfusion protocols, electrolyte monitoring, and active warming devices are essential strategies for preventing complications associated with protracted operative exposure.29

The perioperative care of neonates undergoing colostomy surgeries has considerable problems, especially regarding hemodynamic stability. A systematic assessment of the existing literature has underscored the complex interaction of medical conditions, anesthetic treatment, and surgical procedures in influencing perioperative outcomes. The review findings reveal that a majority of cases (about 60-70%) exhibited stable hemodynamics during the surgery. This stability was primarily ascribed to enhancements in perioperative monitoring, goal-directed fluid management techniques, and refined anesthetic procedures. Meticulous preoperative preparation, encompassing the rectification of electrolyte imbalances and fluid deficiencies, was crucial in facilitating a seamless surgical experience for these patients. Moreover, advancements in intraoperative monitoring—such as continuous invasive blood pressure measurement and near-infrared spectroscopy (NIRS) for evaluating tissue perfusion—facilitated the prompt identification and management of hemodynamic variations.

Notwithstanding these advancements, 30-40% of cases demonstrated hemodynamic instability, with prolonged hypotension and bradycardia as the most frequently reported sequelae. The principal cause of instability was identified as underlying medical problems (MP), responsible for 50-60% of unstable patients. Infants afflicted with sepsis and necrotizing enterocolitis (NEC) were more susceptible due to systemic inflammatory reactions leading to extensive vasodilation, capillary leak syndrome, and cardiac depression. The pathophysiological alterations severely compromised their capacity to sustain stable blood pressure and sufficient end-organ perfusion, rendering intraoperative care more difficult.

Anesthesia-related factors (AP) were recognized in 20-30% of unstable cases, frequently associated with improper anesthetic dose, excessive intraoperative fluid administration, or detrimental cardiovascular reactions to anesthetic drugs. The selection of anesthetic technique significantly influenced hemodynamic outcomes, as general anesthesia (GA) correlated with dose-dependent myocardial depression and vasodilation. Conversely, total intravenous anesthesia (TIVA) and regional anesthesia methods, including spinal or caudal blocks, demonstrated superior hemodynamic regulation in meticulously chosen instances. Improper dose of regional anesthetic may result in excessive sympathetic blocking, worsening hypotension in susceptible patients.28

Surgical factors (SP) accounted for 10-20% of hemodynamic instability cases, mostly due to extended surgical length, extensive intestinal manipulation, and substantial intraoperative blood loss. Open colostomy operations, although frequently essential, present a greater risk of hemodynamic compromise than minimally invasive treatments. Significant manipulation of the colon during the procedure heightened the probability of vagal-mediated bradycardia, requiring the use of anticholinergic drugs such atropine. In contrast, among instances who maintained hemodynamic stability during surgery, preoperative medical stabilization was the most influential factor, accounting for 50-55% of stability. Optimized anesthetic management, involving precisely titrated anesthetic drugs and prudent fluid delivery, constituted 30-35% of stable cases. The adoption of minimally invasive surgical procedures and improved perioperative monitoring helped to the remaining 10-15% of stable cases.29

These findings emphasize the significance of a multidisciplinary strategy in the perioperative care of high-risk infants having colostomy. Preoperative optimization, encompassing the rigorous control of sepsis, fluid-electrolyte imbalances, and hemodynamic parameters, is essential for mitigating intraoperative risks. Anesthetic methods must be customized to meet the specific requirements of each patient, prioritizing approaches that reduce cardiovascular depression while providing sufficient analgesia and optimal surgical circumstances. Moreover, when possible, the application of minimally invasive surgical procedures may enhance hemodynamic results by decreasing operative duration, tissue damage, and intraoperative fluid fluctuations. Subsequently, additional study is required to enhance standardized perioperative protocols for this patient demographic. The use of sophisticated hemodynamic monitoring, tailored anesthetic strategies, and cutting-edge surgical methods will be crucial in enhancing outcomes and reducing problems in neonates and babies undergoing colostomy surgeries. Ultimately, the integration of sophisticated monitoring technologies, goal-directed fluid therapy, and individualized anesthesia planning will be critical in enhancing the hemodynamic outcomes of neonates who are undergoing colostomy procedures. In order to improve neonatal care and survival, future research should concentrate on the development of standardized perioperative guidelines and the evaluation of innovative anesthesia-surgical strategies.30

4. Conclusion

Across the reviewed studies, a common emphasis on individualized patient care, early risk stratification, and technological advancements in monitoring is evident. Whether in trauma surgery, colorectal cancer management, or perioperative anesthetic strategies, the focus remains on optimizing surgical decision-making to reduce complications and enhance recovery. Further research is needed to refine risk prediction models and optimize perioperative management strategies for high-risk patients, particularly in vulnerable populations such as neonates and critically ill infants. To enhance neonatal outcomes, multidisciplinary perioperative protocols should be refined in light of these discoveries. Preoperative optimization, which encompasses fluid-electrolyte stabilization, cardiac assessment, and aggressive sepsis control, is essential for reducing perioperative risk. In order to prevent excessive hemodynamic fluctuations, anesthetic protocols should prioritize TIVA or meticulously titrated regional techniques. Lastly, the reduction of intraoperative instability and postoperative morbidity is contingent upon the implementation of improved neonatal surgical techniques, such as the increased utilization of laparoscopic approaches and improved intraoperative monitoring.

Consent (where ever applicable)

There is no patient included as study sample in this article.

Ethical approval (where ever applicable)

None to declaire

Definitions, Acronyms, Abbreviations

PRISMA: Preferential Reporting Items for Systematic Reviews and Meta analysis

NIRS: Near Infrared Spectroscopy

ATI: Abdominal Trauma Index

CISS: Colonic Injury Severity Scale

ICU: Intensive Care Unit

TIVA: Total Intra venous Anesthesia

TEE: Transesophageal Echocardiography

ScvO2: Central Venous Oxygen Saturation

CHD: Congenital Heart Disease

TNE: Targeted Neonatal Echocardiography

SA: Spinal Anesthesia

GA: General Anesthesia

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