

Fundoscopy In the Emergency Room: A Systematic Review of Diagnostic Utility and Clinical Relevance in Critical Situations



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Abstract

Introduction: Fundoscopy, also known as funduscopy, is an essential technique for the evaluation of ocular and systemic alterations, playing a critical role in medical emergencies.

Objective: to conduct a systematic review of the scientific evidence on the use of fundoscopy in emergencies, addressing its applicability, diagnostic accuracy and impact on patient outcomes.

Methods: This study is a systematic review, classified as exploratory and descriptive. The research was carried out through a bibliographic search in electronic databases on methods associated with SLR (Systematic Literature Review) and applications of SMARTER (Simple Multi-Attribute Rating Technique using Exploiting Rankings).

Results: A comprehensive systematic search of the literature yielded a total of 9,464 articles related to the topic addressed, of which 33 articles were eligible to compose this systematic review.

Conclusion: This systematic review demonstrated that, despite its clinical importance, fundoscopy is still underused in emergency services, mainly due to the lack of adequate training and the difficulty in performing the examination using conventional methods.

Keywords: Fundoscopy; Emergency; Diagnosis; Critical Situations

Abbreviations: SLR: Systematic Literature Review; SMARTER: Simple Multi-Attribute Rating Technique using Exploiting Rankings

Introduction

Fundoscopy, also known as fundus examination, is an essential technique for the evaluation of ocular and systemic alterations, playing a critical role in medical emergencies [1]. This examination allows visualization of the retina, optic nerve and

blood vessels, providing advanced information for the diagnosis of a direct variety of conditions, including intracranial hypertension, diabetic retinopathy, retinal detachment and papilledema [2,3]. Despite being an easy-to-perform and relatively accessible

procedure, its practice in emergencies is often underutilized, mainly due to the lack of adequate training and the perception that it is not a priority examination in critical situations [4]. However, fundoscopy can provide essential data that directly influence clinical decision-making in emergency situations, aiding in the diagnosis of conditions such as papilledema, diabetic retinopathy and subarachnoid haemorrhage, which require rapid interventions and can have a critical impact on the patient's prognosis [5].

The importance of fundoscopy in emergencies lies in its ability to provide diagnostic clues that often go unnoticed in practical physical examinations [6]. The optic nerve, for example, can reveal early signs of increased intracranial pressure, a condition often associated with traumatic brain injury, intracranial haemorrhage, and haemorrhagic tumours. Early identification of these signs can be essential for deciding on neurosurgical interventions or for specific patient monitoring, helping to prevent serious complications, such as cerebral hernia [7,8]. Furthermore, in cases of hypertensive crises, fundus examination may reveal hypertensive retinopathy, which reflects systemic vascular damage and may guide the need for urgent blood pressure control [9]. Recent studies demonstrate that fundoscopy has a high predictive value in neurological and systemic emergencies [10-12].

Although evidence points to the relevance of fundoscopy in emergency settings, the practical reality reveals a worrying underutilization. Research indicates that, in many emergency services, fundoscopy is not routinely performed, even in patients with conditions that warranted the examination [13]. A study conducted by Rufai[14], highlights that fundoscopy remains an underutilized examination in the detection of intracranial hypertension in patients with craniosynostosis, despite its clinical relevance and potential for early identification of signs of neurological impairment, evidencing a significant gap between clinical recommendations and actual practice, which may compromise the early detection of potentially fatal conditions and subsequent critical interventions for appropriate management.

This discrepancy can be attributed to several factors, including professionals' lack of familiarity with the technique and the lack of suitable devices, such as quality ophthalmoscopes and high-resolution imaging devices [15]. Furthermore, in emergency situations, where time is of the essence, fundoscopy may be seen as a time-consuming examination, to the detriment of other interventions considered more immediate [13]. However, with the development of retinal imaging devices and targeted training programs, the performance of fundoscopy can be optimized, allowing more healthcare professionals to effectively use this diagnostic tool, thus improving the identification of ocular and systemic diseases in emergency settings, which may result in more agile management [16]. Given this situation, it is essential

that fundoscopy practice be more consistently integrated into emergency care, with a focus on conditions that can rapidly alter patient prognosis. The use of technologies that facilitate examination, such as digital fundoscopy, may help overcome some of the practical barriers that limit its widespread use. In addition, it is crucial to develop and implement clinical guidelines that reinforce the systematic use of fundoscopy in specific emergency situations, ensuring that all patients with critical environmental conditions are adequately evaluated, which may result in more accurate diagnoses and more effective treatment instructions.

The objective of this study was to conduct a systematic review of the scientific evidence on the use of fundoscopy in emergency care, addressing its applicability, diagnostic accuracy, and impact on patient outcomes. By synthesizing the available data, we sought to provide a solid basis for the development of strategies that encourage the broader and more effective use of this examination in emergency services, improving diagnostic capacity and, therefore, optimizing clinical management, rapidly reducing morbidity and mortality associated with ophthalmological and systemic conditions.

Methods

This study is a systematic review, classified as exploratory and descriptive. The research was carried out through bibliographic research in electronic databases on methods associated with SLR (Systematic Literature Review) and applications of SMARTER (Simple Multi-Attribute Rating Technique using Exploiting Rankings). The work carried out is of a qualitative and quantitative nature. The qualitative analysis of the data was carried out intuitively and inductively during the survey of the theoretical framework. It is also quantitative by using the multicriteria method. In addition, there is also a numerical experimental study in order to simulate a situation of article selection based on the observed criteria. The bibliographic research was carried out in the following databases: Web of Science; Science Direct; Wiley; Springer Link; Taylor and Francis and PubMed.

In addition, searches were carried out using bibliographic references of studies that addressed the topic in a relevant manner on the Google Scholar search platform. The search in the databases was performed using terminologies registered in the Health Sciences Descriptors created by the Virtual Health Library, developed from the Medical Subject Headings of the US National Library of Medicine, which allows the use of common terminology in Portuguese, English and Spanish. The present study sought to investigate the literature on fundoscopy in the emergency room. For this purpose, the descriptors "fundoscopy", "emergency", "diagnostic utility" and "clinical relevance" were used, initially in English, and complementary in Spanish and Portuguese.

As a tool to support decision-making in the selection and prioritization of articles, a set of criteria were considered

essential to represent the state of the art of the research topic. This method has the following characteristics: (i) rigorous logic allows the method to be accepted as a decision-making support tool; (ii) simple to understand and apply, with results that are easy to interpret. References of selected papers were also searched for other documents of potential interest. Once qualified for full text in the evaluation, articles were included in the qualitative review if they met the following inclusion criteria: a) contained data on fundoscopy; b) contained data on fundoscopy in the emergency room. Articles were excluded if they were reports, banners or conference abstracts. There was no review of confidential health information and the study was not interventional. Therefore, ethics committee approval was not required. In the end, the result obtained totalled 33 articles that contemplated the desired characteristics for the study. Four independent researchers extracted data from articles that met the inclusion criteria and entered them into a Microsoft Excel-generated “data extraction

form” on the use of ketamine in patients with depression. From this form, the authors and year of publication, study abstract, study type, outcome measure, limitations and conclusions of the main studies selected were included, which is shown in (Table 1).

Results

A comprehensive systematic literature search yielded a total of 9464 articles on fundoscopy in the emergency department. Of these, 25 studies were excluded due to data overlap. From this, the SMARTER (Simple Multi-Attribute Rating Technique using Exploiting Rankings) method was chosen and 178 articles that were suitable for full-text screening were selected, of which 134 articles were included for data extraction, of which 101 were excluded by the exclusion criteria, making 33 articles eligible for inclusion in the systematic review. In (Figure 1), we describe the selection strategy for articles on the topic in question.

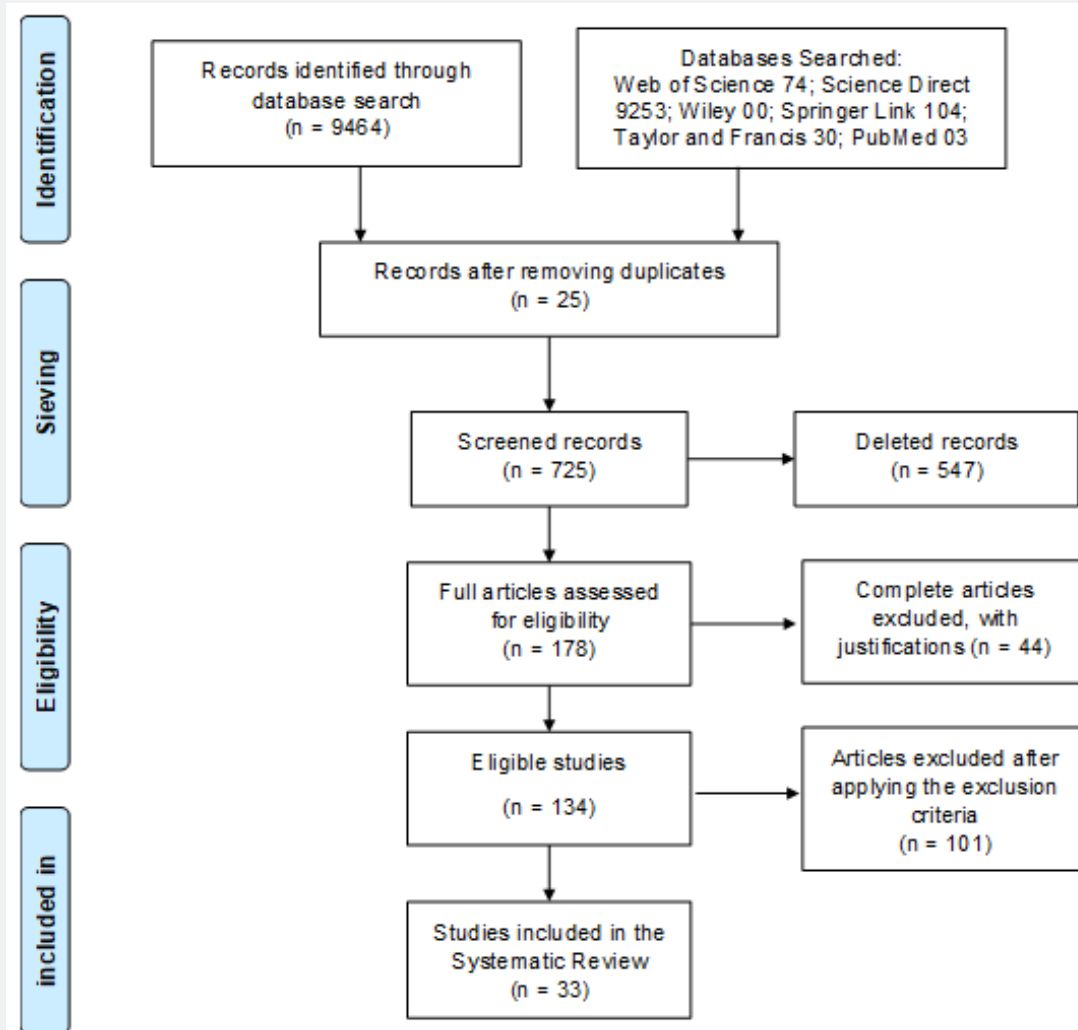


Figure 1: Article search strategy

Table 1: Main selected studies and their findings

Author/ Year	Summary	Type of study	Measured result	Conclusion
[2]	This chapter covers fundamental aspects of neuro-ophthalmology, including anatomy, physiology, diagnosis, and management of neuro-ophthalmologic disorders.	Book chapter	ND*	Provides a comprehensive overview of the principles and practices in neuro-ophthalmology, serving as an essential resource for professionals in the field.
[15]	This review explores the use of smartphones for fundus imaging, highlighting its clinical applications, advantages, limitations, and future directions. The technology offers an affordable and portable alternative to traditional imaging techniques, facilitating early detection and monitoring of retinal pathologies.	Revision	Evaluation of clinical applications, image quality, standardization and regulatory considerations related to smartphone fundus imaging.	Smartphone-based fundus imaging has significant potential to improve patient care and visual outcomes, especially in resource-limited settings. However, challenges related to image quality, standardization, and regulatory issues need to be addressed for its full implementation.
[4]	This article discusses technological advances in optic nerve imaging and their implications for the diagnosis and management of optic neuropathies. Recent developments have improved the care of patients with conditions such as papilledema, idiopathic intracranial hypertension, and inflammatory and compressive optic neuropathies.	Revision	Impact of advances in imaging techniques on the evaluation and management of optic neuropathies.	Advances in ocular imaging strategies have significantly improved the diagnosis and monitoring of patients with optic neuropathies, allowing for a better understanding and management of these conditions.
[10]	This retrospective observational study analyzes the demographics, clinical characteristics, and imaging studies of patients diagnosed with optic neuropathy in the emergency department over 18 years, exploring diagnostic accuracy and predictive factors that may influence diagnosis.	Retrospective Observational Study	Diagnostic accuracy of optic neuropathy in the emergency setting.	Most patients with optic neuropathy can be accurately diagnosed in the emergency department through clinical history assessment, neurological examination, and ophthalmologic examination.
[22]	This cross-sectional study examines the prevalence of incidental signs of intracranial hypertension detected by magnetic resonance imaging (MRI) in outpatients undergoing brain MRI for any clinical indication and explores their association with papilledema.	Cross-sectional study	Prevalence of signs of intracranial hypertension on MRI and its association with papilledema.	Signs of intracranial hypertension on MRI are common among patients undergoing brain MRI but are rarely associated with papilledema. Management of patients with incidental signs of intracranial hypertension probably does not require systematic lumbar puncture unless worrisome symptoms or papilledema are present.
[7]	This article describes the various neuro-ophthalmological manifestations associated with intracranial malignancies, emphasizing the importance of recognizing these presentations for early diagnosis and adequate management of intracranial tumors.	Narrative Review	Specific neuro-ophthalmological manifestations associated with different intracranial malignant tumors.	Recognition of neuro-ophthalmological manifestations is crucial for early diagnosis and adequate treatment of intracranial malignancies, as different tumors can present distinct signs and symptoms that affect the visual system.

Author/ year	Summary	Type of study	Measured result	Conclusion
[11]	This article covers basic ocular anatomy and physiology, discusses a systematic approach to ocular examination, and presents evidence-based treatments for common ocular complaints, both non-emergency and emergency. For each complaint, essential questions of history, examination techniques, differential diagnoses, and emergency management are presented.	Literature Review	Diagnostic and therapeutic approaches to common ophthalmologic emergencies.	A thorough understanding of ocular anatomy, coupled with a systematic approach to ocular examination, is essential for the effective management of ophthalmic emergencies. The article provides practical guidance for the evaluation and treatment of various emergency ocular conditions.
[20]	This retrospective observational study investigates the diagnostic process, diagnostic errors and biases in patients with suspected idiopathic intracranial hypertension (IIH), aiming to improve the diagnostic accuracy and clinical management of these patients.	Retrospective Observational Study	Frequency of incorrect diagnoses and identification of biases in the diagnosis of IIH.	Diagnostic errors have resulted in overdiagnosis of IIH in a significant proportion of patients, leading to unnecessary testing and missed diagnoses. The study highlights the need for rapid access to specialists experienced in optic nerve disorders to reduce errors and improve patient care.
[23]	This article reviews the evaluation and management of patients with symptoms consistent with idiopathic intracranial hypertension (IIH) in the emergency department and discusses newly proposed mechanisms and treatments for the disease.	Narrative Review	New imaging techniques, such as bedside MRI and ultrasound, which may provide evidence to support the clinical diagnosis of IIH; newly suggested metabolic mechanisms and possible treatments for the disease.	In the emergency department, clinicians should consider IIH in the differential diagnosis of patients presenting with headache and/or papilledema, utilizing novel imaging techniques and considering emerging metabolic mechanisms to guide management.
[6]	This article addresses the high prevalence of headaches in emergency departments and the complexity of their assessment, highlighting the importance of a systematic approach to avoid misdiagnosis and inadequate management.	Literature Review	Challenges in headache assessment due to the complexity of symptoms and the possibility of significant underlying pathologies; need for a structured approach to differential diagnosis.	Most headaches presenting to the emergency department are primary migraines; however, careful assessment is crucial to identify cases with serious underlying causes and ensure appropriate management.

Author/ year	Summary	Type of study	Measured result	Conclusion
[5]	This study analyzed the prevalence of changes in funduscopy of patients with Diabetes Mellitus and/or Systemic Arterial Hypertension treated at a Basic Health Unit.	Cross-Sectional Descriptive Study	Among the 22 patients evaluated, 36.3% were diabetic, 27.4% hypertensive and 36.3% had both conditions; the main alterations found were diabetic retinopathy, hypertensive retinopathy, cataract, glaucoma, choroidal nevus, retinitis pigmentosa and peripapillary staphyloma.	Ocular changes are common in patients with diabetes and/or hypertension, highlighting the importance of regular fundus examination for early detection and adequate management of these conditions.
[30]	This systematic review assessed the confidence of UK doctors working in general emergency departments in the management of ophthalmic emergencies.	Systematic Review of Cross-Sectional Studies	Seven studies, totaling 956 physicians, were analyzed; a widespread lack of confidence was found, especially among early-career physicians, in managing ophthalmic emergencies; many reported inadequate formal trainings in ophthalmology.	There is an urgent need to improve ophthalmology training for emergency physicians to increase confidence and competence in managing ophthalmic emergencies.
[14]	This study evaluated the diagnostic accuracy of funduscopy and visual evoked potentials (VEPs) in detecting intracranial hypertension (IH) in patients with craniosynostosis undergoing spring-assisted posterior expansion.	Retrospective study of diagnostic accuracy	The sensitivity of funduscopy to detect IH was 32.1%, with a specificity of 100%. For isolated VEPs, the sensitivity was 58.3% and the specificity was 83.3%.	The presence of papilledema on funduscopy reliably indicates IH, but its absence does not exclude it. VEP tests increase sensitivity, although with reduced specificity, depending on the method of analysis.
[31]	This review explores the importance of fundus examination in the diagnosis and management of systemic infections, especially in hospitalized patients or during infectious outbreaks.	Narrative review	Fundus examination can be an essential diagnostic tool and sometimes the only viable practice in bedside settings to detect signs of systemic infections affecting the eye.	Implementing a systematic examination of the ocular fundus may improve clinical outcomes by allowing early detection of ocular manifestations of systemic infections.

Discussion

Funduscopy is an essential examination in the evaluation of patients in emergency situations, providing a direct window for the observation of the patient's vascular and neurological status [17]. The retina is a privileged site for the detection of systemic and neurological diseases, as it allows direct visualization of blood vessels and the optic nerve, without the need for invasive procedures [18,19]. However, despite its diagnostic importance, the use of funduscopy in emergencies is still underestimated, often due to the lack of training of health professionals and the unavailability of adequate equipment in the hospital environment [14].

Intracranial hypertension is one of the conditions in which funduscopy can be decisive in the emergency [20]. Papillary edema, a characteristic sign of this condition, may indicate the need for immediate interventions to avoid serious neurological sequelae [21]. In patients with traumatic brain injury, for example, the identification of papilledema can guide the performance of additional imaging tests and therapeutic decisions, such as early management of intracranial hypertension [22,23]. Another

fundamental application of funduscopy in the emergency room is the evaluation of retinopathies associated with systemic diseases, such as hypertensive retinopathy and diabetic retinopathy [17]. The presence of retinal haemorrhages, hard exudates, and macular edema may indicate significant metabolic imbalance, being a warning for cardiovascular complications and the need for hospitalization for more rigorous monitoring. Early identification of these changes can directly impact the patient's prognosis, enabling more effective management of the underlying condition [24].

Infectious diseases can also manifest in the retina, making funduscopy an important complementary exam in suspected pathologies such as infective endocarditis and neurotoxoplasmosis [25]. In the case of endocarditis, the presence of candle flame haemorrhages and Roth spots can strengthen the diagnostic hypothesis and contribute to more targeted treatment [26]. In immunosuppressed patients, such as those with HIV, the observation of retinal lesions may indicate opportunistic infections, guiding the need for complementary laboratory tests and early intervention [27,28]. Although funduscopy has significant diagnostic potential, its application in emergency care

faces significant challenges [15]. The direct ophthalmoscope, often used for this examination, requires technical skill for its correct application, which may limit its use by professionals without specific training [29].

Technological advances, however, have helped to overcome these limitations. The introduction of digital ophthalmoscopes and portable non-mydratic fundus cameras has facilitated the acquisition of high-quality retinal images, allowing documentation of lesions and telemedicine for remote analysis by specialists [15,1]. These innovations have the potential to make funduscopy more accessible and integrated into the emergency care flow, increasing its clinical applicability. Training healthcare professionals is another crucial aspect for expanding the use of funduscopy in emergency care. Specific training in ophthalmoscopic techniques can improve the diagnostic skills of emergency physicians and increase the frequency of performing this exam. In addition, clearer clinical guidelines on when and how funduscopy should be performed can promote its incorporation into hospital routine [1,30].

The integration of funduscopy with other diagnostic methods, such as computed tomography and magnetic resonance imaging, can also improve diagnostic accuracy in complex neurological and systemic cases. The combination of these exams can provide a more comprehensive view of the patient's condition, allowing more assertive therapeutic decisions and improving clinical advances [31]. In addition to the impact on diagnosis, the wider implementation of funduscopy in emergency care can contribute to reducing hospital costs and optimizing resources [32]. Early detection of pathologies through funduscopy can avoid the need for more complex and expensive exams, in addition to reducing the length of patient hospitalization by enabling faster and more efficient management [33].

Given these aspects, funduscopy remains a diagnostic tool that is little used in emergency care, despite its great clinical potential. Improved medical training, investment in new technologies, and the creation of specific protocols can contribute to its greater implementation and efficiency in the emergency setting. Future studies are needed to evaluate strategies that facilitate its application and make this exam a standard practice in the care of patients in critical situations.

Final Consideration

Funduscopy is an essential examination in the evaluation of patients in emergency situations, providing valuable diagnostic information on several neurological, cardiovascular and systemic conditions. This systematic review demonstrated that, despite its clinical importance, funduscopy is still underutilized in emergency services, mainly due to the lack of adequate training and the difficulty in performing the examination using conventional methods. The findings reinforce the need for training medical professionals to perform funduscopy effectively and systematically, expanding its application in the screening

and management of critical conditions, such as intracranial hypertension, papilledema, and retinopathies associated with hypertensive emergencies. In addition, advances in imaging technologies, such as digital funduscopy for automated analysis, emerge as a promising alternative to facilitate the performance and interpretation of the exam in emergency settings.

Thus, it is concluded that the incorporation of funduscopy as a diagnostic tool in emergency care can significantly contribute to the early detection of serious pathologies, improving clinical advances and complications associated with delayed diagnosis. Further studies are needed to evaluate the impact of implementing training strategies and new technologies on the use of funduscopy in emergency care, directing the optimization of care and the qualification of clinical practice.

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