e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(1); 760-765

Original Research Article

Ethambutol-Induced Toxic Optic Neuropathy Visual Effects

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Received: 26-11-2025 / Revised: 25-12-2025 / Accepted: 26-01-2026

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Conflict of interest: Nil

Abstract:

Background: Since there is currently no effective treatment for EON, stopping EMB as soon as possible is still the best way to stop the disease's progression and speed up visual recovery. As a result, early risk factor identification and EON detection are crucial.

Objectives: The aim of the study was to evaluate the visual outcomes of patients with ethambutol-induced toxic optic neuropathy and to identify clinical and structural factors associated with visual recovery following discontinuation of the drug.

Materials and Methods: It was a retrospective, observational study. The study was carried out at a tertiary care centre. The study data that was retrieved was for one year and six months, i.e., from April 2024 to October 2025. Data from 65 participants were retrieved for the study. Patients with ethambutol-induced optic neuropathy who were at least eighteen years old and had comprehensive ocular records, including visual acuity and OCT data, were included in the study.

Results: Patients were about 55 years old on average. Nearly 80% of individuals had both eyes affected. The majority had moderate to severe visual impairment at the time of presentation, with just 18.5% having relatively good vision (≥ 6/18). Severe vision loss was present in nearly two-fifths of individuals (< 6/60).

Conclusion: The study concluded that less than half of individuals with ethambutol-induced optic neuropathy showed improvement in their vision after stopping the medication.

Recommendations: All patients on ethambutol therapy should undergo routine baseline and follow-up ocular screening; high-risk people, such as the elderly and those with low baseline vision, should be closely monitored.

Keywords: EON, Toxic Optic Neuropathy, Ethambutol, Visual Outcomes, EMB, Ethambutol-induced Optic Neuropathy.

DOI: 10.25258/ijcpr.18.1.128

Introduction

A bacteriostatic antibiotic called ethambutol (EMB) is used in combination with other medications to treat illnesses brought on by the Mycobacterium group of organisms, most frequently tuberculosis (TB). Since 1960, it has been used extensively in anti-tubercular therapy, and since then, reports of its potential to impair vision have been made [1]. Recent research indicates that 1%–2% of persons globally suffer from EMB optic neuropathy (EON), which affects about 100,000 people annually [2, 3].

Over 25% of all new cases of tuberculosis worldwide were found in India, according to the World Health Organization's (WHO) 2019 Global TB report. Ethambutol-induced optic neuropathy (EON) currently has no effective treatment other than stopping the medication. On the other hand, early detection and stopping the medication may stop future decline in visual function [4].

If a patient experiences visual impairment, ethambutol should be stopped right away. In at least two-thirds of instances, vision impairments and field abnormalities continue or get worse even after stopping the medication. In order to avoid irreversible vision loss, early diagnosis of ethambutol poisoning is essential [5, 6, 7]. The thickness of the retinal nerve fiber layer (RNFL) on optical coherence tomography (OCT) is useful for the early diagnosis of toxic optic neuropathy, according to numerous studies that have examined the structural alterations [5, 8, 9].

Since there is currently no effective treatment for EON, stopping EMB as soon as possible is still the best way to stop the disease's progression and speed up visual recovery. As a result, early risk factor identification and EON detection are crucial. The average visual recovery is two lines on the Snellen chart, and full visual recovery is relatively uncommon, even though 30% to 64% of patients demonstrate some visual improvement over a period of many months with quick termination of EMB [10, 11].

Old age, initial visual acuity (VA) of less than 6/60, and loss of temporal peripapillary retinal nerve fiber layer (pRNFL) are clinical variables linked to poor visual results [12, 13]. However, there is currently little research on the visual recovery duration in EON patients. For patients and professionals who must wait for recovery after stopping the medication without receiving any further therapy, predicting the visual recovery period might be very helpful.

The study aimed to evaluate the visual outcomes of patients with ethambutol-induced toxic optic neuropathy and to identify clinical and structural factors associated with visual recovery following discontinuation of the drug.

Methodology

Study Design: The study was a retrospective, observational.

Study Settings: It was carried out at a tertiary care centre. The study data that was retrieved was for one year and six months, i.e., from April 2024 to October 2025.

Study Population: Data of 65 participants were retrieved for the study. Patients with ethambutol-induced optic neuropathy who were at least eighteen years old and had comprehensive ocular records, including visual acuity and OCT data, were included in the study. Patients with insufficient data, a history of eye damage or surgery, pre-existing ocular disease, or usage of other medications that cause optic neuropathy were not included.

Data Collection: Demographic parameters such as age, gender, length of ethambutol therapy, time to visual symptom onset, laterality of involvement, baseline best-corrected visual acuity (BCVA), color vision status, and visual field defects were all noted. The temporal peripapillary retinal nerve fiber layer (pRNFL) thickness was measured using optical coherence tomography (OCT). Following the cessation of ethambutol, visual outcomes such as improvement, no change, or worsening of eyesight were recorded.

Study Procedure: Best-corrected visual acuity (BCVA), color vision testing, visual field evaluation, and optical coherence tomography (OCT) assessments of temporal peripapillary retinal nerve fiber layer (pRNFL) thickness were among the baseline ophthalmic evaluations that were recorded. Visual results after stopping ethambutol were divided into three categories: improvement, no change, and worsening.

Statistical Analysis: The statistical analysis was conducted using SPSS version 26.0. Microsoft Excel was used to originally enter the data. The information has been displayed as mean±SD or as the number of participants (n) with percentages (%).

For statistical analysis, the independent t-test was employed. A p-value of less than 0.05 was considered to be statistically significant.

Results

Patients were about 55 years old on average. Nearly 80% of individuals had both eyes affected. The majority had moderate to severe visual impairment at the time of presentation, with just 18.5% having relatively good vision (≥ 6/18). Severe vision loss was present in nearly two-fifths of individuals (< 6/60). The demographics of research participants' patients are shown in Table 1.

Table 1: Patient's Demographics

Parameter	Value
Age (in years)	54.6 ± 12.8
Duration of ethambutol therapy (in months)	4.8 ± 1.6
Time to onset of visual symptoms (in months)	3.9 ± 1.4
Laterality of involvement	
Bilateral	51 (78.5)
Unilateral	14 (21.5)
Best-corrected visual acuity at presentation	
≥ 6/18	12 (18.5)
< 6/18 to ≥ 6/60	28 (43.1)
< 6/60	25 (38.4)
Color vision abnormality	48 (73.8)
Visual field defects	
Central/centrocecal scotoma	36 (55.4)
Generalized depression	19 (29.2)
Normal	10 (15.4)

Figure 1 shows the distribution of gender among study participants. 23 (35.4%) participants were female, while 42 (64.6%) participants were male among all.

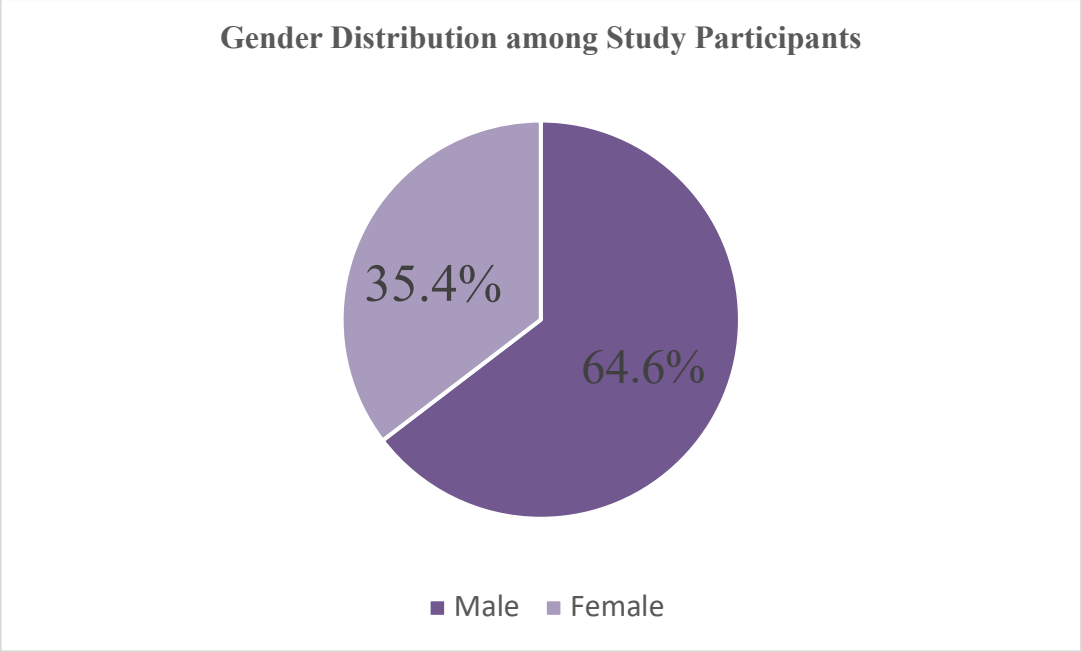

Figure 1: Distribution of Gender among Study Participants

While 55.4% of patients experienced poor visual results, 44.6% of patients showed visual improvement. The average improvement in visual acuity among patients who made progress was 2.1 ± 0.9 Snellen lines. With a p-value of 0.001, patients who had a poor visual outcome were considerably older (60.1 ± 11.4 years) than those who exhibited improvement (47.8 ± 10.6 years). Visual results following ethambutol withdrawal are shown in Table 2, along with related recovery factors.

Table 2. Visual Outcomes After Ethambutol Discontinuation along with Associated Recovery Factors

Parameter	Improved Vision (n = 29)	Non-Recovery (n = 36)	p-value
Visual outcome	29 (44.6)	36 (55.4)	-
Mean improvement in Snellen lines	2.1 ± 0.9	-	-
Age (in years)	47.8 ± 10.6	60.1 ± 11.4	**0.001**
Baseline BCVA (logMAR)	0.92 ± 0.34	1.46 ± 0.41	**< 0.001**
Temporal pRNFL thickness (in µm)	61.7 ± 7.8	49.3 ± 8.4	**< 0.001**
Color vision abnormality	17 (58.6)	31 (86.1)	**0.01**
Central/centrocecal scotoma	13 (44.8)	23 (63.9)	**0.04**

Figure 2 shows visual outcomes after discontinuation of ethambutol. 29 participants observed to have improvement in vision, while 27 had no improvement, and lastly, in 09 participants worsening of vision was observed.

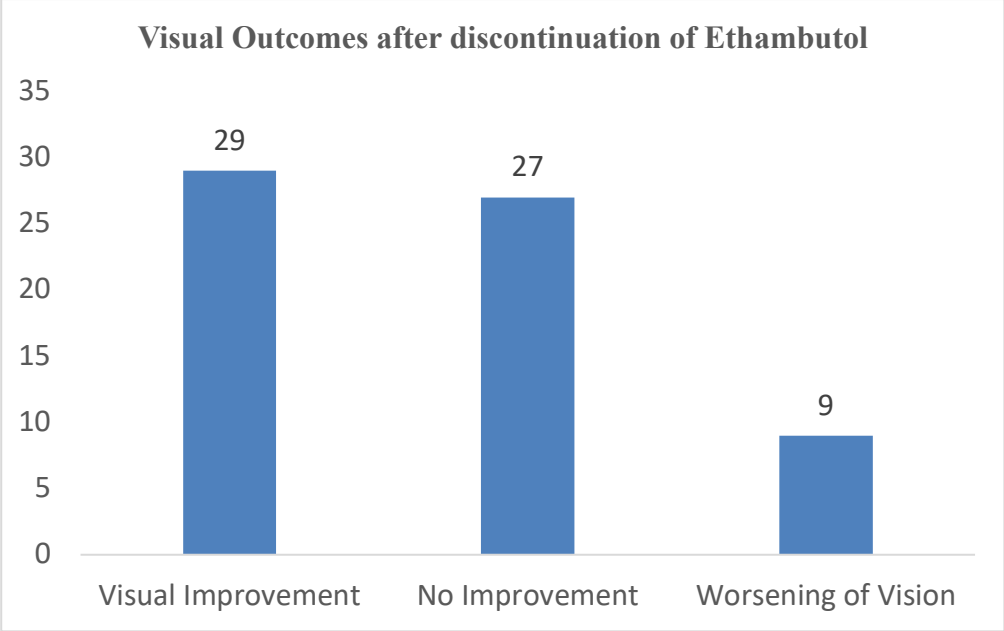

Figure 2: Visual Outcomes after Discontinuation of Ethambutol

Discussion

This retrospective study evaluated visual outcomes following the discontinuation of ethambutol and identified clinical and structural predictors of visual recovery. In this cohort, visual improvement was observed in 44.6% of patients, while 55.4% experienced no improvement or worsening of vision, highlighting the substantial burden of permanent visual impairment associated with EON.

The percentage of patients in this study who showed improvement in their vision is in line with earlier studies that reported partial visual recovery in between 30% and 64% of instances after stopping ethambutol [10, 11]. Nevertheless, full vision recovery is still rare, and typical improvement is usually modest. Patients who improved in this study obtained an average of 2.1 ± 0.9 Snellen lines, which is consistent with previous findings that most patients only regain one or two lines of visual acuity [10, 12].

Poor visual outcomes were shown to be significantly predicted by age. Patients who recovered poorly were considerably older than those who recovered well, indicating that aging may decrease the optic nerve's ability to regenerate or make it more vulnerable to ethambutol toxicity. Previous research has found that older age is a risk factor for irreversible visual loss in EON [12, 13]. This emphasizes how crucial it is to monitor older individuals getting ethambutol medication more closely and with increased attention.

Another significant predictor of visual outcome was baseline visual acuity at presentation. Visual improvement was substantially less common in patients with lower initial BCVA (higher logMAR values). This result corroborates earlier research showing that substantial visual impairment at the beginning is a sign of extensive optic nerve injury, which may not be reversible even after stopping medication quickly [5, 6].

RNFL thinning, especially in the temporal quadrant, has been repeatedly linked to a poorer visual prognosis and may be an early indicator of irreparable optic nerve damage [8, 9, 13]. Patients with poor visual outcomes were also considerably more likely to have functional deficiencies including central or centrocecal scotomas and anomalies in color vision. These characteristics indicate involvement of the central visual circuits and are typical of toxic optic neuropathy. Previous investigations have found similar correlations between central scotomas, poor recovery, and chronic color vision impairments [6, 7].

A significant percentage of patients in this trial continued to have steady or worsening eyesight even after stopping ethambutol, highlighting the fact that stopping the medication does not ensure visual recovery. This result is in line with other findings that imply optic nerve damage may worsen or stay the same even after stopping medication, especially if identification is delayed [5, 12].

There is no known effective treatment for EON other than quitting the medication. Patients with low plasma zinc levels have been found to have a higher risk of developing EON, which has been hypothesized to be caused by either disrupted oxidative phosphorylation due to decreased available copper in human mitochondria or inhibited lysosomal activation due to zinc chelation [14, 15, 16].

Conclusion

The study concluded that less than half of individuals with ethambutol-induced optic neuropathy showed improvement in their vision after stopping the medication. Poor visual outcomes were linked to temporal pRNFL thinning, older age, and low baseline visual acuity. The results emphasize the need for early identification and timely ethambutol withdrawal in preventing irreversible vision loss.

Limitations

It might not be possible to generalize the results of this study to a larger population because it was carried out in a single urban tertiary care facility. Furthermore, the study's sample size was insufficient for extrapolating results and drawing inferences.

Recommendations

All patients on ethambutol therapy should undergo routine baseline and follow-up ocular screening; high-risk people, such as the elderly and those with low baseline vision, should be closely monitored. Since early drug withdrawal is essential to prevent irreversible visual loss and improve visual results, any visual problems should be promptly evaluated, and ethambutol should be stopped.

List of Abbreviations

BCVA- Best-Corrected Visual Acuity

EON- Ethambutol-Induced Optic Neuropathy

EMB- Ethambutol

OCT- Optical Coherence Tomography

pRNFL- Peripapillary Retinal Nerve Fiber Layer

RNFL- Retinal Nerve Fiber Layer

TB- Tuberculosis

VA- Visual Acuity

WHO- World Health Organization

References

1. RE C. Ocular manifestation of ethambutol. Arch Ophthalmol. 1962; 67:566-71.
2. Chamberlain PD, Sadaka A, Berry S, Lee AG. Ethambutol optic neuropathy. Current opinion in ophthalmology. 2017 Nov 1;28(6):545-51.
3. Sadun AA, Wang MY. Ethambutol optic neuropathy: how we can prevent 100,000 new cases of blindness each year. Journal of Neuro-Ophthalmology. 2008 Dec 1;28(4):265-8.
4. Saxena R, Phuljhele S, Prakash A, Lodha R, Singh D, Karna S, Mohan A, Gandhi R, Menon V, Garg R. Ethambutol Optic Neuropathy: Vigilance and Screening, the Keys to Prevent Blindness with the Revised Anti-tuberculous Therapy Regimen. The Journal of the Association of Physicians of India. 2021 Feb 1;69(2):54-7.
5. Saxena R, Phuljhele S, Prakash A, Lodha R, Singh D, Karna S, Mohan A, Gandhi R, Menon V, Garg R. Ethambutol Optic Neuropathy: Vigilance and Screening, the Keys to Prevent Blindness with the Revised Anti-tuberculous Therapy Regimen. The Journal of the Association of Physicians of India. 2021 Feb 1;69(2):54-7.
6. Menon V, Jain D, Saxena R, Sood R. Prospective evaluation of visual function for early detection of ethambutol toxicity. British journal of ophthalmology. 2009 Sep 1;93(9):1251-4.
7. Kim KL, Park SP. Visual function test for early detection of ethambutol induced ocular toxicity at the subclinical level. Cutaneous and ocular toxicology. 2016 Jul 2;35(3):228-32.
8. Chai SJ, Foroozan R. Decreased retinal nerve fibre layer thickness detected by optical coherence tomography in patients with ethambutol-induced optic neuropathy. British journal of ophthalmology. 2007 Jul 1;91(7):895-7.
9. Pavan Taffner BM, Mattos FB, Cunha MC, Saraiva FP. The use of optical coherence tomography for the detection of ocular toxicity by ethambutol. PLoS One. 2018 Nov 8;13(11):e0204655.
10. Chen HY, Lai SW, Muo CH, Chen PC, Wang IJ. Ethambutol-induced optic neuropathy: a nationwide population-based study from Taiwan. British journal of ophthalmology. 2012 Nov 1;96(11):1368-71.
11. Ezer N, Benedetti A, Darvish-Zargar M, Menzies D. Incidence of ethambutol-related visual impairment during treatment of active tuberculosis. The International journal of tuberculosis and lung disease. 2013 Apr 1;17(4):447-55.
12. TSAI RK, LEE YH. Reversibility of ethambutol optic neuropathy. Journal of ocular pharmacology and therapeutics. 1997 Oct;13(5):473-7.
13. Lee JY, Choi JH, Park KA, Oh SY. Ganglion cell layer and inner plexiform layer as predictors of vision recovery in ethambutol-induced optic neuropathy: a longitudinal OCT analysis. Investigative Ophthalmology & Visual Science. 2018 Apr 1;59(5):2104-9.
14. Chung H, Yoon YH, Hwang JJ, Cho KS, Koh JY, Kim JG. Ethambutol-induced toxicity is mediated by zinc and lysosomal membrane permeabilization in cultured retinal cells. Toxicology and applied pharmacology. 2009 Mar 1;235(2):163-70.
15. Kozak SF, Inderlied CB, Hsu HY, Heller KB, Sadun AA. The role of copper on ethambutol's

antimicrobial action and implications for ethambutol-induced optic neuropathy. Diagnostic microbiology and infectious disease. 1998 Feb 1;30(2):83-7.
16. De Palma P, Franco F, Bragliani G, Michetti L, Marescotti A, Pirazzoli G, Fiorenza M. The incidence of optic neuropathy in 84 patients treated with ethambutol. Metabolic, Pediatric, and Systemic Ophthalmology (New York, NY: 1985). 1989 Jan 1;12(1-3):80-2.