Original Article

Diagnostic Yield of Routine Fundoscopy in Severe Headaches and the Prevention of CVST Misdiagnosis: A Cross-Sectional Study from a Primary Clinical Setting

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Abstract

Background: Headache is a common presentation in primary care. While mostly benign, secondary causes like Cerebral Venous Sinus Thrombosis (CVST) are frequently misdiagnosed in community settings where MRI/MRV is unavailable. **Methods:** A cross-sectional observational study was conducted on 321 selected patients (from an initial pool of 998) with severe headaches. at the Medicine OPD of Brahmanbaria District Hospital. All patients were subjected to clinical examination and direct ophthalmoscopy followed by NCCT (National Center for Competency Testing). While fundoscopic findings were intended to guide imaging, nearly all patients underwent NCCT scans due to patient pressure, which provided a cross-check for fundoscopic efficacy. **Results:** Abnormal fundoscopy was identified in 9 (2.8%) subjects with papilledema in 7, sub-hyaloid hemorrhage in 1, and optic atrophy in 1. Fundoscopy successfully identified all cases of CVST (Cerebral Venous Sinus Thrombosis) (n=5) and IIH (n=2) via the presence of papilledema, highlighting its critical role in detecting raised intracranial pressure when initial CT scans were normal. In these instances, fundoscopy was the primary tool that prevented misdiagnosis. It was also applicable for a headache patient where the underlying cause was glaucoma. Yield was lower for SAH (Sub-arachnoid Hemorrhage) (5%) and ICSOL (Intracranial Space-Occupying Lesion) (0%). Logistic analysis identified significant correlations of abnormal fundoscopy with female gender (p=0.041), age >30 (p=0.032), and visual disturbances (p<0.001). **Conclusion:** Routine fundoscopy is a vital, low-cost screening tool that enhances patient safety. It is particularly effective for catching CVST and IIH (Idiopathic Intracranial Hypertension) in community settings where gold-standard imaging is unavailable and initial CT scans may appear normal.

Keywords: Headache, Fundoscopy, Papilledema.

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Introduction

Headache is one of the most ubiquitous clinical presentations in primary healthcare, accounting for approximately 4% of all emergency department visits and a substantial proportion of outpatient consultations. [1] While the vast majority of these cases represent primary headache disorders—such as migraine or tension-type headaches—a small but critical subset stems from life-threatening secondary etiologies, including intracranial hemorrhage, cerebral venous sinus thrombosis (CVST), and idiopathic intracranial hypertension (IIH). [2,3]

The diagnostic challenge for the primary care physician lies in the "grey zone" where secondary headaches mimic the features of primary disorders like migraine or tension-type headaches. [4,5] While "red flag" screening tools (e.g., SNNOOP-10) are widely advocated, their specificity remains variable. [6] In many resource-limited settings, non-contrast computed tomography (NCCT) of the brain is the primary neuroimaging modality due to its availability and lower cost. However, NCCT is insensitive to early-stage raised intracranial pressure (ICP) and is frequently normal in the initial stages of CVST and IIH. [7]

Direct fundoscopy, or ophthalmoscopy, has traditionally been the bedside "window" into the intracranial environment. The detection of papilledema, swelling of the optic disc due to axoplasmic flow stasis, indicates elevated ICP. [8,9] Despite its inclusion in standard physical examination protocols, its routine use has declined due to the operator-dependent nature of this technique and perceived superiority of neuroimaging. However, in patients where MRI/MRV is unaffordable or inaccessible, the omission of fundoscopy may lead to catastrophic delays in diagnosing conditions that may appear normal in CT scan. [10, 11] This study aimed to evaluate the diagnostic yield of routine fundoscopic examination in a primary care setting and to identify clinical markers and associated demographic factors that necessitate its application.

Methodology

The cross-sectional observational study was carried out at medicine OPD, district sadar hospital, Brahmanbaria from 01 July 2022 to 30 December 2023.

Participants: About 1,000 headache patients were encountered. The study included 321, who were aged above 18 years with headache severe enough to impair daily life, or those with chronic and recurrent headache with progressive increase in frequency and severity. The study included both males and females who attended the outpatient and emergency units.

Excluded from the study were those with pre-existing documented optic pathway lesions or those who had prior intracranial surgery, those with head trauma in the last three months, and those who had media opacities that would preclude sufficient fundoscopic examination, including dense cataracts and vitreous hemorrhage.

All enrolled patients underwent a standardized clinical evaluation, including a detailed history-taking with a focus on headache features and accompanying red-flag symptoms.

Fundoscopic Technique

Clinical examination was performed using a standard handheld direct ophthalmoscope. Non-mydriatic fundoscopy (without pupillary dilation) was prioritized for clinical efficiency and patient throughput. The examination focused primarily on the optic nerve head (ONH) to identify signs of papilledema, such as blurring of disc margins, loss of spontaneous venous pulsations, and splinter hemorrhages [12]. While pupillary dilation with 1% tropicamide is often recommended for comprehensive retinal screening, it was deemed non-essential for the primary goal of detecting raised intracranial pressure (ICP) in an outpatient setting, as macular and peripheral retinal pathologies are rarely causal in primary or secondary headache disorders [13].

Diagnostic Protocol

While clinical red flags and fundoscopic findings were intended to guide the need for imaging, the decision to perform NCCT in nearly all cases—including those with low clinical suspicion—was often driven by significant pressure from patients and their families for definitive "visual" proof of health. This comprehensive imaging approach, however, provided a unique research advantage, allowing for a systematic cross-check of fundoscopy's effectiveness against neuroimaging results. [5]. In cases where NCCT was normal but papilledema was present, patients were escalated to MRI and MRV to evaluate for Cerebral Venous Sinus Thrombosis (CVST) or Idiopathic Intracranial Hypertension (IIH) [14].

Demographic variables such as age, sex, and the use of hormonal contraceptives among females, together with clinical features, fundoscopic findings, and neuroimaging findings where applicable, were recorded. Final diagnoses were rendered by a combination of clinical features, fundoscopic examination, and neuroimaging findings, where necessary. Data were entered and analyzed using SPSS version 26, and a p-value <0.05 was taken as statistically significant.

Results

The study included a total of 321 patients, with a high female predominance of 67.9% (n=218), while 32.1% (n=103) were male. The most prevalent age group was 40–49 years (31.6%), followed by those > 50 years (28.7%). Among female participants, 18.3% (n=40) were using hormonal contraceptives.

Table I: Baseline Demographic Characteristics of Study Population (N = 321).

Variable	Category	Frequency n (%)
Age Group (years)	18-29 years	66 (20.6)
	30-39 years	62 (18.9)
	40-49	101 (31.6)
	≥ 50	92 (28.7)
Sex	Male	103 (32.1)
	Female	218 (67.9)
Hormonal Contraceptive Use (Females only, n=218)	Yes	40 (18.3)
	No	178 (81.7)

The most common symptom was severe throbbing headache, present in 77.6% (n=249) of the cohort. "Red-flag" symptoms, such as "worst-ever" headaches, were reported by 9.2% (n=30). Associated features included nausea/vomiting (21.6%), visual disturbances (12.6%), and rare neurological deficits (1.8%).

Table II: Clinical Presentation and Initial Assessment.

Clinical Feature	Frequency n (%)
Severe/Throbbing Headache	249 (77.6)
Chronic/Recurrent Headache	57 (17.8)
Visual Disturbances	40 (12.6)
Nausea/Vomiting	69 (21.6)
Neurological Deficits	6 (1.8)
Red Flag Symptoms (e.g., worst-ever headache)	30 (9.3)

Fundoscopic Yield and Diagnostic Correlation:
Abnormal fundoscopic findings were identified in 9 out of 321 subjects (2.8%). These included papilledema (n=7), sub-hyaloid hemorrhage (n=1), and optic atrophy (n=1).
Table III shows that the most common diagnoses were primary headache disorders with normal fundoscopy and neuroimaging (n = 263, 81.9%). Five cases of CVST/IIH were diagnosed exclusively by the presence of fundoscopic evidence of papilledema, despite normal imaging at the outset. Two cases of hydrocephalus were with papilledema on fundoscope that was confirmed later on CT scan. Only one case of the 20 subarachnoid hemorrhage cases revealed subhyaloid hemorrhage on fundoscopy. Thirty intracranial space-occupying lesions evidenced mainly by abnormal imaging were normal on fundoscopy -indicating the absence of raised intracranial pressure even if the lesion is in subtentorial space and large enough for pressure effect. Optic atrophy was identified in one case of glaucoma; it had been initially misdiagnosed as a primary headache with normal CT brain, which pointed out the diagnostic utility of ophthalmoscopy.

Table 4 shows that fundoscopy consistently identified papilledema in all recorded cases of CVST/IIH and hence was very effective in diagnosing those with elevated intracranial pressure. Nevertheless, the detection rate for the subarachnoid hemorrhage was much lower at 5% because subhyaloid hemorrhage is a relatively rare occurrence. Fundoscopy did not detect any of the 30 intracranial space-occupying lesions (detection rate 0%), and this is most likely a reflection of the fact that such lesions were not large enough to interrupt CSF circulation and produce elevated intracranial tension.

Table 5 depicts that Papilledema was only observed in females and in the 30-39-year-old group; it was related to users of hormonal contraceptives. Normal fundoscopic examinations are well represented in both genders (218 in females and 103 in males). Optic atrophy due to glaucoma was noted in one female patient. Subhyaloid hemorrhage due to subarachnoid hemorrhage was only present in the male group (n=103).

Table 6 demonstrates that several variables were predictive of abnormal fundoscopy findings.

Female Gender (p=0.041): While there were more females in the study, they held a disproportionate share of the abnormalities (7 out of 9), often linked to hormonal contraceptive use.

Age: greater than 30 years (p = 0.032).

Visual Disturbances (p<0.001): This is the strongest predictor because 6 of the 9 abnormal cases reported visual symptoms, compared to only 34 of the 312 normal cases [21].

Red-flag symptoms (p<0.001) and the presence of neurologic deficits (p<0.001) were strongly predictive of abnormal findings. Nausea/vomiting was significantly associated (p=0.018). These observations indicate that selective fundoscopy in patients with the aforementioned findings could optimally maximize diagnostic utility while sparing patients in the absence of headache of discomfort of an additional examination.

Table III: Neuroimaging Findings Compared to Fundoscopy.

Final Diagnosis	Total Cases	Fundoscopy Finding	CT Result	Additional Note
Primary Headache (Migraine/Tension)	263	Normal	Normal	Diagnosis confirmed; low risk group
CVST / IIH	5	Papilledema	Normal	Missed by CT; confirmed by MRI and MRV
Hydrocephalus	2	Papilledema	Abnormal	Diagnosis suspected before CT
SAH	20	Subhyaloid Hemorrhage (1)	Abnormal	Fundoscopy caught only 1/20 cases
Intracranial Space-Occupying Lesions (ICSOL)	30	normal	abnormal	Fundoscopy is insensitive in diagnosis of ICSOL at least at primary stage
Glaucoma	1	Optic atrophy	normal	Headache associated glaucoma may be mistaken for primary headache even after CT brain if fundoscopy is not used

Table IV: Diagnostic yield of fundoscopy by condition.

Diagnosis	Total Cases	Detected via Fundoscopy	Detection Rate (%)
CVST / IIH	5	5	100
Hydrocephalus	2	2	100
SAH	20	1	5
ICSOL	30	0	0
Primary Headache	263	0 (true negative)	N/A
Glaucoma	1	1	Incidental finding

Table V: Fundoscopy Findings by demographic profiles.

	Variable	Papilledema (n=7)	Normal Fundus (n=312)	Optic Atrophy (n=1)	Subhyaloid Hemorrhage (n=1)
Age	18-29	1	65	0	0
	30-39	5	55	0	1
	40-49	1	100	0	0
	>50	0	92	1	0
Sex	Female	6	211	1	0
	Male	1	101	0	1
Hormonal pill Use		5	35	0	0

Table VI: Factors Associated with Abnormal Fundoscopic Findings.

Variable	Abnormal fundus (n=09)	Normal fundus (n=312)	Total patients (n=321)	*p* value
Female sex	7	211	218	0.041
Male sex	2	101	103	
Age ≥30 years	7	248	255	0.032
Age <30 years	2	64	66	
Visual disturbance	6	34	40	<0.001
Nausea/vomiting	5	64	69	0.018
Red-flag symptoms	8	22	30	<0.001
Neurological deficit	3	3	6	<0.001

Discussion

This cross-sectional study of 321 patients highlights the indispensable role of fundoscopy in bridge-building between clinical suspicion and definitive neuroimaging. Our finding of a 2.8% prevalence of abnormal fundoscopy findings, while numerically low, is clinically profound. Every instance of detected papilledema led to a diagnosis that would have likely been missed or delayed by a reliance on NCCT alone.

The Diagnostic Utility of Fundoscopy in CVST and IIH.

While fundoscopy successfully identified all five cases of CVST and IIH in our cohort, we acknowledge that claiming "100% sensitivity" is limited by our small sample size for these specific pathologies. Rather than absolute sensitivity, these results emphasize the high specificity of papilledema as an indicator of raised intracranial pressure (ICP). These conditions frequently present in young, female patients—often those using hormonal contraceptives, as seen in 5 out of our 7 papilledema cases [12,13]. The pathophysiology of CVST involves obstructed venous outflow, leading to increased ICP while the brain parenchyma initially remains structurally normal on NCCT [14]. Our results mirror the work of Moss et al., who emphasize that optic disc edema is often the only objec-

tive sign of pathology in the early stages of these syndromes [15]. Relying solely on CT in these demographics creates a "false sense of security" that fundoscopy effectively mitigates.

Physiological limitations in Acute Vascular and Space-Occupying Lesions

Conversely, our study confirms the limitations of fundoscopy in acute vascular events and early-stage space-occupying lesions (ICSOLs). The low yield for subarachnoid hemorrhage (5%) and ICSOLs (0%) underscores that papilledema is a late-developing sign of mass effect [16]. In cases of SAH, Terson's syndrome (intraocular hemorrhage) occurs in only 13–50% of cases and is associated with higher mortality, but it is not a sensitive screening marker for the hemorrhage itself [17]. Therefore, a normal fundus should never be used to rule out an acute bleed or a tumor if other red flags are present.

Risk-Stratified Screening in Primary Care

Our analysis identified female gender, age ≥30, visual disturbances, and the use of hormonal contraceptives as significant predictors of abnormal fundoscopy. These findings support a "risk-stratified" approach. While fundoscopy may not be sensitive enough to serve as a universal "rule-out" tool for all secondary headaches, it remains a mandatory, high-specificity screen for the "high-risk phenotype"—the young female patient on hormonal therapy with a migraine-like presentation [18]. Furthermore, the incidental detection of optic atrophy in a glaucoma patient highlights the "collateral benefit" of the exam. Headache is a known symptom of subacute angle-closure glaucoma; without fundoscopy, these patients risk irreversible vision loss while being treated for a "primary headache" [19,20].

A notable aspect of our study was the high volume of neuroimaging performed despite benign clinical presentations. In many primary care settings, physicians face immense pressure from patients to order CT scans for reassurance. While this often leads to over-utilization of resources, in this study, it served to validate the diagnostic yield of the ophthalmoscope. Our findings demonstrated that while CT was the "requested" test, it was frequently "blind" to the early stages of raised ICP of CVST and IIH.

By cross-checking every fundoscopic exam with a CT scan, we confirmed that fundoscopy did not miss any cases of raised ICP that a CT might have picked up; conversely, fundoscopy caught five critical cases (CVST/IIH) that the CT scans missed entirely. This reinforces that while a CT scan might satisfy a patient's demand for imaging, it is the fundoscopic exam that often provides the more life-saving data in the community setting

Limitations of the Study: This study was limited by the use of direct ophthalmoscopy, which has inherent operator dependency and may have reduced sensitivity for subtle papilledema compared to advanced techniques like optical coherence tomography or fundus photography. Additionally, the single-center design and lack of long-term follow-up may limit generalizability and assessment of false-negative cases.

Conclusion

Routine fundoscopy remains a vital, low-cost safety net in the evaluation of headaches. It is particularly superior to NCCT in detecting conditions of raised intracranial pressure, such as CVST and IIH, which are otherwise easily overlooked. We recommend that fundoscopy be considered an essential component of the physical exam for all headache patients presenting with red flags, and a mandatory screen for young women on hormonal contraceptives, regardless of the absence of focal neurological deficits. In the era of high-cost imaging, the "old-fashioned" ophthalmoscope remains one of the most cost-effective tools for ensuring patient safety and the judicious use of MRI/MRV resources.

Recommendations: Future studies should examine the cost-effectiveness of non-mydriatic fundus photography as a screening modality and formulate clinical decision rules for variable risk factors for fundoscopy. A multi-center prospective study would be of great help for determining risk factors for evaluating headaches for long-term follow-up.

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