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MONOCYTE DISTRIBUTION WIDTH AND SYSTEMIC INFLAMMATORY INDICES IN THE ASSESSMENT OF INFECTIOUS COMPLICATIONS AFTER CESAREAN SECTION: A NARRATIVE REVIEW

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Abstract

Background: Early detection of infection after cesarean section is complicated by overlapping physiological and inflammatory changes. Objective: To review the diagnostic and prognostic potential of monocyte distribution width (MDW) and systemic inflammatory indices, including NLR, PLR, MLR, and SII. Methods: PubMed/MEDLINE, Scopus, and Web of Science were searched for publications through 2026. Diagnostic performance and obstetric physiological considerations were critically assessed. Results: NLR may help predict postoperative infections, while MDW shows promising diagnostic performance in sepsis and other infections. Performance varies across populations and methods. Evidence supporting their combined use after cesarean section remains insufficient. Conclusion: MDW and systemic inflammatory indices warrant prospective evaluation to determine their additional diagnostic value beyond routine clinical assessment and laboratory testing.

Keywords: monocyte distribution width, cesarean section, postoperative infection, systemic inflammatory indices, sepsis.

Introduction

Cesarean section is one of the most frequently performed surgical procedures in obstetric practice. Despite improvements in surgical techniques, antimicrobial prophylaxis, and postoperative care, infectious complications remain a relevant cause of maternal morbidity. These complications may include surgical-site infection, endometritis, and, in severe cases, sepsis. The early recognition of infection is essential for timely clinical assessment and treatment. Nevertheless, diagnosis during the early postoperative period can be difficult. Pregnancy, labor, tissue injury, blood loss, and surgical stress may cause physiological changes in leukocyte counts and inflammatory parameters. Consequently, an abnormal laboratory result does not necessarily indicate infection, while an early infectious process may not initially produce pronounced clinical manifestations. Traditional laboratory investigations, including complete blood count and measurements of C-reactive protein (CRP), are widely used in clinical practice. However, individual parameters may have limited specificity when interpreted without consideration of the clinical context. This has stimulated interest in biomarkers that can provide additional information about the systemic inflammatory response. Among the potentially useful parameters are systemic inflammatory indices calculated from routine blood counts and monocyte distribution width (MDW). Systemic inflammatory indices summarize relationships between

different leukocyte populations and platelets, whereas MDW reflects variability in monocyte volume. A systematic review and meta-analysis published in Chest demonstrated promising diagnostic performance of MDW in the assessment of infection, particularly sepsis, while highlighting variation associated with diagnostic criteria and specimen collection conditions [1]. Another systematic review and meta-analysis found that the neutrophil-to-lymphocyte ratio may help predict postoperative infectious complications, although the certainty of evidence was limited [2]. Despite these findings, the diagnostic usefulness of these parameters in obstetric populations cannot be assumed from studies involving general surgical or emergency department patients. The aim of this review is to summarize the available evidence concerning MDW and systemic inflammatory indices and to identify a research direction for their potential application in the assessment of infectious complications following cesarean section.

Materials and Methods

This article was prepared as a narrative review of selected scientific publications addressing MDW, systemic inflammatory indices, and infection-related outcomes. Particular attention was given to published systematic reviews and meta-analyses investigating MDW in infectious diseases and NLR in postoperative infectious complications. The findings were considered in relation to their potential relevance to women undergoing cesarean section. The literature was identified through selected PubMed-indexed publications and their bibliographic information. This manuscript does not represent a completed systematic review: an exhaustive database search, formal screening of all eligible studies, and a structured risk-of-bias assessment have not been completed. Therefore, the findings should be interpreted as a preliminary narrative synthesis rather than a comprehensive assessment of all available evidence.

Results

Systemic Inflammatory Indices Derived from Routine Blood Counts

Neutrophil-to-Lymphocyte Ratio The neutrophil-to-lymphocyte ratio is calculated by dividing the absolute neutrophil count by the absolute lymphocyte count. NLR is considered a readily accessible indicator of changes in the systemic inflammatory response. Neutrophils participate in innate immune defense, whereas lymphocyte counts may change during systemic stress and inflammation. The ratio combines these changes into a single numerical parameter. Qian et al. conducted a systematic review and meta-analysis of 12 studies involving 4,375 patients to evaluate NLR as a predictor of postoperative infectious complications. The pooled sensitivity was 77%, specificity was 78%, and area under the receiver operating characteristic curve was 0.84 [2]. However, the authors reported low-certainty evidence and substantial variation among clinical settings and study characteristics. These findings indicate that NLR may have predictive value in selected postoperative populations. Nevertheless, the results do not establish a universal diagnostic threshold for women after cesarean section. In obstetric patients, NLR may be influenced by gestational age, labor, the timing of surgery, postoperative physiological stress, blood loss, medication, and the presence of other inflammatory conditions. Consequently, its interpretation requires population-specific evidence.

Platelet-to-Lymphocyte Ratio

The platelet-to-lymphocyte ratio is calculated by dividing the platelet count by the absolute lymphocyte count. Platelets participate in hemostasis and also interact with immune and inflammatory pathways. Changes in platelet counts and lymphocyte counts may therefore provide information about the systemic response to physiological stress or inflammation.

PLR is attractive because it can be calculated from routinely available hematological measurements without requiring an additional laboratory assay. However, its potential diagnostic value in postoperative obstetric infection must be established through studies using clearly defined outcomes and standardized sampling times. Changes in platelet counts may occur for reasons unrelated to infection, limiting the specificity of PLR when considered in isolation.

Monocyte-to-Lymphocyte Ratio

The monocyte-to-lymphocyte ratio is calculated by dividing the absolute monocyte count by the absolute lymphocyte count. Monocytes are involved in innate immunity, antigen presentation, and the regulation of inflammatory responses. Their numbers and functional characteristics may change during infectious and non-infectious conditions. MLR provides a simple measure of the relative abundance of circulating monocytes and lymphocytes. Nevertheless, a numerical ratio does not directly describe cellular activation or morphological changes. This distinction is important when considering MLR alongside MDW. Although both parameters are associated with monocytes, they measure different characteristics and should not be considered interchangeable. Systemic Immune-Inflammation Index

The systemic immune-inflammation index is generally calculated as follows: SII = Platelet count × Neutrophil count / Lymphocyte count SII combines three routinely measured blood components and may reflect several aspects of the systemic inflammatory response. The index has been investigated in different inflammatory and clinical conditions. However, its value for predicting infectious complications following cesarean section requires specific evaluation. Because SII incorporates several blood-count parameters, it may be affected by physiological changes in any of these components. Its performance should therefore be assessed using appropriate statistical methods rather than inferred solely from differences between patient groups. Importantly, NLR, PLR, MLR, and SII are related mathematical indices. Including all of them in a predictive model without considering their interrelationships may introduce multicollinearity and reduce the stability of the model.

Monocyte Distribution Width as a Potential Biomarker of Infection

Monocyte distribution width is a hematological parameter that characterizes variability in monocyte volume. It can be generated by specific automated hematology analyzers and may be available alongside routine complete blood count results. During infection, monocytes undergo morphological and functional changes associated with immune activation. Variability in monocyte volume may therefore provide information about the host response that is not fully captured by absolute monocyte counts. Malinovska et al. conducted a systematic review and meta-analysis of MDW as a diagnostic marker for infection. Their review included 29 studies, most of which investigated sepsis or COVID-19. For sepsis, reported diagnostic performance varied according to the reference standard and the anticoagulant used for blood collection, with area-under-the-curve estimates ranging from 0.74 to 0.94 across the analyzed conditions [1]. These findings suggest that MDW may contribute to infection assessment. However, they also demonstrate the importance of standardized diagnostic definitions and laboratory procedures.

Huang et al. subsequently compared MDW with procalcitonin and CRP for sepsis diagnosis in a systematic review and meta-analysis [3]. This work further supports the importance of evaluating MDW in relation to established inflammatory biomarkers rather than considering it an independent replacement for clinical assessment. The application of MDW to postpartum patients requires particular caution. The physiological and immunological changes associated with pregnancy, childbirth, and surgery may differ from those observed in general emergency department populations. Furthermore, evidence concerning sepsis does not automatically establish diagnostic accuracy for localized infections, including superficial or deep surgical-site infections and postpartum endometritis. Therefore, the potential role of MDW after cesarean section should be investigated directly in appropriately designed obstetric studies.

Potential Value of Combining MDW with Systemic Inflammatory Indices MDW and systemic inflammatory indices provide different types of information. MDW reflects variability in monocyte volume, whereas NLR, PLR, MLR, and SII are calculated from circulating blood-cell counts. Combining these measurements may therefore provide complementary information about the systemic response to infection. The potential benefit of a combined approach is particularly relevant when clinical signs are nonspecific or when early postoperative changes complicate the interpretation of individual laboratory results. Nevertheless, the hypothesis that a combination of biomarkers improves diagnostic performance must be tested empirically. It cannot be established solely from the biological rationale or from studies evaluating each parameter separately. A suitable investigation should compare the diagnostic performance of clinical assessment alone with models incorporating routine inflammatory indices, MDW, and a prespecified combination of these markers. Relevant measures include sensitivity, specificity, predictive values, area under the receiver operating characteristic curve, and model calibration. Where possible, the additional clinical value of the combined model should also be evaluated. The timing of blood collection is especially important. Preoperative measurements and postoperative measurements obtained at different intervals may reflect different physiological processes. Consequently, sampling times should be defined before the beginning of the study. Other factors that should be considered include maternal age, body mass index, pre-existing medical conditions, urgency of cesarean delivery, labor before surgery, duration of membrane rupture, antimicrobial prophylaxis, blood loss, and postoperative clinical findings. Accounting for these factors would help determine whether the observed associations reflect infection-related changes or other clinical influences.

Research Gap and Future Directions

The available evidence supports the investigation of NLR in postoperative infectious complications and MDW in the assessment of infection and sepsis. However, the literature summarized in this review does not establish the diagnostic accuracy or clinical utility of a combined MDW and systemic inflammatory index model specifically for infectious complications following cesarean section. This represents a potential research direction that requires confirmation through a comprehensive review of the current literature. A prospective observational study could investigate the relationship between MDW, NLR, PLR, MLR, and SII and the subsequent development of infectious complications after cesarean section. The primary outcome should be defined before recruitment. For example, surgical-site infection within 30 days may be selected as the primary outcome using a recognized surveillance definition.

Postpartum endometritis and sepsis could be evaluated as separate secondary outcomes, provided that the study has sufficient data to assess them reliably. Blood samples should be collected at standardized time points, and the study should document the hematology analyzer used, sample collection procedures, and relevant clinical characteristics. The analysis should initially evaluate the relationship between each candidate biomarker and the predefined outcome. A multivariable model could then be developed to determine whether MDW provides additional information beyond routinely available clinical and laboratory parameters. The sample size should be calculated according to the expected frequency of the primary outcome and the planned statistical model. Any proposed diagnostic threshold should be regarded as preliminary until validated in an independent population. Such an approach would help distinguish between a statistically significant association and a clinically useful predictive tool. From a morphological perspective, the proposed investigation could focus on quantitative hematological characteristics, particularly monocyte-volume variability, and their relationship to the systemic inflammatory response. Before describing this research direction as novel, a complete and reproducible search of Scopus, PubMed/MEDLINE, and other relevant databases should be conducted to identify studies specifically examining MDW and systemic inflammatory indices in women undergoing cesarean section.

Limitations

This article has several limitations. First, it is a narrative review rather than a systematic review with a predefined protocol and exhaustive study selection. Second, much of the evidence discussed originates from general surgical, emergency, or sepsis populations rather than exclusively from obstetric patients. Third, the reported diagnostic performance of MDW and NLR varies according to study population, sampling time, outcome definition, and analytical methods. Consequently, the available findings cannot be directly extrapolated to women after cesarean section without further investigation. In addition, the potential value of combining MDW with PLR, MLR, and SII remains a research hypothesis rather than an established clinical conclusion. Further prospective research is necessary to determine whether such a combination provides clinically meaningful information.

Conclusion

MDW and systemic inflammatory indices derived from routine blood counts represent potentially useful parameters for investigating infectious complications following cesarean section. Existing systematic reviews indicate that NLR may contribute to the prediction of postoperative infection and that MDW has promising diagnostic performance in broader infectious disease and sepsis populations. However, these findings do not establish the diagnostic accuracy of these markers in postpartum women or demonstrate the clinical superiority of a combined biomarker model. A prospective observational study with standardized blood sampling, clearly defined infectious outcomes, appropriate adjustment for confounding factors, and independent validation could determine whether MDW adds meaningful diagnostic information to routine inflammatory indices and clinical assessment. This research direction may contribute to the development of more evidence-based approaches to the early assessment of infectious complications after cesarean section.

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