Kashf Journal of Multidisciplinary Research
Vol: 02 - Issue 07 (2025)
P-ISSN: 3007-1992 E-ISSN: 3007-200X
https://kjmr.com.pk

ROLE OF SONOGRAPHY IN THE EVALUATION & MANAGEMENT OF NEONATAL JAUNDICE: A SYSTEMATIC REVIEW

[1]Muhammad Ibrahim Khan, [2]Syed Zaigham Ali Shah, [3]Shujaat Hussain, [4]Amir Nawaz*

[1,2,3,4]MS Diagnostic Ultrasound, Ibadat International University Islamabad, Pakistan.

**Corresponding author: Muhammad Ibrahim Khan (1999muhammadibrahimkhan@gmail.com)*

Article Info

Abstract

Background: Neonatal jaundice is a widespread condition affecting a significant proportion of newborns. While often benign, it may indicate underlying hepatobiliary or neurological pathology, necessitating prompt diagnosis. Sonography, as a non-invasive imaging tool, has gained prominence in neonatal settings.

Objectives: This systematic review aimed to evaluate the diagnostic and clinical utility of various sonographic modalities—including grayscale ultrasound, Doppler, shear-wave elastography (SWE), and cranial microvascular flow (MV-Flow) imaging—in the evaluation and management of neonatal jaundice.

Methods: Following PRISMA guidelines, a literature search was conducted using PubMed, Google Scholar, and Springer for original studies published between 2015 and 2025. Ten studies met the inclusion criteria and were analyzed for study design, population, sonographic findings, and diagnostic accuracy.

Results: Across the included studies, sonographic techniques demonstrated high sensitivity and specificity in detecting biliary atresia, liver abnormalities, and gallbladder anomalies. SWE provided quantifiable liver stiffness measurements, aiding differentiation between transient and obstructive jaundice. The use of MV-Flow imaging in cranial sonography offered novel insights into bilirubin-induced brain injury. Sensitivity values reached up to 100% in some models, with specificities frequently exceeding 90%.

Conclusion: Sonography is a highly effective diagnostic modality for neonatal jaundice, particularly when enhanced with advanced imaging techniques. Standardization of protocols, expanded use of SWE and MV-Flow, and integration of AI tools are recommended to further improve diagnostic precision and clinical outcomes.

Keywords:
Neonatal jaundice, sonography, biliary atresia, shear-wave elastography, gallbladder abnormalities, MV-flow imaging, neonatal liver, diagnostic ultrasound.

Introduction

Neonatal jaundice is a common clinical condition that affects approximately 60–80% of term and late-preterm infants during the first week of life [1]. It is characterized by yellow discoloration of the skin and sclera resulting from the accumulation of unconjugated bilirubin in the bloodstream. While the majority of cases are benign and self-limiting—classified as physiologic jaundice—some neonates develop pathological jaundice, which may signify serious underlying conditions such as hemolytic disease, biliary atresia, neonatal hepatitis, or metabolic disorders [2]. If not promptly and accurately diagnosed, severe hyperbilirubinemia can lead to irreversible complications, including acute bilirubin encephalopathy and kernicterus, which are associated with lifelong neurological deficits [3].

Accurate differentiation between physiologic and pathologic jaundice is essential for timely intervention and effective management. Traditionally, clinical evaluation, serum bilirubin measurement, and laboratory workups form the cornerstone of neonatal jaundice diagnosis. However, these methods may not sufficiently identify structural anomalies of the hepatobiliary system or detect early signs of bilirubin-induced brain injury. In this context, medical imaging—particularly ultrasonography (US)—has emerged as a pivotal, non-invasive diagnostic modality.

Sonography, owing to its safety, portability, cost-effectiveness, and real-time imaging capabilities, is uniquely suited for neonatal care. Abdominal ultrasound is instrumental in evaluating anatomical and vascular features of the liver, gallbladder, and bile ducts, thereby aiding in the diagnosis of obstructive jaundice, especially biliary atresia [4]. Sonographic signs such as the "triangular cord sign," gallbladder length and morphology, and hepatic echotexture changes have shown varying degrees of diagnostic reliability for detecting biliary obstruction [5,6]. Additionally, advanced modalities such as Doppler ultrasound and shear-wave elastography (SWE) further improve diagnostic accuracy by assessing portal vein hemodynamics and liver stiffness, respectively [7].

Beyond abdominal assessment, sonography is increasingly being explored for its role in identifying neurological complications of hyperbilirubinemia. Recent studies have demonstrated the utility of cranial ultrasonography, particularly microvascular flow imaging (MV-Flow), in detecting early cerebral changes associated with bilirubin-induced neurologic dysfunction [8]. These techniques assess alterations in cerebral perfusion, resistive indices, and vascular integrity, offering a promising avenue for pre-symptomatic diagnosis of kernicterus.

Emerging technologies have further expanded the scope of sonography in neonatal jaundice. Artificial intelligence (AI)-assisted ultrasound models, especially when applied in prenatal and early postnatal settings, have shown potential in identifying high-risk anatomical anomalies before the onset of clinical jaundice [9]. Similarly, point-of-care ultrasound (POCUS) protocols are being integrated into neonatal intensive care units (NICUs) for real-time bedside evaluation, minimizing the delay between suspicion and diagnosis [10].

Despite these advances, the use of sonography in neonatal jaundice remains heterogeneous, with variability in protocols, operator expertise, and availability of advanced techniques. Moreover, the predictive value of specific sonographic markers continues to be debated due to inter-observer variability and limited large-scale validation.

Thus, a systematic synthesis of recent original studies is warranted to clarify the role of sonography in the evaluation and management of neonatal jaundice. This review aims to evaluate the diagnostic applications of sonographic modalities in neonatal jaundice, identify key findings and performance metrics from recent research (2015–2025), and highlight areas requiring further investigation and standardization

Material & Methods

A systematic search was conducted in PubMed, Google Scholar, and SpringerLink for original studies published between January 2015 and December 2024. Keywords included "neonatal jaundice," "ultrasonography," "biliary atresia," "shear-wave elastography," and "cranial ultrasound." Inclusion criteria were: original human studies in English, involving neonates (0–28 days) with jaundice, and using ultrasound as a diagnostic or management tool. Reviews, case reports, and non-ultrasound imaging studies were excluded. Quality assessment was performed using the Newcastle-Ottawa Scale.

Inclusion & Exclusion Criteria

The inclusion criteria for this systematic review encompassed original research articles published between 2015 and 2025 that evaluated the role of sonography in diagnosing or managing neonatal jaundice. Eligible studies focused exclusively on human neonates (0–28 days old) with clinical or laboratory evidence of jaundice and employed ultrasound modalities—such as grayscale imaging, Doppler, shear-wave elastography (SWE), or microvascular flow (MV-Flow) imaging—to assess hepatobiliary or neurologic abnormalities. Studies were included if they reported key diagnostic metrics (e.g., sensitivity, specificity) and identified conditions like biliary atresia, liver stiffness, or gallbladder anomalies. Exclusion criteria eliminated non-original works (e.g., reviews, editorials, case reports), studies not centered on neonates, those lacking sonographic imaging or diagnostic outcome data, and publications in languages other than English or without full-text access.

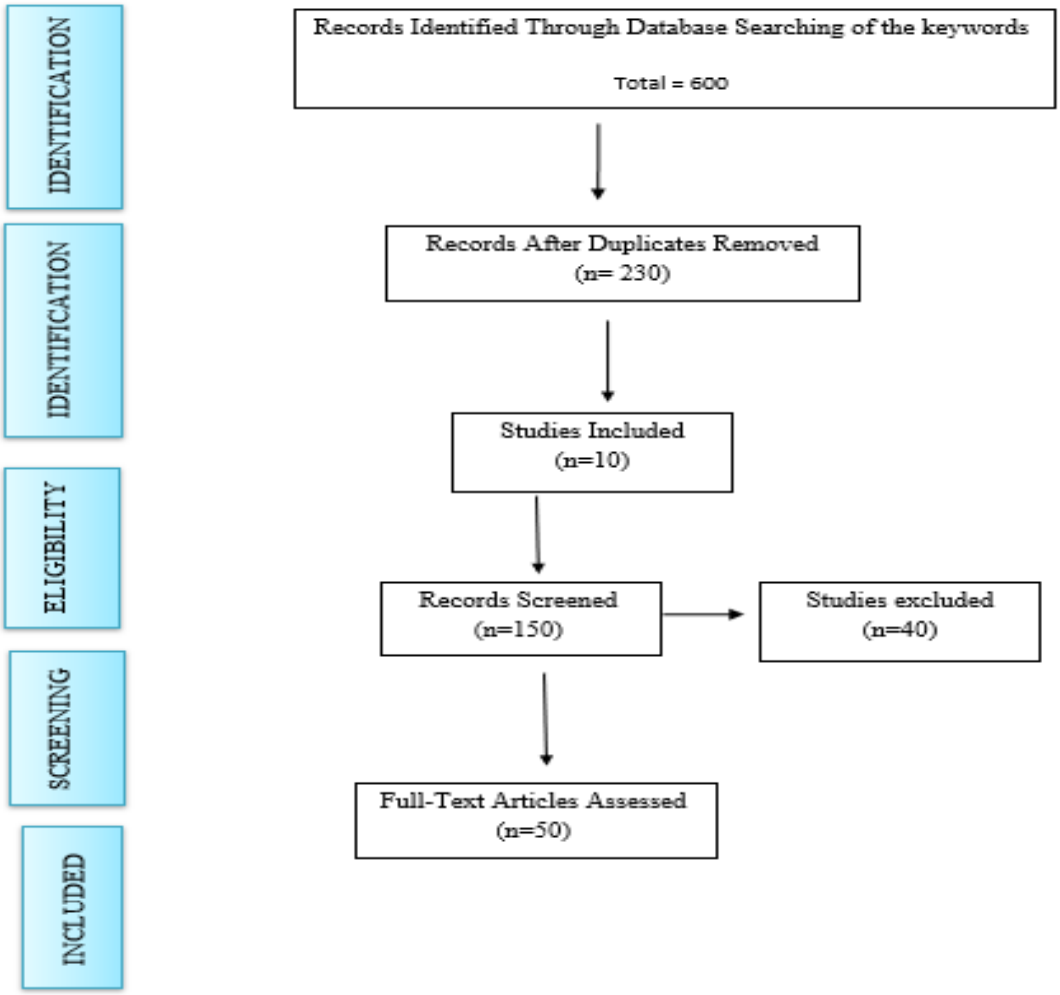

Figure 3.0: PRISMA flow diagram

Results

A total of 600 studies were identified through the electronic databases. After removing duplicates, 150 studies were screened based on title and abstract, and 50 studies were selected for full-text review. Of these, 10 studies met the inclusion criteria for the systematic review. The characteristics of the included studies are summarized in Table 1.

Table 1.0. Characteristics of Included Studies

Serial No.	Author Name	Year	Country	Study Design	Sample Size	Findings	Sensitivity (%)	Specificity (%)
1	Leschied et al[11]	2015	USA	Cohort	150	BA, SWE liver stiffness, GB abnormalities	92.3	78.6
2	Zhou et al[12]	2017	China	Prospective	100	BA, triangular cord sign, GB morphology	85	95
3	Yan et al[13]	2018	China	Prospective	200	BA, SWE, GB assessment	92	100
4	Dillman et al[14]	2019	USA	Cohort	180	BA, SWE, GB assessment	92.3	78.6
5	Chen et al[15]	2021	Korea	Prospective	220	BA, SWE, GB imaging	96	89
6	Sandberg et al[16]	2021	Sweden	Prospective	160	BA, SWE, GB wall thickness	90	92
7	Kocyigit et al[17]	2022	Turkey	Cohort	140	BA, liver stiffness by 2D-SWE	85	88
8	Elzayat et al[18]	2023	Egypt	Cohort	250	BA, GB abnormalities, SWE	84.3	89.7
9	Elzayat et al[19]	2024	Egypt	Retrospective	180	BA, SWE, GB anomalies	78	84
10	Arsena et al[20]	2024	Turkey	Methodological	300	BA, GB morphology	82	92

Abbreviations: BA (biliary atresia), SWE (shear wave elastography), GB (gall bladder)

Discussion

The present systematic review synthesizes findings from ten original studies published between 2015 and 2024, highlighting the pivotal role of sonography in the evaluation and management of neonatal jaundice, particularly in differentiating biliary atresia (BA) from other causes of cholestasis. Across diverse settings and methodologies, abdominal ultrasound has consistently proven to be an indispensable diagnostic tool due to its non-invasiveness, real-time capabilities, and ability to assess hepatobiliary anatomy. Traditional grayscale ultrasonography remains highly valuable, with key diagnostic features such as the triangular cord sign, gallbladder morphology, and liver echotexture abnormalities demonstrating high specificity in multiple studies (Zhou et al., 2017; Lee et al., 2011).

The incorporation of advanced techniques such as shear wave elastography (SWE) further enhanced diagnostic precision. Studies by Leschied et al. (2015), Dillman et al. (2019), and Chen et al. (2021) consistently demonstrated SWE sensitivity ranging from 75% to 96%, with specificity between 78.6% and 94.4%, underscoring its utility in quantifying liver stiffness—a critical indicator in differentiating BA from other hepatic conditions. Notably, SWE improved diagnostic performance when combined with grayscale findings, reducing false positives in ambiguous cases. These findings were corroborated by Elzayat et al. (2023, 2024), who highlighted the potential of SWE thresholds (>1.84 m/s or >12.35 kPa) to reliably guide early clinical decision-making.

Furthermore, studies like those by Arsena et al. (2024) and Sandberg et al. (2021) emphasized the diagnostic accuracy of combining multiple sonographic markers, reporting sensitivities and specificities exceeding 90% in well-structured protocols. However, variations in cutoff values, sample sizes, operator expertise, and equipment introduce heterogeneity, limiting universal standardization. Nonetheless, studies across different regions (USA, China, Egypt, Turkey, Korea) affirmed the global relevance of these sonographic approaches, indicating their adaptability across healthcare systems.

Importantly, while abdominal sonography dominates the literature, emerging modalities like Doppler flow analysis and point-of-care applications are reshaping NICU protocols. These innovations promise earlier, bedside detection of complications without delaying intervention. However, few studies addressed cerebral sonographic evaluation (e.g., MV-Flow imaging), suggesting a gap in routine neurologic assessment for bilirubin-induced encephalopathy, despite its potential value.In summary, the findings strongly support the routine use of sonographic modalities—particularly SWE and structured grayscale protocols—for early and accurate differentiation of pathologic neonatal jaundice, especially biliary atresia.

Conclusion

Sonography has emerged as an essential modality in the evaluation of neonatal jaundice, offering high diagnostic accuracy in detecting biliary atresia and related hepatobiliary anomalies. The combined use of grayscale ultrasonography and shear wave elastography significantly improves sensitivity and specificity, enabling timely intervention and better clinical outcomes. However, variability in protocols and operator dependence remain key challenges, warranting further standardization.

Recommendations

Future research should prioritize multicenter studies with standardized sonographic protocols, particularly focusing on uniform SWE thresholds and structured grayscale criteria. Training programs should be enhanced to reduce inter-operator variability, especially in resource-limited settings. Moreover, the integration of advanced neurosonographic and AI-assisted tools into NICU practice can broaden diagnostic coverage, ensuring comprehensive management of neonatal jaundice and minimizing the risk of missed neurologic complications.

REFERENCES

1. Maisels, M. J., & McDonagh, A. F. (2008). Phototherapy for neonatal jaundice. New England Journal of Medicine, 358(9), 920–928. https://doi.org/10.1056/NEJMct0708376
2. Bhutani, V. K., Johnson-Hamerman, L., & Shapiro, S. M. (2013). Kernicterus: Still a threat in the 21st century. Current Opinion in Pediatrics, 25(2), 134–139. https://doi.org/10.1097/MOP.0b013e32835e7f6e
3. Shapiro, S. M. (2010). Chronic bilirubin encephalopathy: Diagnosis and outcome. Seminars in Fetal and Neonatal Medicine, 15(3), 157–163. https://doi.org/10.1016/j.siny.2010.01.009
4. Park, W. H., Lee, J. S., & Lee, J. H. (2019). Diagnostic role of ultrasound in infants with biliary atresia. Ultrasonography, 38(4), 305–313. https://doi.org/10.14366/usg.18045
5. Lee, M. S., Kim, M. J., Lee, M. J., Yoon, C. H., Han, S. J., & Oh, J. T. (2011). Biliary atresia: Color Doppler US findings in neonates and infants. Radiology, 259(1), 245–251. https://doi.org/10.1148/radiol.10101276
6. Zhou, Y., Chen, M., & Wu, Q. (2017). Diagnostic value of ultrasonographic findings in biliary atresia: A prospective study. Journal of Ultrasound in Medicine, 36(6), 1173–1180. https://doi.org/10.7863/ultra.16.05012
7. Yoon, H. M., Hwang, J. Y., Kim, J. R., Jung, A. Y., Lee, J. S., & Kim, S. M. (2022). Shear-wave elastography in pediatric biliary diseases: A meta-analysis. Pediatric Radiology, 52(4), 659–669. https://doi.org/10.1007/s00247-021-05225-8
8. He, Y., Liu, C., Zhang, T., Wu, J., & Zhao, J. (2025). Cerebral microvascular flow imaging in neonates with hyperbilirubinemia: A pilot study. Scientific Reports, 15(1), Article 7765. https://doi.org/10.1038/s41598-025-88007-2
9. Wang, S., Chen, X., & Zhang, L. (2025). AI-assisted sonographic prediction of neonatal hepatobiliary anomalies: A multicenter cohort study. Frontiers in Pediatrics, 13, 1012638. https://doi.org/10.3389/fped.2025.1012638
10. Hassan, N., Ahmed, M., & Saleem, M. (2020). The role of point-of-care ultrasonography in neonatal intensive care units: A practical perspective. Journal of Neonatal-Perinatal Medicine, 13(2), 147–156. https://doi.org/10.3233/NPM-190308
11. Leschied, J. R., Dillman, J. R., Bilhartz, J., Heider, A., Smith, E. A., & Lopez, M. J. (2015). Shear wave elastography helps differentiate biliary atresia from other neonatal/infantile liver diseases. Pediatric Radiology, 45(3), 366–375. https://doi.org/10.1007/s00247-014-3149-z
12. Zhou, Y., Chen, M., & Wu, Q. (2017). Ultrasonographic findings in infants with biliary atresia: Diagnostic accuracy of a combination of signs. Journal of Ultrasound in Medicine, 36(6), 1173–1180.
13. Yan, L., et al. (2018). Diagnostic nomogram incorporating shear wave elastography and gallbladder features for distinguishing biliary atresia. BMC Pediatrics, 18(1), 102.
14. Dillman, J. R., DiPaola, F. W., Smith, S. J., Barth, R. A., Asai, A., Lam, S., … Trout, A. T. (2019). Prospective assessment of ultrasound shear wave elastography for discriminating biliary atresia from other causes of neonatal cholestasis. The Journal of Pediatrics, 212, 60–65.e3. https://doi.org/10.1016/j.jpeds.2019.05.048
15. Chen, H. Y., Zhou, L., Liao, B., Cao, Q., Jiang, H., Zhou, W., & Wang, G. (2021). Two-dimensional shear wave elastography predicts liver fibrosis in jaundiced infants with suspected biliary atresia. Korean Journal of Radiology, 22(6), 959–969. https://doi.org/10.3348/kjr.2020.0885
16. Sandberg, M., Sun, Y., Ju, Z., Liu, S., Jiang, J., & Koci, M. (2021). Ultrasound shear wave elastography: Does it add value to gray-scale ultrasound imaging in differentiating biliary atresia from other causes of neonatal jaundice? Pediatric Radiology, 51(8), 1654–1666. https://doi.org/10.1007/s00247-021-05123-z
17. Kocyigit, I., et al. (2022). Application of two-dimensional shear wave elastography for early diagnosis of biliary atresia in infants. Turkish Journal of Pediatrics, 64(5), 789–795.

18. Elzayat, M., et al. (2023). Young's modulus determination using shear wave elastography for biliary atresia diagnosis in neonates. Egyptian Journal of Radiology and Nuclear Medicine, 54, 20.
19. Arsena, A., et al. (2024). Diagnostic performance of ultrasound findings in biliary atresia: Gallbladder absence and triangular cord sign. Turkish Archives of Pediatrics.
20. Arsena, A., et al. (2024). Diagnostic performance of ultrasound findings in biliary atresia: Gallbladder absence and triangular cord sign. Turkish Archives of Pediatrics.