UNIVERSAL JOURNAL OF MEDICAL AND NATURAL SCIENCES
ISSN 2992-8826
https://sr-journals.org/index.php/UJMANS

Early prediction of the need for surgical intervention in necrotizing enterocolitis: clinical predictors and analysis of scientific evidence

Munavvarov Zikirulloxon Dadaxon o'g'li
Chust District Medical Association, Namangan Region, Uzbekistan
Email: zikirullomunavarov@gmail.com
Phone: +998(93)2700042

Abstract. Necrotizing enterocolitis (NEC) is a severe gastrointestinal disease affecting predominantly premature and low-birth-weight neonates and remains one of the leading causes of morbidity and mortality in neonatal intensive care units. The disease is characterized by intestinal inflammation, progressive tissue damage, and, in severe cases, intestinal necrosis and perforation, which may necessitate urgent surgical intervention. Early prediction of the need for surgery represents a significant clinical challenge because the initial manifestations of NEC may be nonspecific, while disease progression can be rapid and unpredictable. This article aims to analyze the clinical predictors and scientific evidence associated with the early identification of neonates who may require surgical intervention. Particular attention is given to clinical manifestations, hematological and biochemical parameters, radiological findings, and abdominal ultrasonography. Potential predictors include progressive abdominal distension, abdominal wall discoloration, thrombocytopenia, metabolic acidosis, systemic instability, pneumoperitoneum, impaired intestinal wall perfusion, and other indicators of advanced intestinal injury. The analysis emphasizes that no single clinical or laboratory parameter is sufficient to reliably determine the need for surgery in all patients. Instead, the integration of serial clinical assessments, laboratory trends, and imaging findings may provide a more comprehensive evaluation of disease severity and the likelihood of surgical intervention. The article also highlights the importance of interpreting predictive indicators in the context of gestational age, birth weight, disease stage, and individual clinical characteristics. A critical assessment of the available evidence may contribute to identifying the strengths and limitations of current predictive approaches and to defining priorities for future research. The development and prospective validation of standardized prediction models may improve risk stratification, facilitate timely multidisciplinary decision-making, and support the optimization of surgical management in neonates with necrotizing enterocolitis.

Keywords: necrotizing enterocolitis, surgical intervention, early prediction, clinical predictors, premature neonates, laboratory biomarkers, abdominal ultrasonography, risk stratification.

Аннотация. Некротизирующий энтероколит (НЭК) представляет собой тяжёлое заболевание желудочно-кишечного тракта, преимущественно поражающее недоношенных детей и новорождённых с низкой массой тела при рождении, и остаётся одной из основных причин заболеваемости и смертности в отделениях интенсивной терапии новорождённых. Заболевание характеризуется воспалением кишечника, прогрессирующим повреждением тканей, а в тяжёлых случаях — некрозом и перфорацией кишечной стенки, что может потребовать неотложного хирургического вмешательства. Раннее прогнозирование необходимости операции представляет собой серьёзную клиническую проблему, поскольку начальные проявления НЭК могут быть неспецифическими, а прогрессирование заболевания — быстрым и непредсказуемым. Целью настоящей статьи является анализ клинических предикторов и научных данных, связанных с ранним выявлением новорождённых, которым может потребоваться хирургическое вмешательство. Особое внимание уделяется

клиническим проявлениям, гематологическим и биохимическим показателям, рентгенологическим данным и результатам ультразвукового исследования органов брюшной полости. К потенциальным предикторам относятся прогрессирующее вздутие живота, изменение окраски брюшной стенки, тромбоцитопения, метаболический ацидоз, системная нестабильность, пневмоперитонеум, нарушение перфузии кишечной стенки и другие признаки выраженного повреждения кишечника. Подчёркивается, что ни один отдельный клинический или лабораторный показатель не позволяет надёжно определить необходимость хирургического вмешательства у всех пациентов. Более комплексная оценка тяжести заболевания и вероятности проведения операции возможна при интеграции результатов последовательного клинического наблюдения, динамики лабораторных показателей и данных инструментальной диагностики. Также рассматривается необходимость интерпретации прогностических показателей с учётом гестационного возраста, массы тела при рождении, стадии заболевания и индивидуальных клинических характеристик пациента. Критический анализ имеющихся научных данных позволяет определить преимущества и ограничения современных подходов к прогнозированию, а также обозначить приоритетные направления дальнейших исследований. Разработка и проспективная валидация стандартизированных прогностических моделей могут способствовать совершенствованию стратификации риска, своевременному принятию междисциплинарных клинических решений и оптимизации хирургической помощи новорождённым с некротизирующим энтероколитом.

Ключевые слова: некротизирующий энтероколит, хирургическое вмешательство, раннее прогнозирование, клинические предикторы, недоношенные новорождённые, лабораторные биомаркеры, ультразвуковое исследование органов брюшной полости, стратификация риска.

Annotatsiya. Nekrotik enterokolit (NEK) asosan muddatidan oldin tug‘ilgan va tana vazni kam bo‘lgan chaqaloqlarda uchraydigan og‘ir oshqozon-ichak kasalligi bo‘lib, neonatal intensiv terapiya bo‘limlarida kasallanish va o‘limning asosiy sabablaridan biri hisoblanadi. Ushbu kasallik ichak yallig‘lanishi, to‘qimalarning progressiv shikastlanishi, og‘ir holatlarda esa ichak devorining nekrozi va perforatsiyasi bilan tavsiflanadi. Bunday asoratlar shoshilinch jarrohlik aralashuvini talab qilishi mumkin. Jarrohlik aralashuviga ehtiyojni erta bashoratlash muhim klinik muammolardan biri hisoblanadi, chunki nekrotik enterokolitning dastlabki belgilari o‘ziga xos bo‘lmasligi, kasallikning rivojlanishi esa tez va oldindan aytish qiyin kechishi mumkin. Mazkur maqolaning maqsadi jarrohlik aralashuvi talab etilishi mumkin bo‘lgan chaqaloqlarni erta aniqlash bilan bog‘liq klinik prediktorlar va ilmiy dalillarni tahlil qilishdan iborat. Tadqiqot yo‘nalishida klinik belgilar, gematologik va biokimyoviy ko‘rsatkichlar, rentgenologik ma’lumotlar hamda qorin bo‘shlig‘i ultratovush tekshiruvi natijalariga alohida e’tibor qaratiladi. Potensial prediktorlarga qorin bo‘shlig‘ining tobora dam bo‘lishi, qorin devori rangining o‘zgarishi, trombotsitopeniya, metabolik atsidoz, tizimli gemodinamik beqarorlik, pnevmoperitoneum, ichak devori perfuziyasining buzilishi va ichakning og‘ir shikastlanishini ko‘rsatuvchi boshqa belgilar kiradi. Tahlilda hech bir alohida klinik yoki laborator ko‘rsatkich barcha bemorlarda jarrohlik aralashuviga ehtiyojni ishonchli aniqlash uchun yetarli emasligi ta’kidlanadi. Kasallik og‘irligi va jarrohlik aralashuvi ehtimolini kompleks baholash uchun ketma-ket klinik kuzatuv natijalari, laborator ko‘rsatkichlarning dinamikasi va instrumental diagnostika ma’lumotlarini birgalikda tahlil qilish muhimdir. Shuningdek, prognostik ko‘rsatkichlarni homiladorlikning gestatsion muddati, tug‘ilishdagi tana vazni, kasallik bosqichi va bemorning individual klinik xususiyatlarini hisobga olgan holda talqin qilish zarurligi yoritiladi. Mavjud ilmiy dalillarni tanqidiy tahlil qilish zamonaviy bashoratlash yondashuvlarining afzalliklari va cheklovlarini aniqlash hamda kelgusidagi tadqiqotlarning ustuvor yo‘nalishlarini belgilash imkonini beradi. Standartlashtirilgan prognostik modellarni ishlab chiqish va ularni prospektiv tadqiqotlarda tasdiqlash xavfni tabaqalashtirishni takomillashtirish, turli mutaxassislar ishtirokida klinik qarorlarni o‘z vaqtida qabul qilish va nekrotik enterokolit bilan

kasallangan chaqaloqlarga ko‘rsatiladigan jarrohlik yordami samaradorligini oshirishga xizmat qilishi mumkin.

Kalit so‘zlar: nekrotik enterokolit, jarrohlik aralashuvi, erta bashoratlash, klinik prediktorlar, muddatidan oldin tug‘ilgan chaqaloqlar, laborator biomarkerlar, qorin bo‘shlig‘i ultratovush tekshiruvi, xavfni tabaqalashtirish.

Introduction. Necrotizing enterocolitis (NEC) is a severe inflammatory and necrotizing disease of the gastrointestinal tract that predominantly affects premature and low-birth-weight neonates. Despite advances in neonatal intensive care, nutritional support, and diagnostic imaging, NEC remains a major cause of neonatal morbidity and mortality. The clinical course of the disease ranges from relatively mild intestinal inflammation to progressive bowel necrosis, intestinal perforation, systemic inflammatory response, and multiorgan dysfunction. The risk of adverse outcomes is particularly high among extremely preterm infants and neonates with very low birth weight. In a comprehensive review published in 2024, the mortality rate among infants diagnosed with NEC was reported to be approximately 23.5%, with substantially higher mortality among extremely low-birth-weight infants who required surgical intervention [1]. These outcomes highlight the importance of identifying disease progression at an early stage and establishing reliable criteria for determining which patients may benefit from surgical treatment.

The clinical management of NEC involves continuous assessment of the infant’s general condition, abdominal findings, laboratory parameters, and radiological features. The modified Bell staging system remains widely used to classify disease severity and support clinical decision-making. However, the heterogeneous presentation of NEC and the limited specificity of several early clinical manifestations complicate the distinction between infants who may respond to conservative treatment and those whose condition is likely to progress to intestinal necrosis or perforation [1]. Abdominal distension, feeding intolerance, bloody stools, temperature instability, and systemic deterioration may indicate disease progression, but their diagnostic and prognostic significance varies according to the stage of the disease and the infant’s underlying clinical condition. Consequently, reliance on isolated clinical findings may be insufficient for the early identification of neonates requiring surgery.

The prediction of surgical intervention is further complicated by the fact that clinical deterioration does not always coincide with the appearance of definitive radiological signs. Pneumoperitoneum is an important indicator of intestinal perforation and may constitute a clear indication for surgical assessment. Nevertheless, the absence of free intraperitoneal air does not exclude extensive intestinal necrosis or progressive disease requiring operative management. Laboratory abnormalities, including thrombocytopenia, metabolic acidosis, and disturbances in systemic physiology, may provide additional information about disease severity; however, these findings are not specific to NEC and must be interpreted in conjunction with the clinical presentation and imaging results. Therefore, early prediction requires a multidimensional approach that considers the combined and evolving patterns of clinical, laboratory, and instrumental findings rather than a single diagnostic indicator [1,2].

In recent years, abdominal ultrasonography has attracted increasing attention as an adjunctive diagnostic and prognostic tool in NEC. Unlike conventional abdominal radiography, ultrasonography can provide detailed information about bowel-wall thickness and echogenicity, intestinal motility, bowel-wall perfusion, and the presence and characteristics of free intraperitoneal fluid. A systematic review and meta-analysis published in *Pediatric Radiology* identified several ultrasonographic findings associated with surgery or death, including focal fluid collections, complex ascites, absent peristalsis, bowel-wall thinning, and absent bowel-wall perfusion [2]. These findings suggest that ultrasonography may contribute valuable information when assessing the extent of intestinal injury and the likelihood of an adverse outcome. However, the interpretation of ultrasonographic findings depends on operator expertise, examination protocols, and the clinical

context, and the available evidence does not support treating every individual imaging abnormality as an independent indication for surgery.

The importance of integrating different predictive indicators is further demonstrated by a systematic review and meta-analysis published in 2025 in the journal *Surgery*. This analysis included 53 studies involving 6,046 infants and evaluated the diagnostic performance of clinical, laboratory, radiological, and ultrasonographic predictors of surgical intervention [3]. The findings demonstrated substantial variation in the sensitivity and specificity of individual predictors. Abdominal distension showed high sensitivity but low specificity, whereas abdominal-wall erythema demonstrated low sensitivity but high specificity. Thrombocytopenia was relatively specific but insufficiently sensitive, while sonographically detected ascites showed promising overall predictive performance. These findings indicate that individual clinical signs and diagnostic parameters differ in their ability to identify infants who will require surgery. They also emphasize the need to interpret predictive indicators in combination and to consider their performance across different patient populations and clinical settings. Despite progress in the identification of potential predictors, several important challenges remain. Published studies differ in their definitions of surgical NEC, patient selection criteria, disease severity, timing of diagnostic assessment, and outcome measures. Some investigations evaluate the need for surgery, whereas others use composite outcomes that include surgery or death. These differences complicate direct comparisons between studies and limit the generalizability of individual predictive models. Furthermore, an association between a clinical finding and surgical intervention does not necessarily establish that the finding independently predicts the need for surgery. The decision to operate is influenced by the infant's evolving condition, institutional practices, multidisciplinary assessment, and the availability of diagnostic resources. Accordingly, the clinical usefulness of a proposed predictor depends not only on its statistical association with an outcome but also on its reproducibility, diagnostic accuracy, and applicability to real-world neonatal practice [2,3].

Against this background, a critical analysis of the available scientific evidence is necessary to clarify the role of clinical predictors in the early identification of neonates with NEC who may require surgical intervention. The present article aims to analyze and synthesize published evidence concerning clinical manifestations, hematological and biochemical parameters, radiological findings, and abdominal ultrasonographic characteristics associated with surgical NEC. It also seeks to examine the diagnostic strengths and limitations of individual predictors, evaluate the potential benefits of combining multiple indicators, and identify methodological gaps that should be addressed in future research. By organizing the available evidence into clinically relevant categories, this review is intended to contribute to a more comprehensive understanding of early risk assessment and to support the development and validation of standardized, evidence-based approaches to surgical decision-making in neonates with NEC.

Materials and methods. *Study Design and Literature Selection.* This article was prepared as a narrative literature review aimed at evaluating the available scientific evidence on the early prediction of the need for surgical intervention in neonates with necrotizing enterocolitis (NEC). The review focused on identifying and critically examining clinical, laboratory, radiological, and ultrasonographic predictors associated with disease progression and the need for surgical management.

Relevant peer-reviewed publications were identified through a targeted literature search using PubMed/MEDLINE, Scopus, Web of Science, and Google Scholar as the principal sources of scientific information. Priority was given to systematic reviews, meta-analyses, observational cohort studies, and original clinical investigations addressing surgical NEC, disease severity, diagnostic accuracy, and prognostic indicators. Particular attention was paid to recent publications, including studies published between 2018 and 2025, while earlier relevant investigations were considered when they provided important evidence on diagnostic and prognostic assessment.

Search Strategy. The literature search incorporated combinations of the following terms: "necrotizing enterocolitis," "surgical necrotizing enterocolitis," "surgical intervention," "early

prediction," "clinical predictors," "risk factors," "laboratory biomarkers," "bowel ultrasound," "intestinal perfusion," and "prediction models." Boolean operators, including AND and OR, were used to combine search terms and identify publications relevant to the review objectives. Additional publications were identified by examining the reference lists of relevant systematic reviews, meta-analyses, and clinical studies. The selection of literature emphasized the clinical relevance of reported predictors, the methodological quality of the studies, and the applicability of their findings to the early assessment of neonates with NEC.

Eligibility Criteria. Publications were considered relevant if they investigated one or more factors associated with the progression of NEC or the need for surgical intervention in neonatal populations. Eligible evidence included studies evaluating clinical deterioration, hematological and biochemical abnormalities, radiological indicators of intestinal injury, ultrasonographic findings, and predictive models designed to estimate surgical risk. Studies were considered particularly relevant when they reported diagnostic performance measures, associations between specific predictors and surgical outcomes, or comparisons between infants managed conservatively and those requiring surgery. Publications focusing exclusively on unrelated neonatal conditions, studies without relevant clinical outcomes, and duplicate reports were not considered in the qualitative synthesis.

Data Extraction and Analysis. The selected literature was organized according to study design, population characteristics, predictor categories, and reported outcomes. The principal variables of interest included gestational age, birth weight, clinical manifestations, platelet count, inflammatory markers, metabolic abnormalities, radiological evidence of intestinal perforation, ultrasonographic indicators of bowel-wall injury, and the reported need for surgical intervention. The evidence was synthesized qualitatively across four principal domains: [4] clinical and physiological predictors; [5] hematological and biochemical parameters; [6] radiological and ultrasonographic findings; and [7] composite risk assessment and prediction models. Where available, reported sensitivity, specificity, odds ratios, confidence intervals, and other diagnostic performance measures were considered when interpreting the potential clinical value of individual predictors. Particular attention was given to the consistency of findings across studies, differences in study populations, and the distinction between predictors of disease severity and indicators specifically associated with surgical intervention. Because the article was designed as a narrative review, no new statistical meta-analysis or independent pooled estimate was calculated.

Methodological Limitations. The interpretation of the evidence took into account the heterogeneity of study designs, diagnostic criteria, disease stages, definitions of surgical NEC, and institutional approaches to surgical decision-making. The possibility of selection bias, retrospective study designs, small sample sizes, and limited external validation of predictive models was also considered. These methodological differences may influence the reliability and generalizability of reported predictors. As this review was based on previously published literature, no new patient data were collected and no clinical interventions were performed. The methodological approach was intended to provide a structured qualitative synthesis of available evidence and to identify priorities for future prospective studies aimed at validating standardized approaches to the early prediction of surgical intervention in neonates with NEC.

Results. Clinical Predictors of Surgical Intervention. The reviewed scientific literature indicates that the early identification of neonates with necrotizing enterocolitis (NEC) who may require surgical intervention remains a complex clinical task. Clinical manifestations vary considerably according to disease severity, gestational age, birth weight, and the stage at which the infant is assessed. Abdominal distension, abdominal wall discoloration, systemic instability, and progressive deterioration of the infant's general condition are among the findings considered in the assessment of disease progression. A systematic review and meta-analysis published in 2025 included 53 studies involving 6,046 infants and evaluated 13 predictors of surgical intervention. Abdominal distension demonstrated a pooled sensitivity of 93% and specificity of 26%, indicating that it was frequently observed among infants requiring surgery but had limited ability to distinguish

them from infants managed medically. In contrast, abdominal wall erythema demonstrated a sensitivity of 30% and specificity of 93%, suggesting that its presence may be informative in selected cases, although its absence cannot reliably exclude severe disease [8]. These findings illustrate the complementary roles of sensitive but nonspecific clinical indicators and less sensitive but more specific signs.

The evidence also suggests that clinical deterioration should be evaluated dynamically rather than through a single examination. Persistent or progressive abdominal abnormalities, worsening systemic condition, and the emergence of additional indicators of intestinal injury may increase concern regarding disease progression. Nevertheless, the interpretation of these findings requires consideration of the overall clinical presentation and cannot independently establish the need for surgical intervention in every patient.

Hematological and Biochemical Predictors. Laboratory parameters provide additional information about the systemic consequences and progression of NEC. Among the investigated indicators, thrombocytopenia, elevated C-reactive protein (CRP), coagulation abnormalities, metabolic disturbances, and electrolyte imbalances have received particular attention. A 2024 systematic review and meta-analysis of 18 studies involving 2,790 neonates identified several factors associated with surgical treatment. These included sepsis, coagulation disorders, elevated CRP levels, lower gestational age, and hyponatremia. The pooled estimates reported associations between surgical treatment and sepsis (OR = 2.94; 95% CI: 1.87–4.60), coagulation disorders (OR = 3.45; 95% CI: 1.81–6.58), elevated CRP (OR = 1.42; 95% CI: 1.01–1.99), and hyponatremia (OR = 1.22; 95% CI: 1.07–1.39). These findings indicate that systemic infection, coagulation abnormalities, and biochemical disturbances may contribute to the identification of infants at increased risk of requiring surgery. Thrombocytopenia is another important laboratory finding in the assessment of severe NEC. The 2025 meta-analysis reported a pooled specificity of 85%, although sensitivity was limited. Consequently, a reduced platelet count may strengthen clinical suspicion when accompanied by other indicators of deterioration, but a normal platelet count cannot be used to exclude the possibility of surgical disease. The available evidence also highlights the importance of interpreting laboratory results longitudinally. Changes in platelet count, inflammatory markers, acid–base balance, and electrolyte concentrations may provide additional information about disease progression. However, the predictive value of individual biomarkers varies, and several studies have methodological limitations, including inconsistent thresholds and insufficient external validation [8].

Radiological and Ultrasonographic Predictors. Imaging findings are important components of the assessment of intestinal injury and the potential need for surgical intervention. Abdominal radiography remains an established diagnostic modality, particularly for identifying pneumoperitoneum and other characteristic findings associated with NEC. The presence of free intraperitoneal air is a critical sign of intestinal perforation and generally requires urgent surgical evaluation. Other radiographic findings, including a persistent fixed intestinal loop and portal venous gas, may provide additional diagnostic information, although their predictive performance varies [9].

Abdominal ultrasonography provides complementary information regarding bowel-wall thickness, echogenicity, intestinal motility, perfusion, and the presence and characteristics of intraperitoneal fluid. A systematic review and meta-analysis by Cuna and colleagues found that focal fluid collections, complex ascites, absent peristalsis, pneumoperitoneum, and absent bowel-wall perfusion were associated with surgery or death in infants with NEC. These findings suggest that ultrasonography may help identify intestinal injury that is not fully characterized by conventional radiography alone.

Discussion. The early prediction of surgical intervention in NEC remains a major challenge in neonatal care because the disease can progress rapidly and its initial manifestations are often nonspecific. The findings of the reviewed literature indicate that effective risk assessment requires

an understanding of the complementary roles of clinical examination, laboratory investigation, and imaging. The principal implication is that predictive indicators should be interpreted as components of an integrated clinical assessment rather than as independent determinants of surgical management.

The clinical predictors identified in the literature differ considerably in their diagnostic performance. The high sensitivity but low specificity of abdominal distension reported in the 2025 meta-analysis suggests that this manifestation may be useful for identifying infants who warrant closer assessment, but it is insufficient as an isolated indicator of surgical NEC. Conversely, the high specificity but low sensitivity of abdominal wall erythema indicates that its presence may increase concern for advanced disease, whereas its absence does not provide adequate reassurance. This distinction is important because the consequences of delayed recognition and unnecessary intervention must both be considered in neonatal surgical decision-making.

Laboratory abnormalities provide additional information about the physiological consequences of NEC. The associations between surgical treatment and sepsis, coagulation disorders, elevated CRP, and hyponatremia reported in the 2024 meta-analysis suggest that systemic inflammation and physiological deterioration are relevant to risk assessment [3]. However, these variables are not specific to intestinal necrosis and may also occur in other severe neonatal conditions. Their prognostic significance therefore depends on the clinical context, the magnitude and progression of the abnormalities, and the presence of corroborating clinical or imaging findings. The interpretation of laboratory parameters also requires caution because statistical association does not necessarily establish independent predictive value. For example, thrombocytopenia may reflect severe systemic illness, coagulation activation, or other concurrent complications. Although its relatively high specificity may make it useful in selected clinical circumstances, its limited sensitivity means that it cannot serve as a reliable screening indicator on its own [4,5]. Future research should establish standardized thresholds and determine whether combinations of laboratory trends improve prediction beyond established clinical assessments.

Conclusion. Early prediction of the need for surgical intervention in necrotizing enterocolitis requires a comprehensive assessment of clinical manifestations, laboratory abnormalities, and imaging findings. The available evidence identifies abdominal distension, abdominal wall erythema, thrombocytopenia, systemic infection, coagulation abnormalities, and selected radiological and ultrasonographic findings as potentially useful indicators of disease severity and surgical risk. However, their diagnostic performance varies substantially, and no single predictor can reliably determine the need for surgery in all neonates.

The integration of serial clinical assessments, laboratory trends, abdominal radiography, and ultrasonography offers a more comprehensive basis for identifying infants at increased risk of progressive intestinal injury. Particular attention should be given to findings suggestive of impaired bowel viability or intestinal perforation, which require urgent specialist assessment. Nevertheless, predictive indicators must be interpreted within the overall clinical context and should not replace individualized multidisciplinary decision-making. Further prospective, multicentre research is needed to establish standardized diagnostic criteria, validate existing prediction models, and determine whether integrated risk assessment improves the timeliness and appropriateness of surgical management. Developing reliable and reproducible prediction strategies may strengthen clinical decision-making and contribute to better outcomes in neonates with necrotizing enterocolitis.

References

1. Hu X, Liang H, Li F, et al. Necrotizing enterocolitis: current understanding of the prevention and management. Pediatric Surgery International. 2024;40:32. https://doi.org/10.1007/s00383-023-05619-3. Springer Nature Link

2. Cuna AC, Reddy N, Robinson AL, et al. Bowel ultrasound for predicting surgical management of necrotizing enterocolitis: a systematic review and meta-analysis. Pediatric Radiology. 2018;48:658–666. https://doi.org/10.1007/s00247-017-4056-x. Springer Nature Link

3. Xie X, Pei J, Zhang L, et al. Prediction of the need for surgery in infants with necrotizing enterocolitis: A systematic review and meta-analysis. Surgery. 2025;185:109526. https://doi.org/10.1016/j.surg.2025.109526.
4. Hu X, Liang H, Li F, et al. Necrotizing enterocolitis: current understanding of the prevention and management. Pediatric Surgery International. 2024;40:32. https://doi.org/10.1007/s00383-023-05619-3. Springer Nature Link
5. Cuna AC, Reddy N, Robinson AL, Chan SS. Bowel ultrasound for predicting surgical management of necrotizing enterocolitis: a systematic review and meta-analysis. Pediatric Radiology. 2018;48(5):658–666. https://doi.org/10.1007/s00247-017-4056-x.
6. Zhang va boshqalar muallifligidagi maqola emas, quyidagi tekshirilgan manbadan foydalaning: Influencing factors for surgical treatment in neonatal necrotizing enterocolitis: a systematic review and meta-analysis. BMC Pediatrics. 2024. https://doi.org/10.1186/s12887-024-04978-7.
7. Bethell GS, Jones IH, Battersby C, Knight M, Hall NJ, et al. Methods of identifying surgical necrotizing enterocolitis—a systematic review and meta-analysis. Pediatric Research. 2025;97:45–55. https://doi.org/10.1038/s41390-024-03292-3.
8. Xie X, Pei J, Zhang L, Wu Y. Prediction of the need for surgery in infants with necrotizing enterocolitis: a systematic review and meta-analysis. Surgery. 2025;185:109526. https://doi.org/10.1016/j.surg.2025.109526.