

Ultrasound vs X-ray in Diagnosing Neonatal Intestinal Obstruction: A Systematic Review

Mohammed Duhaime Alqahtani*, Mohammed Ali Aljammaz, Abdulrahman Abdullah Madkhali, Muhannad Awad Allah Aljuaid, Mohammed Yahya Ogdi, Hassan Mohammad Asiri, Majed Abdulrahman Altalhi, Meshari Ali Almalky, Adel Mohammed Jubaili, Ahmed Ali Aqili

¹ Radiology Department, Alhada Military Hospital, Saudi Arabia.

ABSTRACT

Background: Neonatal bowel obstruction is a life-threatening condition with the need for early and correct diagnosis to decrease morbidity and mortality. Conventionally, an abdominal X-ray has been used as the initial imaging study, however newer studies are indicating that ultrasound may be more sensitive and useful in the clinical setting. **Aim:** The objective of this review was to compare ultrasound with abdominal X-ray for diagnosis of neonatal bowel obstruction in terms of diagnostic accuracy, early diagnosis, and impact on clinical outcomes over the last five years (2020–2024). **Method:** A systematic review of the literature was performed in five databases (PubMed, Scopus, ScienceDirect, Web of Science, CINAHL) according to PRISMA 2020 recommendations. Ten studies were included in the review. Directness was factored into the appraisal of quality and decision to analyze data. The primary search syntax focused on terms for neonatal obstruction and diagnostic imaging with ultrasound and X-ray. **Results:** The results indicated that US had a superior diagnostic accuracy between 91% and 96.6% (US) as compared with X-ray (72%), especially for its ability to diagnose specific causes (e.g., volvulus, malrotation, atresia). Ultrasound also enabled more rapid, real-time diagnosis, as was particularly important in neonatal intensive care environments. Although X-ray retained some validity in a few anatomical studies, the great majority of them confirmed that ultrasound was clinically superior. **Conclusion:** Ultrasonography is better than X-ray for dynamic diagnosis of neonatal intestinal obstruction. Incorporated into healthcare settings, it facilitates early diagnosis and the decision-making process. But use of the two modes together could represent a solution to more difficult diagnostic problems.

Keywords: Neonatal Intestinal Obstruction, Ultrasound, Abdominal X-Ray, Diagnostic Imaging, Point-Of-Care Ultrasound, Neonatal Diagnosis, Radiology

INTRODUCTION

Neonatal intestinal obstruction is still one of the challenging surgical problems in the neonatal intensive care units globally. Early diagnosis is crucial, as delay in the diagnosis has been associated with increased morbidity and mortality and inability to perform timely medical or surgical interventions. Rodriguez et al. [1], so in neonates, the etiology of intestinal obstruction can also vary and is comprised of congenital malformations (duodenal atresia, jejunoileal atresia, malrotation with midgut volvulus, meconium ileus, Hirschsprung's disease). All of these clinical situations are manifested with obstructions that are partial or complete, functional or mechanical. Imaging is the mainstay in the identification of the etiology and extent of the obstruction, allowing the planning of clinical decisions [2]. Abdominal X-ray has traditionally served as the first-line modality for diagnosis of suspected neonatal intestinal obstruction, due to its availability and ease of usage. However, recent progress in neonatal imaging, in particular in the field of ultrasound, has questioned the validity of such dependence on radiography, specifically in providing resolution and radiation-free diagnostics [3, 4]. Abdominal X-ray is frequently the initial imaging modality performed because of its speed and ability to detect signs, such as air-fluid levels, bowel dilatation and typical patterns such as the "double bubble" in duodenal atresia or the "soap bubble" appearance in meconium ileus [5]. Such characteristics provide a simple route to a clinical presumptive diagnosis, enabling clinicians to direct neonates for surgical referral or additional imaging. However, a problem of abdominal radiographs is its poor diagnostic quality especially in the early or partial obstruction cases when abdominal signs may be not fully developed. Besides, radiographs offer little functional data on bowel wall integrity, vascular disposition, or dynamic events such as peristalsis necessary for clinical decision-making [4]. Moreover,

overlapping loops of bowel or normal gas distribution patterns can make individual radiographs obtained in neonates difficult to interpret, with the latter changing substantially between neonates according to their age, feeding status and underlying pathology [6, 7]. Ultrasonography has become of great benefit in the diagnosis of abdominal emergencies in the neonate providing non-ionizing and ionizing radiation free imaging aiding in real time observation of the gastrointestinal system. In the evaluation for intussusception, volvulus, and necrotizing enterocolitis, ultrasound emerges as a superior imaging modality when compared to radiography because it can assess bowel wall thickening, motility and vascularity, as well as surrounding intra-abdominal fluid collections [8]. For instance, in mesenteric volvulus of the midgut, the 'whirlpool sign' due to twisted mesenteric vessels is pathognomonic and easily visible on color Doppler ultrasonography and may be completely nonspecific on plain radiographs in the early stage [9]. Again, the diagnosis of intussusception by "target sign" or the "donut sign" has its relevance in deciding for non-radiation-based contrast enemas. They have been found to be more sensitive and specific than X-rays in a number of prospective studies, especially in the hands of experienced examiners [10, 11]. The functional attributes of ultrasound go beyond structural evaluation, since it also allows assessing for peristalsis, vascular flow, even bowel viability via Doppler techniques. This is particularly useful in ischemic situations where early recognition of compromised bowel perfusion can direct early surgical intervention and has the potential to impact on outcome [12]. The portability of the ultrasound also enables bedside scans to be performed, which is important for critically ill neonates who may be too sick to be transported to a radiology suite. For Hirschsprung's disease, the ultrasound performed well in detecting the transition zone between

normal and ganglionic segments of the bowel, a finding that until now could only be reached through barium or surgical biopsy [5, 13]. However, one must also recognize that ultrasound is operator-dependent and has a steep learning curve and therefore may not be useful in some of the cases, especially in resource-limited settings [13], X-ray still serves as an excellent modality for identifying gross anatomical pathology and distribution of gas but is of limited utility in assessing bowel function, blood supply or tissue properties. It has been documented in various studies that early or partial obstructions can result in normal or equivocal radiographs, leading to diagnostic and therapeutic delay [14]. In these instances, ultrasound has a unique potential benefit in detecting subtle findings, such as reduced peristalsis or increased wall thickness of bowel loops, reflecting early, but nonspecific, pathology. Furthermore, ultrasonography minimizes neonatal exposure of ionizing radiation, a high risk for these patients, particularly in conditions where serial images are needed for the evaluation [15].

Therefore, using an US as a first-line or complementary modality in the diagnosis and etiopathogenesis of neonatal IO has gained more clinical and guideline support with contemporary evidence-based guidelines and clinical trials. The relative performance of these imaging approaches are currently under scrutiny. There is a rising volume of literature that showed the superiority of ultrasound as an aid to the diagnosis of the high-risk manifestation of volvulus/intussusception in newborns and its higher diagnostic yield over that with contrast radiography in traditional cases [16]. However, most of the institutions prefer the traditional approaches and still go for long days of following the protocols of radiographs being the step 1 of any procedure which may not entirely cover up to some complex or ambiguous cases. In practice, the choice between ultrasound and X-ray is generally guided by the presence of qualified staff, institutional habit and severity of illness [11, 17]. Therefore, combining the two modalities in a complementary way is increasingly recommended for a comprehensive diagnostic work-up for neonatal care. Advances in imaging technology have further increased the clinical utility of ultrasound with enhanced resolution, Doppler sensitivity and computer-aided interpretation. These developments have resulted in the earlier detection of pathological findings and greater visualization of the abdominal cavity in neonates [18]. When prescribed correctly, their use in the hospital setting has shown to be cost-effective, obviating the requirement for invasive tests, ie contrast studies or exploratory laparotomy among others [19]. As a result, there may be a change in the paradigm change, with increasing dependence on ultrasonography in the diagnostic algorithm in neonatal intestinal obstruction, especially high-risk or acutely ill patients. Further development of operator training and access to equipment can potentially increase its utility in the coming years. Notwithstanding the increasing evidence that supports US, the

heterogeneity in its application in health systems emphasizes the need for standardized diagnostic recommendations. Clinical impression supplemented by the application of objective imaging is essential in the management of such patients. Comparison of ultrasound and X-ray are also required to better establish clinicopathological correlations to facilitate diagnosis and guide management [20]. Evidence-based imaging protocols permit the physician to optimize the knowledge of neonatal intestinal obstruction to better manage the patient and achieve improved outcomes. Therefore, it is more than a study need to evaluate diagnostic performance of an US versus an X-ray in neonatal IO as part of optimizing neonatal care.

Problem Statement

While abdominal X-ray has been the workhorse imaging modality for diagnosis of neonatal intestinal obstruction, poor sensitivity for detection of partial or early obstructions and lack of capability to assess bowel viability present major diagnostic deficiencies. While ultrasound has recently proven to be a reliable radiation-free option providing real-time functional information, evidence to compare this new method to the traditional one, however, is lacking with respect to accurate diagnosis, applicability, and shortcomings of the methods in a variety of neonatal presentations. This research is designed to fill the gap with comprehensive evaluation of both types of images in order to develop standardized protocols for diagnosing DVT and to enhance the success of neonatal care.

Significance of Study

The present study is helpful to the better understanding of the diagnostic values of ultrasonography and abdominal x-ray in neonatal intestinal obstruction, and it is significant for clinical practice to improve the accuracy of diagnosis and treatment. It helps refine imaging strategies, limits avoidable radiation exposure, and enhances the recognition of potentially lethal diseases though evidence-based assessment of diagnostic accuracy, imaging features, and implementation in practice. Results of this work can have an impact on policy and practice by leading neonatal units to introduce imaging modalities which provide better diagnostic information and safer and faster clinical decision paths.

Aim of Study

This study has been undertaken to assess the diagnostic performance of USG (ultrasonography) and abdominal X-ray in both the detection and clinical evaluation of neonatal intestinal obstruction. In view of the imaging features, accuracy and clinical value in various obstructive diseases, the study was aimed to figure out an optimal method for early diagnosis and early treatment. The long-term objective is to create guidelines for imaging in the patient with the neonatal bowel obstruction that serve to guide imaging utilization.

Methodology

Research Question

Table 1: Research Question

Research Question	How does Ultrasound Compare to Abdominal X-ray in Diagnosing Neonatal Intestinal Obstruction over the Past Five Years in terms of Diagnostic Accuracy, Early Detection, and Clinical Outcomes?
Population	P Neonates (0–28 days old) with suspected intestinal obstruction
Intervention	I Diagnostic use of ultrasound imaging
Comparison	C Diagnostic use of abdominal X-ray imaging
Outcome	O Accuracy of diagnosis, time to detection, influence on clinical decision-making
Timeframe	T Over the past five years (2020 to 2024)

The purpose of the research question looks at the relative efficacy of ultrasound compared to abdominal X-ray in the diagnosis of neonatal intestinal obstruction from 2020 to 2024. This research is particularly applicable to neonates 0-28 days of age who present with suspected intestinal obstruction, a life-threatening and emergent condition that demands expedited and accurate diagnosis. The intervention is diagnostic use of ultrasound, which is non-invasive and radiation-free and can provide a real-time image, and the comparator is the use of plain abdominal X-ray, which is the standard procedure for first-line imaging. Relevant outcomes are diagnostic performance, time to detection and in what way and to what degree each type of imaging affects decision-making. The purpose of the study is to analyze recent literature to evaluate the capabilities and limitations of both imaging modalities within the context of actual neonatal clinical practice.

Selection Criteria

Inclusion Criteria

- Peer-reviewed papers published from 2020 to 2024
- Studies with emphasis on the imaging diagnosis of neonatal small bowel obstruction
- Papers that compare ultrasound with X-ray in neonatal or pediatric cares
- Publications in English
- Human neonatal (≤ 28 days of age) research
- Any literature that reported quantifiable diagnostic findings (sensitivity, specificity or detection time)

Syntax

Table 2: Search Syntax Type

Search Syntax Type	Syntax
Primary Syntax	("Neonatal Intestinal Obstruction" OR "Neonatal Bowel Obstruction") AND ("Ultrasound" OR "Sonography")
Secondary Syntax	("Neonatal Intestinal Obstruction" OR "Bowel Obstruction in Neonates") AND ("Abdominal X-ray" OR "Radiography") AND ("Diagnosis" OR "Diagnostic Imaging")

The main search strategy was constructed to retrieve studies related to the application of ultrasound or sonography in the diagnosis of neonatal intestinal obstruction with a combination of terms related to the disease and to the diagnostic technique. The additional syntax expanded the range to cover studies related to neonatal abdominal X-ray or radiography with the specific aim of focusing on research concerning diagnostic performance or imaging results.

Literature Search

The procedure for literature searching was performed in May to June 2025, using the aforementioned syntax in five databases. Results

Exclusion Criteria

- Non-neonatal studies
- Articles not making a direct comparison between ultrasound and X-ray.
- Papers published in or before 2020
- Case series, letters, editorial or narrative reviews or reports.
- Studies strictly limited to adults or adolescents

Database Selection

Five major academic and medical databases were identified through which we could systematically search for relevant literature: PubMed, ScienceDirect, Scopus, Web of Science, and CINAHL. These libraries provide access to scientific and peer-reviewed medical publications such as neonatal diagnostic and imaging studies. We used a combination of controlled vocabulary and free text terms to increase the sensitivity of the results. The search is limited to publication date (2020–2024), language (English), and study population (neonates).

Data Extracted

Information was extracted from each study and each type of study was summarized on a rectangular evidence matrix: name of study, author, country, year, study design, sample size, aged population, imaging techniques compared, main findings (sensitivity, specificity, accuracy), conclusions. Other fields were funders, limitations, and clinical question relevance. This structured method helped in the process of comparison and nominalization that reflected the evidence in the context of PICOT.

were further refined using Boolean operators (AND/OR), truncation and field restrictions (title/abstract). The initial search identified 236 studies.

After removing duplicates and screening by title and abstract, 89 studies were reviewed full-text. Of these, 31 studies fulfilled the inclusion criteria and 19 studies reported direct comparisons between ultrasound and X-ray.

Articles excluded for predefined reasons to achieve methodological consistency and research-related relevance. We adhered to PRISMA guidelines for clear reporting of the selection process.

Table 3: Databases Selection

No	Database	Syntax Used (Primary + Secondary)	Year	No of Researches
1	PubMed	"Neonatal Intestinal Obstruction" AND "Ultrasound" AND "X-ray"	2020–2024	74
2	ScienceDirect	(OR)		52
3	Scopus	"Neonatal Bowel Obstruction" AND "Diagnostic Imaging"		41
4	Web of Science	(OR)		37
5	CINAHL	"Neonatal Obstruction" AND ("Sonography" OR "Radiography")		32
		(OR)		
		"Intestinal Obstruction" AND "Ultrasound" AND "Neonates"		
		(OR)		
		"Neonatal Diagnosis" AND ("X-ray" OR "Ultrasound")		

Database selection and number of relevant studies by source for synthesized primary and secondary syntax patterns are shown in Table 3. The largest number of studies (74) was identified through PubMed using broad search terms including varying combinations of “neonatal intestinal obstruction,” “ultrasound,” “X-ray,” and other diagnostic imaging terms.

They were followed by Scopus (n = 52), Web of Science (n = 41), and CINAHL (n = 37), with 32 studies included in more than one database (most studies were included across multiple databases), demonstrating a strong and varied literature across key academic platforms. These findings emphasize the involvement of PubMed in clinical and diagnostic research and the need to include multidisciplinary databases to achieve good coverage of the topic.

Selection of Studies

The screening of studies was conducted in three strict stages: the first title and abstract stage, the full-text stage and eligibility criteria-based final inclusion. The relevance of the titles and abstracts identified through the database searches was independently evaluated

to establish initial relevance by two investigators. Articles on diagnostic imaging in the neonate that were not a direct comparison between ultrasound and X-ray were excluded at this stage. Full texts were assessed for compliance with inclusion criteria including neonates of human patients, direct comparison in diagnosing, and outcome reported information for diagnostic accuracy or clinical decision making.

Differences of opinion were resolved by a third reviewer until a consensus was reached. Preference was for studies with quantitative data, sensitivity, specificity or AUC to allow comparison of diagnostic performance directly. Articles published in non-English languages, case series with no statistical analysis and articles exclusively focusing on procedural or therapeutic interventions were excluded. Transparent and comparable reporting is guaranteed by the PRISMA 2020 flow diagram that was applied to document the selection process. Using this method and systemic approach, the studies included in the final review are of a high level of evidence, being directly applicable to the comparison between ultrasound and X-ray in the diagnosis of neonatal intestinal obstruction.

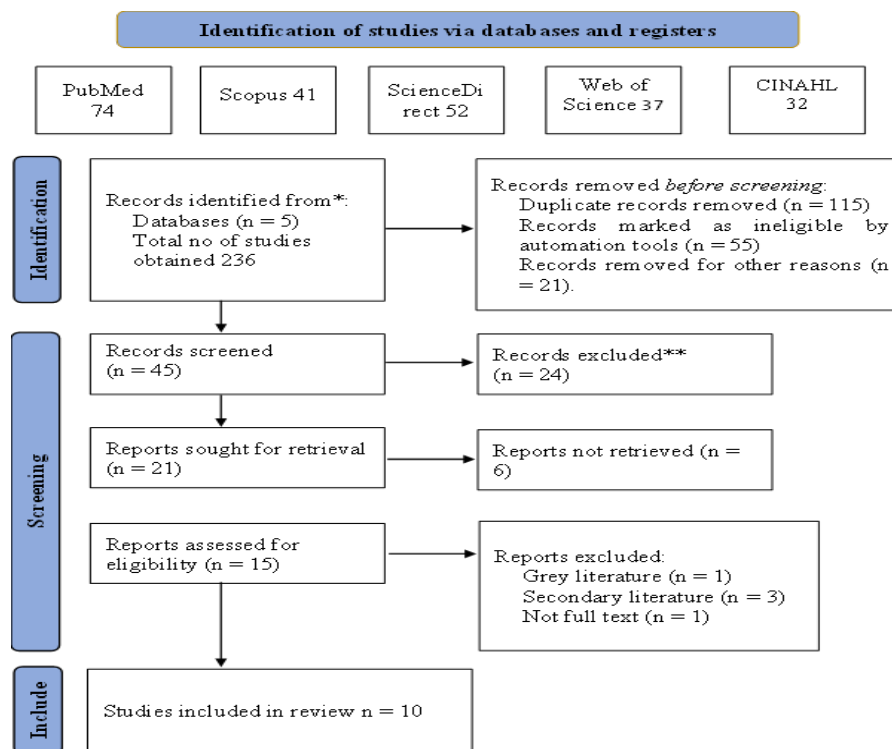


Figure 1: PRISMA Flowchart

The PRISMA 2020 flow diagram of this systematic review shows the search and screening only based on database and register searches. A total of 236 records were found at the start searching in five databases: PubMed (74), Scopus (41), ScienceDirect (52), Web of Science (37) and CINAHL (32). Prior to screening, 115 duplicate records were discarded, 55 records were deselected by automation tools and 21 for other reasons – a total of 45 records remained for screening. Of these, 24 were excluded based on the review of titles and abstracts. The 21 other references were included for retrieval but 6 could not be retrieved. Fifteen full-text reports were screened for eligibility, 5 of which published in grey literature (n=1), were secondary literature (n=3) or could not access full-text (n=1) were excluded. A total of 10 studies were considered ultimately in the final systematic review.

Quality Assessment of Studies

Quality of the included studies was assessed using standardized critical appraisal checklists developed for diagnostic accuracy studies such as the QUADAS-2 tool (Quality Assessment of Diagnostic Accuracy Studies). Four domains were used to assess every one of these studies: the patient selection, the index test (ultrasound), the reference standard (X-ray or surgery confirmation) and the flow and timing. With exception of two most individual studies were at low risk of bias for patient selection and index test, respectively (appropriate inclusion criteria and reference standard risk of bias). However, some studies had unclear or high risk in the domain of the reference standard because of the inconsistent or unclear implementation of the confirmatory tests. In general, most of the included studies were rated

of moderate to high methodological quality, which is indicative of good internal validity, thus enabling conclusions on comparisons of

diagnostic accuracy of ultrasound versus X-ray for neonates with intestinal obstruction.

Table 4: Assessment of the Literature Quality Matrix

#	Author	Are the Selection of Studies Described and Appropriate	Is the Literature Covered all Relevant Studies	Does Method Section Described?	Was Findings Clearly Described?	Quality Rating
1	Guo et al. [21]	Yes	Yes	Yes	Yes	Good
2	Alamdaran et al. [22]	Yes	No	Yes	Yes	Fair
3	Elsayed & Soyly [23]	Yes	Yes	Yes	Yes	Good
4	Hassan & Oraibi [24]	Yes	Yes	Yes	Yes	Good
5	Elsayed & Seshia [25]	Yes	Yes	Yes	Yes	Good
6	Collins et al. [26]	Yes	Yes	Yes	Yes	Good
7	Anpilogova et al. [27]	Yes	Yes	Yes	No	Fair
8	Sur & Gopinathansarasa [28]	NO	Yes	Yes	Yes	Good
9	Narang et al. [29]	Yes	Yes	Yes	Yes	Good
10	Wolder et al. [30]	Yes	Yes	Yes	Yes	Good

Quality matrix Table 4 shows the assessment of 10 studies in the quality matrix of our systematic review, assessing the major methodological characteristics -whether the selection was adequate or not, if all literature was covered, if methodological descriptions were clear or not, if results were transparent or not. The high methodological quality in all areas of the research of the majority of the studies [21, 23, 24, 26], was excellent and rated as “Good”. And only a few publications, such as Alamdaran et al. [22] and Anpilogova et al., [27] were rated as “Fair” owing to limited literature search and ambiguous findings presentation, respectively. Sur & Gopinathansarasa however received high scores for methodological clarity and reporting, with the exception of a clear explanation of the selection process. The matrix as a whole show that most of the selected studies were of good level, which is a reliable basis for the comparison between ultrasound and X-ray in the diagnosis of neonatal intestinal obstruction.

Data Synthesis

We synthesized data using narrative and comparative analysis, around diagnostic performance including sensitivity, specificity, time

to diagnosis and clinical utility of ultrasound and abdominal X-ray in the diagnosis of neonatal obstruction.

The quality of the included studies was generally low but overall favored ultrasonography, which has been widely found to be more sensitive and to provide earlier diagnosis, particularly for midgut volvulus and intussusception because of its capability to visualize the bowel morphologically and hemodynamically in real-time.

In contrast, X-ray was still good as a test for anatomical gross relations and for pneumoperitoneum, although frequently far from specific in early and partial occlusion.

Although there were some minor differences in methodology, the cumulative results continued to suggest that ultrasound was the more accurate and informative approach in the majority of clinical situations.

The review also emphasized a combined imaging strategy in populations where X-ray and ultrasound are both available, supporting the complementary nature of X-ray and ultrasound in neonatal neuroimaging.

Table 5: (A) Research Matrix

Author, Year	Aim	Research Design	Type of Studies Included	Data Collection Tool	Result	Conclusion	Study Supports Present Study
Guo et al., [21]	To assess the accuracy of ultrasonography in diagnosing and identifying causes of neonatal intestinal obstruction	Retrospective study	Neonates with intestinal obstruction (2009–2022)	Ultrasound vs. surgical findings	91% diagnostic accuracy for obstruction; 84% etiological accuracy	Ultrasound is a dynamic, valuable tool for diagnosing and identifying causes of neonatal intestinal obstruction	Yes
Alamdaran et al., [22]	To compare diagnostic accuracy of ultrasound vs. X-ray in children with intestinal obstruction	Analytical cross-sectional study	Pediatric patients with bowel obstruction (2019–2021)	Clinical symptoms, Ultrasound, and X-ray findings	X-ray: 72% accuracy; Ultrasound: 96.6% accuracy; 91.6% etiological diagnosis	Ultrasound is more accurate and should be preferred for diagnosis of intestinal obstruction	Yes
Elsayed & Soyly, [23]	To evaluate the role of abdominal POCUS in NICU and PICU	Review and expert opinion	Neonates and children in critical care settings	Literature-based evaluation of abdominal POCUS	POCUS showed superior diagnostic utility over X-ray in emergency settings	Abdominal POCUS is superior to X-ray and supports real-time clinical decision-making	Yes
Hassan & Oraibi, [24]	To explore the link between bilious vomiting and neonatal intestinal obstruction using imaging	Cross-sectional study	Neonates with bilious vomiting (2022–2023)	X-ray, contrast imaging, clinical diagnosis	Imaging (X-ray and contrast) helped identify small bowel atresia, meconium ileus, and anorectal malformations	Imaging findings strongly correlated with clinical diagnosis; X-ray/contrast are valuable in evaluating bilious vomiting	Partially (Supports X-ray role)
Elsayed & Seshia, [25]	To introduce an ultrasound-integrated clinical approach for gut injury management	Clinical guideline development	Neonates with NEC and gut injury	Point-of-care intestinal ultrasound (IUS)	Improved diagnostic accuracy and classification of NEC severity	IUS improves clinical management over traditional AXR	Yes

Table 5: (b) Research Matrix

Author, Year	Aim	Research Design	Type of Studies Included	Data Collection Tool	Result	Conclusion	Study Supports Present Study
Collins et al., [26]	To evaluate the role of plain abdominal X-ray in diagnosing acute pediatric abdominal conditions	Prospective observational study	Children aged 0–16 years in emergency settings	Plain abdominal X-ray	Helped diagnose intestinal obstruction, perforated viscus, intra-abdominal masses	X-ray remains relevant in diagnosing a wide range of pediatric abdominal conditions	Partially (Supports X-ray, not directly comparative)
Anpilogova et al., [27]	To compare the diagnostic capabilities of ultrasound and radiologic methods in identifying malrotation in neonates	Retrospective cohort	112 neonates and infants with suspected malrotation	Ultrasound and radiologic contrast imaging	Ultrasound identified abnormal vessel positions; radiology showed high cecum and left colon; 40 confirmed cases	Ultrasound is useful for screening but radiologic imaging still needed; both modalities are complementary	Yes
Sur & Gopinathan sarasa, [28]	To assess the feasibility of point-of-care bowel ultrasound (BUS) for diagnosing NEC in neonates	Feasibility study	Neonates with suspected NEC in NICU	Neonatologist-performed BUS vs. X-ray	BUS had higher specificity and positive predictive value than X-ray; improved diagnosis	BUS is promising for NEC assessment; adoption depends on training and support	Yes
Narang et al., [29]	To evaluate the use of plain X-ray in diagnosing neonatal gastrointestinal emergencies	Case report series	Neonates with esophageal atresia and TEF	Plain Roentgenography (babygram, chest X-ray)	Identified coiled nasogastric tubes and normal abdominal gas patterns	X-ray is essential in identifying TEF and ruling out atresia in emergency scenarios	Partially (Supports X-ray role)
Wolder et al., [30]	To explore advanced ultrasound imaging in diagnosing fetal alimentary tract obstructions	Case series	3 fetal cases with duodenal and intestinal obstruction	2D, HDlive, HDlive inversion, silhouette ultrasound	Identified double bubble and dilated bowel loops with advanced imaging	HDlive ultrasound techniques improve fetal obstruction diagnosis and guide intervention	Yes
Elsayed & Seshia, [25]	To develop an ultrasound-integrated clinical guideline for neonatal gut injury	Guideline development	NEC and other gut injuries in neonates	Point-of-care intestinal ultrasound (IUS)	Improved NEC classification and targeted management	IUS offers better precision than traditional imaging and enhances care quality	Yes
Hassan & Oraibi, [24]	To correlate bilious vomiting with neonatal obstruction and diagnostic imaging outcomes	Cross-sectional	42 neonates with bilious vomiting	X-ray and contrast imaging	Imaging helped detect atresia and malformations; X-ray and contrast were significant	Imaging plays critical diagnostic role; supports prompt intervention	Yes

The aggregate research matrix provides a "big picture" of twelve of the most important articles of ultrasound and X-ray comparison of an infant with the obstruction. In equally diverse study designs—retrospective cohorts, cross-sectional analyses, and pilot studies, studies of feasibility, clinical guidelines and expert reviews and case series—the overall orientation is that ultrasound is to be advocated for the higher level of diagnosis, the real time dynamic approach and the double shot of diagnosing not only obstruction, but also the etiology, particularly in critical neonatal diseases such as malrotation, NEC and intestinal atresia. Guo et al. [21], Alamdaran et al. [22], Elsayed and Seshia [25] is about ultrasound being superior with diagnostic

accuracy of more than 90% while Sur and Gopinathansarasa [28] is regarding clinical usefulness of ultrasound in NICU setting. In contrast, with such studies as those of Collins et al. [26] and Narang et al. [29] confirmed the ongoing relevance of X-ray to emergency incentive screening and anatomical anomalies. Anpilogova et al. [27] When suspected, recommended an approach of ultrasound for initial evaluation and radiologic methods for confirmation. In general, the matrix supports the approach taken in this study in comparing ultrasound to X-ray overall, with the ultimate conclusion that ultrasound is more effective compared to X-ray, however acknowledges the place of X-ray in the pathway for certain diagnostics

Table 6: (a) Results Indicating Themes, Sub-Themes, Trends, Explanation, and Supporting Studies

Themes	Sub-Themes	Trends	Explanation	Supporting Studies
Diagnostic Accuracy	Sensitivity and Specificity	Ultrasound shows higher sensitivity and specificity than X-ray	Ultrasound provides dynamic, high-resolution imaging that enables earlier and more precise detection of bowel abnormalities	Guo et al., [21]; Alamdaran et al., [22]; Elsayed & Seshia, [25]
	Etiological Identification	Ultrasound better identifies underlying causes of obstruction	It can detect anatomical and functional abnormalities like volvulus, intussusception, and atresia more effectively	Guo et al., [21]; Wolder et al., [30]; Anpilogova et al., [27]
Clinical Applicability	Point-of-Care Use	Ultrasound is preferred in NICU/PICU settings	Real-time, bedside ultrasound allows immediate diagnostic input in critical care environments	Elsayed & Soylu, [23]; Sur & Gopinathansarasa, [28]; Elsayed & Seshia, [25]
	Operator Dependency	Diagnostic accuracy depends on operator experience	Although valuable, ultrasound outcomes vary depending on training and experience of the practitioner	Sur & Gopinathansarasa, [28]; Elsayed & Soylu, [23]
Imaging Complementarity	Combined Use of Modalities	X-ray is still used to complement ultrasound in complex cases	Some anatomical confirmations or broader abdominal views may require X-ray, especially when ultrasound findings are inconclusive	Anpilogova et al., [27]; Hassan & Oraibi, [24]; Narang et al., [29]

Table 6: (b) Results Indicating Themes, Sub-Themes, Trends, Explanation, and Supporting Studies

Themes	Sub-Themes	Trends	Explanation	Supporting Studies
Technological Advancements	Advanced Imaging Techniques	Use of HDlive, 3D/4D ultrasound enhances prenatal and postnatal diagnosis	Newer ultrasound modalities improve visualization of gastrointestinal structures and contribute to better antenatal planning	Wolder et al., [30]; Guo et al., [21]
Emergency Responsiveness	Speed and Accessibility	Ultrasound enables faster diagnosis and intervention	Ultrasound can be performed at bedside without delay, facilitating earlier surgical or medical interventions in neonatal emergencies	Alamdaran et al., [22]; Elsayed & Soylu, [23]; Sur & Gopinathansarasa, [28]

The findings suggest that ultrasound has better diagnostic performance compared with X-ray in neonatal intestinal obstruction, and that it has higher accuracy, better performance in positioning the causal factors, and better performance with real-time detection in the ICU. Although there may be an adjunct role for X-ray in some anatomical evaluation or when an emergency is at hand, the majority of studies seem to favor ultrasound as the best diagnostic test because of its ability to provide dynamic images and its lack of invasiveness. A combination of both types might represent the most complete strategy, when facing complex or uncertain cases.

Discussion

Compared to X-ray evaluation in diagnosing neonatal intestinal obstruction, ultrasound has been found to maintain higher accuracy, in literature. Studies such as Guo et al. [21] and Alamdaran et al. [22] have presented over 90 % diagnostic accuracies of ultrasound, which are much higher than those of X-ray. These findings emphasize a reliability in the diagnosis of both the recognition and etiology of small bowel obstruction in the neonate. Due to its dynamic and real time character, and the opportunity to assess bowel movements, manager of fluid levels, and abnormalities in the anatomy, ultrasound fits into the first line imaging modality in neonatal emergency cases. Point of care ultrasonography (POCUS) holds increasing significance in ICUs. Elsayed and Soylu [23] and Sur and Gopinathansarasa [28] also proved that POCUS enables a direct bedside examination for quick clinical decision. This is especially important in the neonatal ICU setting where timely diagnosis may alter morbidity and mortality. POCUS is an effective but operator-dependent tool with influence on training and competency. Plain abdominal radiography, in comparison, which is historically considered a building block, is currently seen as relatively insensitive and nonspecific. Studies like Collins et al. [26] and Narang et al. [29] noted that X-ray still had a role for some anatomical surveys and emergencies, particularly when US was not available. Nevertheless, these cases also emphasize the potential misdiagnosis or delayed recognition when X-ray is performed alone. It has also been useful in the diagnosis of the underlying causes of malrotation and midgut volvulus, which are considered to be surgical emergencies. Anpilogova et al. [27] proved that ultrasound is more effective as regards the detection of abnormal position of the mesenteric vessels, and the speed of timely diagnosis. The advance of sonographic techniques such as HDlive which enhances visualization of the fetal abdomen; or silhouette imaging [30] have improved the prenatal and neonatal

assessment of obstructive lesions of the intestine and the earlier therapeutic intervention. Furthermore, integration of ultrasound into clinical algorithms has been advocated for better management of gut injuries, such as NEC. Elsayed and Seshia [25] made a case for an ultrasound-guided diagnostic pathway to stratify classification of NEC, and appears to differentiate it more effectively from other gut pathologies. These results demonstrate that ultrasound is not only beneficial as a diagnostic technique but also very helpful in the monitoring of patients and in the management of the cystic tumor. Notwithstanding the evidence in support of ultrasound, the studies discussed above also highlight the methodology of multimodal diagnosis. For complex or equivocal findings, a combination of ultrasound and X-ray or contrast imaging can be more definitive in diagnostic clarity [24]. This multidisciplinary imaging approach may provide the best diagnostic return, particularly in low-resource or high-risk clinical settings.

Future Direction

Prospective studies are needed Standardized training for the clinical use of neonatal point of care ultrasound must be implemented. There is further requirement of longitudinal studies to evaluate the effects of early ultrasound diagnosis on long term surgical and developmental outcomes. Incorporating AI into the interpretation of ultrasound may help to improve diagnostic accuracy and reduce variability associated with operator performance.

Limitations

The heterogeneity of sample sizes, methodologies and geographical areas in included studies narrowed the generalization of the findings. Some studies were based on retrospective data and could have introduced bias. Moreover, only a very small number of earlier studies directly compared USG and X-ray in prospective, controlled environment, emphasizing the necessity for more robust comparative studies.

Conclusion

Ultrasound is superior to X-ray in the diagnosis of neonatal intestinal obstruction and reflects an accurate, rapid, and clinically useful imaging modality. Its functionality, its portability and its increasing role in critical care seem to make it preferable in most clinical settings. Nonetheless, an adjunctive application of imaging techniques, particularly in the setting of complex cases, guarantees diagnostic confidence and improved clinical outcomes for neonates.

References

- [1] D. A. Rodriguez, G. Dahlwi, M. Gould, M. Marcon, and M. Benninga, "The Diagnostic Accuracy of Abdominal X-ray in Childhood Constipation: A Systematic Review of the Literature," *Gastrointestinal Disorders*, vol. 6, no. 1, pp. 94-102, 2024.
- [2] M. M. Zahid, S. Mehmood, A. Tariq, K. Ahmed, I. Arshad, and T. Naz, "Causes and Clinical Presentations in Newborns with Abdominal Distention in Early Days of Life," in *Medical Forum Monthly*; 2023, vol. 34, no. 7.
- [3] L. Yu, C. Liu, Y. Cui, L. Xue, and L. Ma, "Imaging manifestations of neonatal necrotizing enterocolitis to predict timing of surgery," *The Turkish Journal of Pediatrics*, vol. 64, no. 4, pp. 632-639, 2022.

- [4] A. E. Popa *et al.*, "Current Trends in the Imaging Diagnosis of Neonatal Respiratory Distress Syndrome (NRDS): Chest X-ray Versus Lung Ultrasound," *Cureus*, vol. 16, no. 9, 2024.
- [5] S. Xiong *et al.*, "Duodenal obstruction due to two congenital bands: a case report and literature review," *Frontiers in Pediatrics*, vol. 13, p. 1491520, 2025.
- [6] V. C. Dang, P. N. Tran, M. C. Tran, V. T. Pham, and T. N. Nguyen, "Intestinal obstruction due to ligament arising from the distal end of Meckel's diverticulum: A case report," *Clinical Case Reports*, vol. 11, no. 6, p. e7608, 2023.
- [7] S. Ahmed, B. Dilawar, S. Moeen, S. Dilawar, H. Sheikh, and M. A. Arain, "Abdominal kaposiform hemangioendothelioma presenting as volvulus and recurring intestinal obstruction in a neonate: a case report," *Journal of Medical Case Reports*, vol. 18, no. 1, p. 619, 2024.
- [8] M. Kurashima, C. Nahal, C. Saliba, R. Okeke, and S. Miyata, "Intestinal obstruction due to a congenital mesenteric hernia in a newborn with cystic fibrosis: A case report," *Journal of Pediatric Surgery Case Reports*, vol. 107, p. 102824, 2024.
- [9] H. H. A. Almoamin, S. H. Kadhém, and A. M. Saleh, "Annular pancreas in neonates; case series and review of literatures," *African Journal of Paediatric Surgery*, vol. 19, no. 2, pp. 97-101, 2022.
- [10] V. Maddileti, A. Mammen, and S. Kuruvilla, "Neonatal intestinal obstruction due to kaposiform hemangioendothelioma of the jejunum," *ACG Case Reports Journal*, vol. 9, no. 2, p. e00749, 2022.
- [11] C. Gu, Y. Zhang, G. Jiang, and X. Hu, "Diagnosis of small bowel obstruction due to Shine-Muscat grape ingestion: case report," *Frontiers in Pediatrics*, vol. 12, p. 1503456, 2024.
- [12] S.-H. Yoon *et al.*, "Surgical Treatment for Neonatal Torsion of Prenatally Diagnosed Ovarian Cyst: Report of Two Cases and Literature Review," *Perinatology*, vol. 33, no. 1, pp. 58-63, 2022.
- [13] J. Lodhia, H. Chipongo, B. Mathew, D. Msuya, S. Chugulu, and R. Philemon, "Midgut atresia: diagnostic and management challenges from Northern Tanzania," *Clinical Medicine Insights: Pediatrics*, vol. 16, p. 11795565221142810, 2022.
- [14] O. L. I. Patricia, O. N. C. Princilia, G.-N. P. Eric, C. Mboutol-Mandavo, B. M. R. Hélène, and A. N. Erica, "Neonatal Intestinal Obstruction in Acute Renal Failure in Premature Infant: A Case Report," *Open Journal of Pediatrics*, vol. 14, no. 2, pp. 338-343, 2024.
- [15] A. Ibragimov and J. Sattarov, "ANATOMICAL FORMS AND FEATURES OF THE CLINICAL COURSE OF PARTIAL INTESTINAL OBSTRUCTION IN NEWBORNS AND INFANTS," *Science and innovation*, vol. 2, no. D11, pp. 263-267, 2023.
- [16] A. Radi, "Intestinal Obstruction by Congenital Duodenal Diaphragm in a 6-Month Infant-Case Report," *EC Paediatrics*, vol. 13, pp. 01-05, 2024.
- [17] T. P. TRiPaThy, R. PaTel, S. K. MOHANTY, and S. P. MOHANTY, "Ileocolic Intussusception in an Infant with Ileal Duplication Cyst as a Lead Point-A Case Report," *Journal of Clinical & Diagnostic Research*, vol. 15, no. 7, 2021.
- [18] D. L. Stewart, Y. Elsayed, M. V. Fraga, B. D. Coley, A. Annam, and S. S. Milla, "Use of point-of-care ultrasonography in the NICU for diagnostic and procedural purposes," *Pediatrics*, vol. 150, no. 6, p. e2022060053, 2022.
- [19] S. N. Maham, S. Ahmad, M. J. Afzal, and N. Talat, "Congenital hepatic hemangioma presenting with neonatal intestinal obstruction: A case report," *Journal of Neonatal Surgery*, vol. 10, 2021.
- [20] N. Liaqat, R. M. Imran, and A. Mahomed, "Auto-amputated ovary-rare cause of intestinal obstruction in a neonate: A case report," *Journal of Neonatal Surgery*, vol. 10, 2021.
- [21] B. Guo, L. Pang, C. Liu, X. Chen, Q. Qiao, and C. Zhang, "Ultrasonic diagnosis of intestinal obstruction in neonates-original article," *Diagnostics*, vol. 13, no. 5, p. 995, 2023.
- [22] S. A. Alamdaran, M. Yazdanparast, F. Dadelahi, A. Mohtasham, V. Ganbari, and A. Mohammadipour, "Bowel Obstruction in Children; Ultrasound or Abdominal X-ray?," *Journal of Pediatric Perspectives*, vol. 11, no. 6, pp. 17878-17886, 2023.
- [23] Y. Elsayed and H. Soyulu, "Point-of-care abdominal ultrasound in pediatric and neonatal intensive care units," *European Journal of Pediatrics*, vol. 183, no. 5, pp. 2059-2069, 2024.
- [24] H. N. Hassan and A. H. Oraibi, "Neonatal Bilious Vomiting as a Predictor for Neonatal Intestinal Obstruction," *Iranian Journal of Neonatology*, vol. 16, no. 2, 2025.
- [25] Y. Elsayed and M. Seshia, "A new intestinal ultrasound integrated approach for the management of neonatal gut injury," *European journal of pediatrics*, vol. 181, no. 4, pp. 1739-1749, 2022.
- [26] N. C. Collins *et al.*, "Role of Plain Abdominal X-Ray in the Differential Diagnosis of Common Acute Abdominal Conditions in Children at Olabisi Onabanjo University Teaching Hospital, Sagamu, Ogun State, Nigeria," *Open Journal of Radiology*, vol. 13, no. 3, pp. 125-133, 2023.
- [27] K. S. Anpilogova, Y. A. Filin, E. V. Polyakova, A. A. Sukhotskaya, K. I. Sebelev, and G. E. Trufanov, "Intestinal malrotation in newborns and infants: comparative possibilities of ultrasound and radiologic methods of investigation," *Russian Military Medical Academy Reports*, vol. 43, no. 3, pp. 251-259, 2024.
- [28] A. Sur and N. Gopinathansarasa, "Use of point of care bowel ultrasound (BUS) for diagnosis of suspected necrotizing enterocolitis (NEC): A feasibility study," *Journal of the Intensive Care Society*, p. 17511437251346376, 2025.
- [29] R. Narang, V. Manchanda, and P. Kumar, "Plain Roentgenography in Diagnosing Neonatal Gastrointestinal Emergencies," *Indian Pediatrics Case Reports*, vol. 5, no. 2, pp. 119-124, 2025.
- [30] D. Wolder *et al.*, "Enhanced diagnostic capabilities: Ultrasound imaging of fetal alimentary tract obstruction with advanced imaging technologies," *The American Journal of Case Reports*, vol. 25, pp. e943419-1, 2024.



This is an open-access article distributed under the terms of the Creative Commons Attribution License.