The Research of Medical Science Review
ISSN: 3007-1208 & 3007-1216 Volume 3, Issue 5, 2025

DIAGNOSTIC ACCURACY OF OCULAR ULTRASOUND IN DETECTION OF RETINAL DETACHMENT: A SYSTEMATIC REVIEW

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DOI: https://doi.org/10.5281/zenodo.15423382

Keywords
Ocular ultrasound, Retinal detachment, Diagnostic accuracy, Sensitivity, Specificity, Emergency ultrasound, Point-of-care ultrasound

Article History
Received on 07 April 2025
Accepted on 07 May 2025
Published on 15 May 2025

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Abstract

Background:
Retinal detachment (RD) is an ophthalmic emergency requiring prompt diagnosis and intervention to prevent permanent vision loss. Ocular ultrasound (OUS), especially point-of-care ultrasound (POCUS), has emerged as a valuable diagnostic tool in cases where direct ophthalmoscopic evaluation is limited or not feasible.

Methods: *A comprehensive literature search was conducted using databases including PubMed, Google Scholar, Scopus, CINAHL, and LILACS. From 493 initially identified records, 10 studies met the inclusion criteria after screening and duplicate removal. These studies assessed the diagnostic performance of OUS in RD detection using standard statistical measures, typically at a 95% confidence level.*

Results: *The included studies shows the Diagnostic accuracy ranged from 91% to 99.8%, sensitivity from 66.7% to 100%, and specificity from 67.9% to 99%. The PPV and NPV also varied widely, with NPV consistently high (90.1%–100%), indicating a strong ability to rule out RD when ultrasound findings were negative. Six studies reported 100% sensitivity, underscoring the reliability of OUS in emergency and clinical settings.*

Conclusion: *Ocular ultrasound demonstrates high diagnostic accuracy and sensitivity for detecting retinal detachment, supporting its use as an initial diagnostic modality, especially in emergency or resource-limited settings..*

INTRODUCTION

Retinal detachment (RD) is a serious ophthalmic condition that can lead to permanent vision loss if not diagnosed and treated promptly. It involves the separation of the neurosensory retina from the underlying retinal pigment epithelium, disrupting the visual pathway and resulting in a medical emergency that requires timely intervention, often surgical, to preserve visual function[1]. Clinical diagnosis of RD is traditionally achieved through direct and indirect ophthalmoscopy. However, in many emergency or resource-limited settings, direct visualization of the retina may be hindered by factors such as media

opacities (e.g., cataract, vitreous hemorrhage, corneal edema) or patient non-cooperation. In such cases, ocular ultrasonography, particularly B-scan ultrasound, provides a non-invasive, rapid, and bedside alternative for posterior segment evaluation[2]. B-scan ultrasound allows real-time imaging of intraocular structures and has been increasingly adopted in emergency departments, intensive care units, and preoperative settings. Several studies have demonstrated the utility of ocular ultrasound in detecting retinal detachment, reporting high sensitivity and specificity rates[3]. However, diagnostic accuracy may vary depending on the operator's skill level, the quality of ultrasound equipment, and the clinical setting[4]. Given the increasing reliance on point-of-care ultrasound (POCUS) and the variability of reported diagnostic outcomes, a systematic evaluation of the literature is essential to establish the true diagnostic accuracy of ocular ultrasound for RD detection. This information can support evidence-based practice, guide ultrasound training programs, and inform clinical decision-making in both ophthalmologic and non-ophthalmologic contexts. This PRISMA-compliant systematic review aims to synthesize current evidence on the diagnostic accuracy of ocular ultrasound in the detection of retinal detachment, evaluating key parameters such as sensitivity, specificity, and overall diagnostic performance across diverse patient populations and clinical environments. Ocular complaints are common presentations to the emergency department (ED), accounting for a substantial proportion of acute visits and requiring prompt evaluation to prevent vision-threatening complications. Among these, retinal detachment (RD) represents a serious ophthalmic emergency, where the neurosensory retina becomes separated from the retinal pigment epithelium, disrupting normal phototransduction and potentially leading to irreversible vision loss if not identified and managed in a timely manner[5].Traditionally, the diagnosis of RD relies on direct and indirect ophthalmoscopy, typically performed by ophthalmologists. However, in many emergency or resource-limited settings, accurate fundoscopic examination is often challenged by media opacities such as cataracts, vitreous hemorrhage, or corneal edema, as well as patient non-cooperation or lack of specialist availability[3]. These limitations underscore the growing importance of ocular ultrasonography, particularly B-scan ultrasonography, as a non-invasive, real-time, and bedside tool for evaluating the posterior segment of the eye. Recent advances have facilitated the integration of point-of-care ultrasound (POCUS) into emergency and critical care settings, with ocular ultrasound being increasingly used for the rapid detection of RD, vitreous hemorrhage, intraocular foreign bodies, and other posterior segment pathologies[6]. Numerous studies have reported high sensitivity and specificity of ocular ultrasound in detecting RD, with several reporting diagnostic accuracy exceeding 90%[7,8]. Nevertheless, operator dependency, variability in ultrasound training, and the quality of sonographic equipment remain key factors that may affect diagnostic performance[9,10].

METHOD AND MATERIAL

Study Design

This study is a systematic review conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines but does not include a meta-analysis. The aim was to evaluate the diagnostic accuracy, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of ocular ultrasound (OUS) in the detection of retinal detachment (RD).

Search Strategy

A comprehensive literature search was performed in the following databases: PubMed, Google Scholar, Scopus, CINAHL, LILACS. The search was conducted using combinations of the following keywords terms: "ocular ultrasound," "retinal detachment," "point-of-care ultrasound," "diagnostic accuracy," "sensitivity," and "specificity." Boolean operators such as AND, OR were used to refine the search strategy.

Inclusion and Exclusion Criteria

Articles published up to April 2025 were included. Original research articles evaluating the diagnostic accuracy of ocular ultrasound for RD. Studies reporting at least one of the following: accuracy, sensitivity, specificity, PPV, NPV. Human studies in English. Full-text articles available. The excluded are

case reports, editorials, review articles, and conference abstracts. Non-English studies without available translations. Studies that did not clearly differentiate RD from other posterior segment pathologies.

RESULTS

Study Selection:

A total of 493 studies were initially identified. After removing duplicates and screening titles and abstracts, 32 studies were selected for full-text review. Finally, 10 studies met the inclusion criteria and were included in this review. The screening process followed PRISMA guidelines (see Figure 1 – PRISMA Flow Diagram). From 493 identified records through Google scholar yielded 420 studies, PubMed identified 50 studies, Scopus identified 8 studies, and CINAHL found 9 studies, LILACS found 5. After removing duplicates and meeting the inclusion criteria after screening 10 studies met the criteria for selection. These studies evaluated the diagnostic accuracy, specificity and sensitivity of ocular ultrasound for detection of retinal detachment at 95% confidence level.

Data Extraction and Quality Assessment:

Data extracted from each study included: Author(s) and year of publication, Sample size, Diagnostic accuracy (%), Sensitivity (ST), Specificity (SP), Positive Predictive Value (PPV), Negative Predictive Value (NPV). The QUADAS-2 (Quality Assessment of Diagnostic Accuracy Studies) tool was used to assess the methodological quality and risk of bias of included studies [2]. Quality assessment were performed independently by two reviewers SN and MZ. Due to heterogeneity in study designs, operator expertise, and diagnostic criteria, a meta-analysis was not conducted. Descriptive analysis was used to summarize diagnostic accuracy parameters.

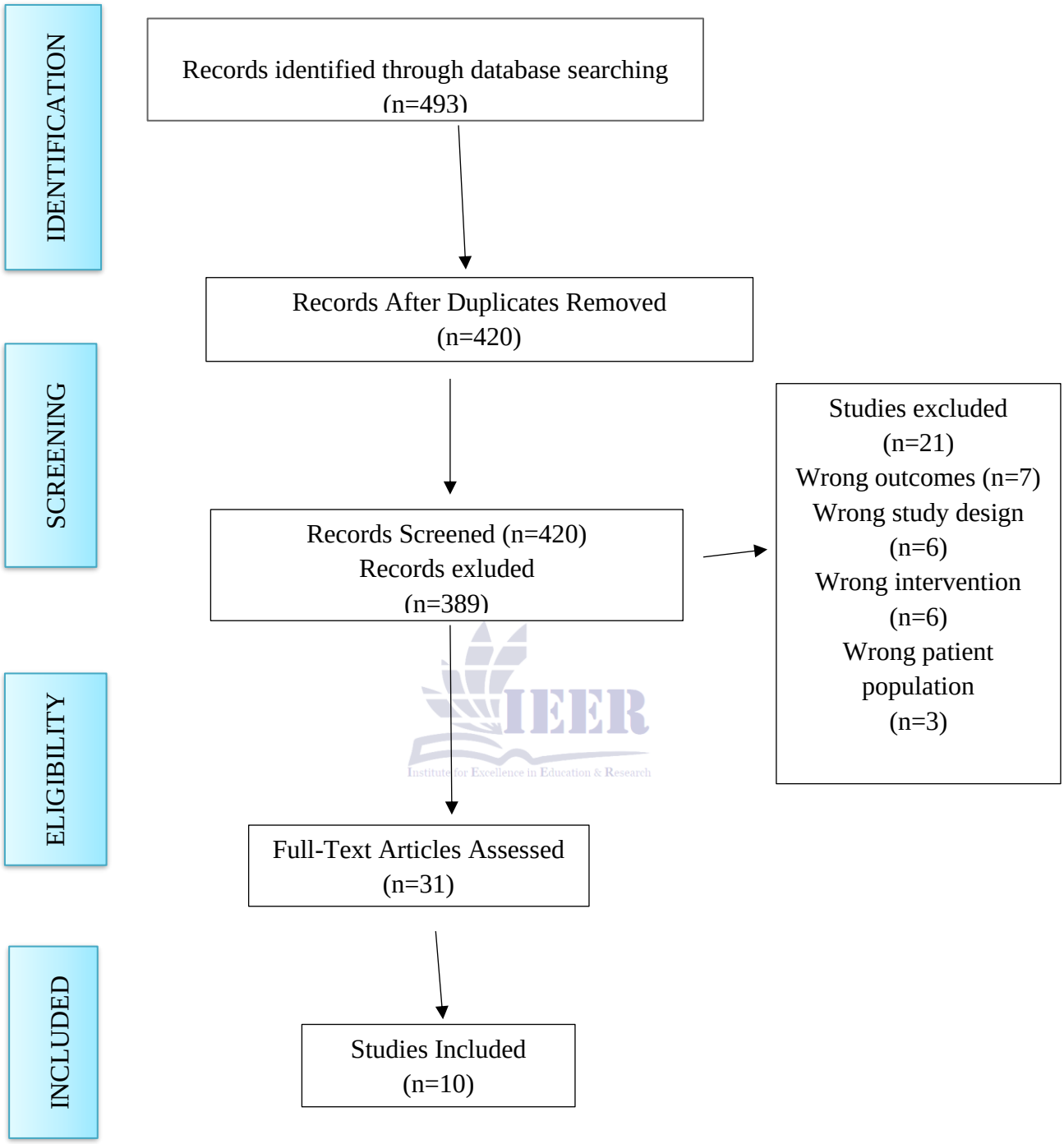

Figure 1.0 Prisma flow diagram.

Table 1: Show the results for diagnostic Accuracy of ocular ultrasound in detection of retinal detachment.

Author Names	Year	Study Design	Sample Size	Ultrasound Mode	Accuracy	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Yooness[1]	2010	Prospective Observational	48	B-mode	99%	100%	83%	78%	100%
Kongsap[2]	2011	Case Series	95	B-mode	99.8%	100%	99%	88%	100%
Shinar[3]	2011	Prospective Observational	92	B-mode	98%	100%	97%	95%	100%
Woo[4]	2016	Prospective Diagnostic Accuracy	62	B-mode	98%	100%	67.9%	79%	98%
Chu[8]	2017	Prospective Surveillance	139	B-mode	99.8%	88%	87%	47%	98%
Jacobsen[9]	2016	Retrospective Chart	109	B-mode	99%	91%	96%	91%	96%
Kim[10]	2018	Prospective Diagnostic Accuracy	115	B-mode	98%	75%	94%	88%	97%
Shadi lahham[11]	2019	Prospective Multicenter Diagnostic Accuracy	225	B-mode	91%	96.9%	88.1%	64.5%	99.9%
Michael gottlieb[7]	2019	Systematic review and meta-analysis	11	B-mode	97%	94.2%	96.3%	96.7%	6.4%
A.J.Adekanmi[12]	2020	Retrospective review	142	B-mode	98%	66.7%	90.4%	62.1%	90.1%

DISCUSSION

This systematic review evaluated 10 selected studies from an initial pool of 493 records, focusing on the diagnostic performance of ocular ultrasound in identifying retinal detachment. The included studies collectively highlight the high diagnostic accuracy, sensitivity, and specificity of OUS, indicating its utility in emergency and clinical ophthalmic settings.The overall diagnostic accuracy across studies ranged from 91% to 99.8%. The highest accuracy was observed in Kongsap (2011)[2] and Chu (2017)[8] with 99.8%, suggesting exceptional performance of OUS when performed under standardized protocols by trained personnel. Even the lowest accuracy (91% by Shadi Lahham, 2019)[11] remains high, indicating reliability. Yoonessi et al. (2010)[1] and Shinar et al. (2011)[3] demonstrated 98–99% accuracy, reinforcing that point-of-care ultrasound (POCUS) is consistent with clinical and surgical findings. These findings align with prior literature which has consistently reported diagnostic accuracy for RD detection using ultrasound above 90%.Sensitivity varied from 66.7% to 100%, with 6 of the 10 studies reporting 100% sensitivity, implying no false negatives—crucial in emergency settings where missing a retinal detachment can result in vision loss. Kim (2018) and Adekanmi (2020)[12] reported the lowest sensitivities (75% and 66.7% respectively), possibly due to operator variability or patient population differences. High sensitivity in studies like Yoonessi (2010)[1] and Woo (2016)[4] supports prior evidence that RD creates a distinguishable hyperechoic membrane on ultrasound, which is easily recognizable Specificity ranged from 67.9% to 99%. False positives were more frequent than false negatives, often due to mimicking conditions such as posterior vitreous detachment or vitreous hemorrhage. Woo (2016)[4] reported a relatively low specificity (67.9%), likely because non-retinal pathologies such as vitreous opacities may resemble RD on ultrasound. The high specificity in Kongsap (2011)[2] and Shinar (2011)[3] (99% and 97% respectively) indicates skilled interpretation reduces misdiagnoses. The PPVs ranged between 47% and 96.7%, and NPVs were uniformly high (90.1% to 100%), suggesting that a negative OUS almost certainly excludes RD. High NPVs are vital for triage and reassurance in acute vision loss, especially in low-resource or rural settings where ophthalmic evaluation is delayed. Michael Gottlieb (2019)[7] reported a very low NPV (6.4%), likely due to small sample size (n=11), reducing statistical power and precision. The consistent performance of OUS in these studies suggests it can be a frontline tool in evaluating retinal detachment. It is particularly beneficial in: Emergency departments with acute visual complaints. Settings without immediate ophthalmology availability, allowing for safe patient referral. Bedside evaluation for trauma or unconscious patients where fundoscopy isn't possible. Training and operator experience were frequently noted as key factors influencing diagnostic performance. This suggests the need for structured POCUS training programs for emergency physicians and general practitioners. Variation in operator skill, machine resolution, and patient demographics can explain discrepancies in sensitivity and specificity. Some studies had small sample sizes (e.g., Gottlieb, n=11), limiting generalizability. Inclusion criteria and blinding varied across studies, introducing potential bias.

Conclusion:

This systematic review demonstrates that ocular ultrasound (OUS) is a highly accurate, sensitive, and specific diagnostic tool for detecting retinal detachment (RD), with diagnostic accuracy ranging from 91% to 99.8%. Despite some variability in sensitivity and specificity due to operator skill, patient population, and equipment differences, the majority of studies reported excellent performance metrics, especially when OUS was performed by trained personnel. The consistently high negative predictive values across studies underscore its reliability in excluding RD, making it particularly valuable in emergency settings, resource-limited environments, and situations where immediate ophthalmologic consultation is unavailable. Structured training and standardized protocols are essential to optimize the diagnostic performance of OUS, highlighting its potential as a frontline tool for evaluating acute visual complaints and facilitating timely patient management.

AUTHOR CONTRIBUTION

Author	Contribution
Safia Noreen	Manuscript writing, Conceptualization, and methodology
Muhammad Zubair	Supervision, review of methodology, and editing of the final draft.
Shamia Kamal	Data extraction, risk of bias assessment, data synthesis, and critical revision of the manuscript.
Khadija	Quality assessment, formatting, reference management, and proofreading

REFERENCES

1. Yoonessi R, Hussain A, Jang TBJAEM. Bedside ocular ultrasound for the detection of retinal detachment in the emergency department. 2010;17(9):913-7.
2. Kongsap P, Kongsap NJAJoO. Use of non-ophthalmic ultrasound for evaluation of retinal detachment in patients with opaque media. 2011;12(4):208-10.
3. Shinar Z, Chan L, Orlinsky MJTJoem. Use of ocular ultrasound for the evaluation of retinal detachment. 2011;40(1):53-7.
4. Woo MY, Hecht N, Hurley B, Stitt D, Thiruganasambandamoorthy VJCJoO. Test characteristics of point-of-care ultrasonography for the diagnosis of acute posterior ocular pathology. 2016;51(5):336-41.
5. Mitry D, Singh J, Yorston D, Siddiqui MR, Wright A, Fleck BW, et al. The predisposing pathology and clinical characteristics in the Scottish retinal detachment study. 2011;118(7):1429-34.
6. Lahham S, Ali Q, Palileo BM, Lee C, Fox JCJOAEM. Role of point of care ultrasound in the diagnosis of retinal detachment in the emergency department. 2019:265-70.
7. Gottlieb M, Holladay D, Peksa GDJAEM. Point-of-care ocular ultrasound for the diagnosis of retinal detachment: a systematic review and meta-analysis. 2019;26(8):931-9.
8. Chu HC, Chan MY, Chau CWJ, Wong CP, Chan HH, Wong TWJHKJoEM. The use of ocular ultrasound for the diagnosis of retinal detachment in a local accident and emergency department. 2017;24(6):263-7.
9. Jacobsen B, Lahham S, Lahham S, Patel A, Spann S, Fox JCJWJoEM. Retrospective review of ocular point-of-care ultrasound for detection of retinal detachment. 2016;17(2):196.
10. Kim DJ, Francispragasam M, Docherty G, Silver B, Prager R, Lee D, et al. Test characteristics of point-of-care ultrasound for the diagnosis of retinal detachment in the emergency department. 2019;26(1):16-22.
11. Lahham S, Shniter I, Thompson M, Le D, Chadha T, Mailhot T, et al. Point-of-care ultrasonography in the diagnosis of retinal detachment, vitreous hemorrhage, and vitreous detachment in the emergency department. 2019;2(4):e192162-e.
12. Adekanmi A, Ogun O, Adeniji-Sofoluwe A, Obajimi MJAoIPM. A 5-year review of ultrasonographic evaluation of ocular diseases at the university college hospital ibadan, south-west, Nigeria. 2020;18(2):152-9.