Revista de Ciencias Médicas de Pinar del Río

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(S1): e6968

REVIEW ARTICLE

Importance of the shock index as a predictor of complications in obstetric hemorrhage

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Received: December 9, 2025
Accepted: December 10, 2025
Published: December 11,2025

Citar como: Chachalo-Sandoval MG, Chacha-Ochoa EP, Laica-Sailema SA, Cabezas-Tapia HG. Importancia del índice de shock como predictor de complicaciones en hemorragias obstétricas. Rev Ciencias Médicas [Internet]. 2025 [citado: fecha de acceso]; 29(S1): e6968. Disponible en: http://revcmpinar.sld.cu/index.php/publicaciones/article/view/6968

ABSTRACT

Introduction: the shock index, also known as the hemorrhagic shock index, is a scoring tool that combines clinical and hemodynamic parameters to assess the degree of shock and the severity of hemorrhage.
Objectives: to describe the importance of the shock index in obstetric hemorrhage for predicting complications associated with morbidity and mortality in obstetric patients.
Methods: a structured literature review was conducted in three stages, searching multiple databases while applying predefined selection criteria. After selection, the sources were analyzed for relevance and currency.
Development: obstetric hemorrhage is a severe complication that remains a significant challenge in maternal care and is one of the leading causes of maternal morbidity and mortality worldwide. In this context, the shock index has emerged as a potentially useful tool to predict complications in cases of obstetric hemorrhage. Its calculation allows for a rapid and objective assessment of the patient's hemodynamic status, helping to identify those at higher risk of complications, with a value ≥0,9 indicating the need for massive blood transfusion.
Conclusions: the obstetric shock index is a key hemodynamic marker that allows estimation of hypovolemia, prediction of massive transfusion and blood loss, and guidance of management protocols, with values ≥0,9 correlating with an increased risk of complications and maternal morbidity and mortality.

Keywords: Heart Rate Determination; Hemodynamics; Postpartum Hemorrhage; Blood Pressure.

ISSN: 1561-3194 **RNPS:** 1877
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INTRODUCTION

Obstetric hemorrhage continues to be a major challenge in maternal care, representing one of the leading causes of morbidity and mortality worldwide. Despite advances in modern medicine, complications related to obstetric hemorrhage persist as a significant concern, especially in resource-limited settings. Rapid identification and management of this obstetric emergency are essential to prevent adverse outcomes for both the mother and the neonate.[1]

One of the essential interventions in the management of obstetric hemorrhage is the accurate calculation of the shock index to predict complications such as the need for blood transfusion, which may be required in cases of significant blood loss to stabilize hemodynamics and prevent clinical deterioration. However, determining when to initiate a massive transfusion can be challenging, as delays may have serious consequences, while unnecessary transfusion entails associated risks.[2]

In this context, the shock index has emerged as a potentially useful tool to predict complications in cases of obstetric hemorrhage. The shock index, also known as the hemorrhagic shock index, is a scoring system that combines clinical and hemodynamic parameters to assess the degree of shock and the severity of hemorrhage. However, it is important to clarify that the parameters currently used to calculate the shock index are solely heart rate and systolic blood pressure.[1]

The concept underlying the shock index is to provide a rapid and objective assessment of the patient's hemodynamic status in emergency situations such as obstetric hemorrhage, where time is critical. By calculating this index, health professionals can more accurately identify those patients at higher risk of requiring massive transfusion, allowing them to intervene early and appropriately.[2,3]

The application of the shock index as a predictor of complications in obstetric hemorrhage has been the subject of research in recent years. Studies have shown that an elevated shock index is associated with a greater likelihood of requiring large-volume blood transfusions and has been correlated with adverse outcomes for both mother and neonate. Furthermore, it has been suggested that the use of the shock index may help improve the efficiency of resource allocation and optimize the management of obstetric hemorrhage through effective multidisciplinary team interventions.[4] Considering this, the present review was developed, aiming to describe the importance of the shock index in obstetric hemorrhage for predicting complications associated with morbidity and mortality in obstetric patients.

METHODS

A structured bibliographic review was carried out with the aim of identifying, analyzing, and synthesizing the available evidence regarding the importance of the shock index in obstetric hemorrhage and its capacity to predict complications associated with maternal morbimortality. The information search was conducted between November 2023 and January 2024 in the SciELO, Cochrane Library, World Health Organization (WHO), and Google Scholar databases, supplemented with reference literature identified through manual review of bibliographic lists.

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(S1): e6968

To optimize the retrieval of relevant studies, controlled terms and keywords in both Spanish and English were used, combined with Boolean operators (AND, OR). The terms employed included: "shock index", "hemorrhagic shock", "obstetric hemorrhage", "maternal morbidity", "maternal mortality", "postpartum hemorrhage", "hemodynamic instability", and "massive transfusion". Language filters (English and Spanish) and date filters were applied, selecting studies published within the last 10 years.

Study selection was carried out in three stages: initial identification through electronic search; screening by title and abstract to exclude duplicates and irrelevant studies; and full-text evaluation. Original articles, systematic reviews, clinical guidelines, technical documents, and observational or experimental studies addressing the use of the shock index in the context of obstetric hemorrhage were included. Case reports, editorials, studies without primary data, and documents whose content did not meet clinical relevance criteria were excluded.

The extracted information was organized thematically, considering key aspects related to the shock index: definition and physiological basis, clinical utility in obstetric hemorrhage, proposed cut-off points, predictive capacity for severe complications, and its role in therapeutic decisions such as the indication for massive transfusion. Synthesis was performed qualitatively, comparing findings and contrasting recommendations across the selected studies.

DEVELOPMENT

The shock index, also known as the hemorrhagic shock index, is a scoring system that combines clinical and hemodynamic parameters to assess the degree of shock and the severity of hemorrhage. However, it is important to clarify that the parameters currently used to calculate the shock index are solely heart rate and systolic blood pressure.[1]

Hypovolemic shock due to hemorrhage is the most common cause of maternal deaths. Hemorrhagic shock is a pathophysiological condition resulting from rapid and significant blood loss, leading to hemodynamic instability, causing tissue hypoperfusion, cellular hypoxia, and cellular damage, which in turn can produce a multiple organ dysfunction syndrome and potentially lead to death if not promptly identified and treated.[3]

The shock index, defined as the ratio between heart rate and systolic blood pressure, has proven to be a useful tool for detecting acute hypovolemia in early stages, even when blood pressure and heart rate values remain within normal ranges. This ratio was first described by Allgöwer and Burri in 1967, who demonstrated that a shock index of 1.0 was associated with a 40 % mortality rate among trauma patients treated in emergency departments.[4] As shown in Table 1, a shock index is considered normal if less than 0,6; mild shock between 0,7 and 1,0; moderate shock between 1,0 and 1,4; and severe shock if greater than 1,4.[3]

Table 1. Shock index indicators.

Grade	Shock Index
Normal	< 0,6
Mild Shock	0,7 – 1,0
Moderate Shock	1,0 – 1,4
Severe Shock	> 1,4

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(S1): e6968

The measurement of the shock index is useful for predicting early shock and has been shown to correlate with other indices of target organ perfusion, such as central venous oxygen saturation and arterial lactate concentration.[4] Studies in adults have suggested that an elevated shock index identifies patients who require activation of the massive transfusion protocol, even in the presence of normal blood pressure. Moreover, an increasing shock index over time has demonstrated a higher risk of mortality than a shock index that decreased or remained stable.[5]

Hemorrhagic shock results from a reduction in intravascular volume due to blood loss to the point where tissue oxygen demands can no longer be met. Consequently, mitochondria can no longer sustain aerobic metabolism and shift to anaerobic metabolism, which is less efficient at meeting cellular adenosine triphosphate (ATP) demands. In anaerobic metabolism, pyruvate is produced and converted into lactic acid to regenerate nicotinamide adenine dinucleotide (NAD^+), thereby maintaining some degree of cellular respiration in the absence of oxygen.[6]

The body compensates for volume loss by increasing heart rate and contractility, followed by baroreceptor activation, which leads to sympathetic nervous system stimulation and peripheral vasoconstriction. Typically, there is a slight increase in diastolic blood pressure with a narrowing of the pulse pressure. As diastolic ventricular filling continues to decrease, cardiac output declines and systolic blood pressure drops.[7]

Due to sympathetic nervous system activation, blood flow is redirected in order to preserve perfusion to vital organs such as the heart and brain. While this sustains cardiac and cerebral function temporarily, it also leads to oxygen deprivation in other tissues, resulting in increased lactic acid production and worsening acidosis. This progressive acidosis, combined with hypoxemia, eventually causes loss of peripheral vasoconstriction, further deteriorating hemodynamic status and potentially leading to death.[5,8]

In this regard, although obstetric hemorrhage is classified according to the volume of blood lost, clinicians' estimations may lack precision because blood often mixes with other fluids or remains retained in the uterus. Visual estimation of blood loss is subjective and contributes to delays in recognizing and initiating interventions to control obstetric hemorrhage.[9]

In obstetric hemorrhage, massive blood loss is defined as bleeding exceeding 2000 mL (or more than 30 % of total blood volume) or blood loss causing hemodynamic decompensation in the patient. These definitions are useful for estimating transfusion requirements during bleeding episodes. Additionally, massive transfusion is defined as the administration of 10 or more units of packed red blood cells within the first 24 hours of bleeding; replacement of one entire blood volume within 24 hours; or transfusion of more than 4 units of packed red blood cells within one hour.[10]

It is important to note that some studies indicate that a shock index >1,0 signifies significant blood loss in cases of obstetric hemorrhage—thus predicting the need for massive transfusion of blood components and correlating with a higher risk of mortality.[10,11] The shock index is calculated by dividing heart rate by systolic blood pressure.

An elevated shock index, calculated as the ratio of heart rate to systolic blood pressure, indicates impaired left ventricular function secondary to shock. In healthy adults, its normal range is 0,5 to 0,7, whereas in obstetric patients, values from 0,7 to 0,9 are considered normal. Values ≥0,9 predict the need for intensive care unit admission and urgent medical intervention. Furthermore, a shock index ≥0,9 has been associated with blood losses exceeding 3000 mL, while values <0,9 correspond to losses <2500 mL. Severe complications linked to elevated values include acute

ISSN: 1561-3194 **RNPS:** 1877
Rev Ciencias Médicas. 2025; 29(S1): e6968

kidney injury, infections, acid–base disturbances, acute respiratory distress syndrome, and the need for transfusion of more than four units of packed red blood cells.[12,13]

Thus, an obstetric shock index cut-off of 0,9 has been significantly associated with the requirement for massive transfusion in women experiencing hemorrhage. These findings are similar to those observed in hypovolemic shock from other causes, such as trauma, where an index greater than 1,0 is associated with high transfusion requirements.[14,15]

Moreover, it should be emphasized that the shock index has several limitations, including variability in interpretation, influence of comorbidities, use of vasoactive medications, lack of standardized data, limited studied populations, interference from external factors, and inconsistent validation across different clinical contexts and patient populations.[16]

In this context, the importance of the shock index lies in its ability—based on the obtained value—to help estimate the approximate blood loss in obstetric hemorrhage, enabling timely and appropriate interventions. Additionally, a shock index >0,9 predicts the need for massive transfusion, indicating that the patient is in severe shock with hypoperfusion, thereby helping clinicians prevent complications.[17,18,19]

Obstetric hemorrhage remains one of the leading causes of maternal morbidity and mortality worldwide and constitutes an obstetric emergency requiring rapid and effective intervention to prevent severe complications. Blood transfusion plays a crucial role in managing obstetric hemorrhage, as it helps restore intravascular volume and improve tissue perfusion in cases of significant blood loss. However, determining when to initiate massive transfusion can be challenging: delay may result in severe clinical deterioration, while unnecessary transfusion carries associated risks, such as volume overload and exposure to blood products.[14,20]

The application of the shock index as a predictor of massive transfusion in obstetric hemorrhage has been the subject of research in recent years. Numerous studies have explored its clinical utility and assessed its capacity to identify patients at higher risk of requiring large-volume blood transfusions. Additionally, its impact on maternal outcomes and its ability to optimize obstetric hemorrhage management and improve resource allocation in clinical settings have been evaluated.[11,19]

Accordingly, multiple studies have demonstrated that a shock index value >0,9 is closely associated with blood loss exceeding 3000 mL, whereas a value <0,9 suggests blood loss of less than 2500 mL. These findings indicate that an elevated shock index is associated with a higher likelihood of requiring large-volume transfusions in obstetric hemorrhage, suggesting that the shock index can be a useful tool for identifying patients at greater risk of clinical deterioration and guiding the decision to initiate massive transfusion. [10,13,14,21]

One of the most important aspects when discussing the shock index as a predictor of complications in obstetric hemorrhage is its ability to provide an early and objective assessment of the patient's hemodynamic status. By calculating this index, clinicians can more accurately identify patients at higher risk of requiring massive transfusion, enabling timely and appropriate intervention. This may contribute to a reduction in maternal morbidity and mortality associated with obstetric hemorrhage.[12]

ISSN: 1561-3194 **RNPS:** 1877
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Beyond its predictive capacity for complications such as the need for massive transfusion, the shock index can also help optimize hospital management of obstetric hemorrhage and improve resource allocation in clinical settings. By early identification of patients at higher risk of requiring large-volume transfusions, healthcare professionals can anticipate treatment needs and ensure that necessary resources are available when required. This can enhance the efficiency of obstetric hemorrhage management and reduce associated maternal morbidity and mortality.[1,10]

However, despite its potential benefits, the use of the shock index as a predictor of complications in obstetric hemorrhage also presents certain limitations and challenges. One major challenge is the variability in interpretation and application of criteria used to calculate the shock index. Different studies and clinical protocols may employ different thresholds to define the severity of shock and the need for massive transfusion, hindering comparability across studies and limiting generalizability of findings.[8,9]

In addition, the accuracy of the shock index as a predictor of complications can be influenced by several factors, including underlying medical comorbidities, the administration of vasoactive medications, and the availability of resources for managing obstetric hemorrhage. For example, in cases of severe obstetric hemorrhage, interventions beyond blood transfusion—such as emergency surgery or arterial embolization—may be required, which can affect both the necessity and volume of blood products needed.[16,17]

Another important consideration is the impact of the shock index on maternal and neonatal outcomes. Although several studies have demonstrated an association between an elevated shock index and adverse outcomes for both mother and neonate—including maternal morbidity and mortality and preterm birth—it is crucial to recognize that the shock index is merely an assessment tool and should not be used as the sole criterion for clinical decision-making. Evaluation and management of obstetric hemorrhage must be multidisciplinary and tailored to each patient's individual needs.[20,21,22]

CONCLUSION

The shock index is a key tool in obstetric hemorrhage, as it enables early and objective assessment of the patient's hemodynamic status and predicts the need for massive transfusion. Its value provides an approximate estimation of blood loss, facilitating the timely implementation of intervention protocols to prevent complications and reduce maternal morbidity and mortality. Studies have demonstrated that a shock index ≥0,9 is associated with a higher risk of requiring large-volume transfusions, and that a progressive increase in the index over time correlates significantly with an increased incidence of severe obstetric complications.

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