Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/zzxyxz54

ACCELERATED VISUAL RECOVERY IN CENTRAL SEROUS CHORIORETINOPATHY: EFFICACY OF MEDICAL AND LASER INTERVENTIONS

Dr. Nisha Bathla[1]*, Dr. Perwez Khan[2], Dr. Manni Punyani[3]

[1]*Consultant Ophthalmologist, Niranjana Healthcare, Khatima, Udham Singh Nagar District, Uttarakhand, India.
[2]Professor, Department of Ophthalmology, GSVM Medical College, Kanpur, Uttar Pradesh, India.
[3]Consultant Anaesthetist, Civil Hospital, Khatima, Udham Singh Nagar District, Uttarakhand, India.

***Corresponding Author:** Dr. Nisha Bathla
*Consultant Ophthalmologist, Niranjana Healthcare Khatima, Uttarakhand, India Email: nisha.bathla@rediffmail.com

ABSTRACT

OBJECTIVES: To evaluate and compare the time taken for visual recovery, final visual outcomes, recurrence rates, and complications in patients with Central Serous Chorioretinopathy (CSCR) who were managed with observation, oral acetazolamide, and double-frequency Nd-YAG laser photocoagulation.

METHODS: This prospective, randomised, interventional, and comparative study was conducted over one year at a tertiary care centre. A total of 56 patients diagnosed with CSCR were enrolled; 48 completed the study. Patients were divided into three groups: Group A (observation), Group B (oral acetazolamide), and Group C (laser photocoagulation). All patients underwent baseline and follow-up assessments at 2, 4, 6, and 12 weeks, including best-corrected visual acuity (BCVA), fundus examination, and fluorescein angiography. BCVA was converted to logMAR for statistical analysis. Visual outcomes and intergroup comparisons were analysed using an unpaired Student's t-test with a significance threshold of $p<0.05$.

RESULTS: A significant improvement in BCVA was observed earliest in Group C (laser) by 2 weeks ($p < 0.001$), with sustained improvement at all subsequent follow-ups. Group B (acetazolamide) showed a gradual but significant improvement, beginning at 2 weeks ($p < 0.05$), which became highly substantial by 4 weeks onward ($p < 0.001$). Group A (observation) showed considerable improvement only after 6 weeks. At 12 weeks, visual acuity outcomes were statistically similar across all groups. No significant complications were noted; however, mild side effects were observed in the acetazolamide group. Recurrence was reported in Groups A and B (12.5% each), while none occurred in Group C.

CONCLUSIONS: Both acetazolamide and laser photocoagulation expedite visual recovery in CSCR compared to observation alone. Laser treatment offers the fastest improvement but requires specialised infrastructure, while acetazolamide provides a viable, cost-effective alternative.

Keywords: Central Serous Chorioretinopathy, Visual Outcome, Acetazolamide, Laser Photocoagulation, Nd-YAG, Observation, Retinal Detachment

INTRODUCTION

Central Serous Chorioretinopathy (CSCR) is an idiopathic retinal disorder characterised by serous detachment of the neurosensory retina secondary to leakage through a defective retinal pigment epithelium (RPE), typically localised to the macular region. It predominantly affects young to middle-aged men and is commonly associated with type-A personality traits, stress, corticosteroid use, and systemic hypertension [1,2]. The disorder often presents with an acute onset of blurred vision, central scotoma, metamorphopsia, micropsia, and colour desaturation. Optical Coherence Tomography (OCT) and Fundus Fluorescein Angiography (FFA) play a crucial role in confirming the diagnosis, as they reveal a dome-shaped elevation of the neurosensory retina and characteristic ink-blot or smoke-stack leakage patterns, respectively [3,4].

While acute CSCR is typically self-limiting and may resolve spontaneously within 3–4 months, a subset of patients requires intervention due to persistent or recurrent fluid accumulation, visual disability, or occupational constraints [5]. In such cases, pharmacological options, such as carbonic anhydrase inhibitors (e.g., acetazolamide) and focal laser photocoagulation, have been explored. Acetazolamide enhances subretinal fluid (SRF) absorption by influencing the polarity and pump function of the RPE [6]. On the other hand, focal laser photocoagulation using a green or double-frequency Nd: YAG laser accelerates fluid reabsorption by sealing the leakage point and inducing localised RPE remodelling [7].

Given the socioeconomic impact of prolonged visual impairment in a working-age population and the therapeutic variability across treatment modalities, there remains a need for comparative studies evaluating the efficacy of these options. Hence, this study was undertaken to assess the time to visual recovery, final visual outcome, recurrence rate, and complication profile in patients with CSCR managed with observation, oral acetazolamide, and laser photocoagulation.

Purpose of the Study

To evaluate and compare the visual outcomes and recurrence patterns in CSCR patients treated with observation, oral acetazolamide, and Nd-YAG laser photocoagulation.

MATERIALS AND METHODS

Study Design and Duration

This was a prospective, randomised, interventional, and comparative clinical trial conducted over a period of one year (January 2016 to December 2016) in the Department of Ophthalmology, GSVM Medical College, Kanpur, Uttar Pradesh, India.

Study Population

A total of 56 patients clinically diagnosed with central serous chorioretinopathy (CSCR) were initially enrolled based on predefined inclusion and exclusion criteria. Of these, 48 patients completed the study; 8 were lost to follow-up. All participants provided written informed consent before enrollment.

Ethical Consideration

The study protocol was approved by the Institutional Ethics Committee before initiation. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki, which governs biomedical research involving human subjects.

Inclusion Criteria:

- Male and female patients aged 20–50 years
- Clinical diagnosis of CSCR with confirmed findings on Optical Coherence Tomography (OCT) and Fluorescein Angiography (FA)
- Clear ocular media and visual axis
- Willingness to participate and comply with follow-up schedule

Exclusion Criteria:

- Patients with diabetic retinopathy, hypertensive retinopathy, cystoid macular edema, choroidal neovascular membrane (CNVM), or ischemic maculopathy
- Ocular media opacities precluding retinal evaluation
- History of hypersensitivity to fluorescein dye
- Pregnant or lactating women

Grouping and Treatment Protocol

Patients were randomly allocated into three groups (n = 16 each) using a computer-generated random number table:

- **Group A:** Observation only
- **Group B:** Treated with oral acetazolamide (FDC Ltd., Mumbai, India). The dosage regimen was 250 mg three times daily (t.d.s.) for 2 weeks, followed by 125 mg t.d.s. for the next 2 weeks, and then 125 mg twice daily (b.d.) for 2 additional weeks. The drug was administered per os (p.o.).
- **Group C:** Underwent focal laser photocoagulation using a double-frequency Nd: YAG green laser (532 nm) (Novus Spectra™, Lumenis Ltd., Israel). Laser parameters included 2–3 focal burns directed at the leakage point, using a 100 μm spot size, 0.1-second duration, and power titrated to produce a mild grey burn.

Ophthalmic Evaluation and Data Collection

All participants underwent a detailed ophthalmic examination, including:

- Best Corrected Visual Acuity (BCVA) using Snellen's chart
- Slit-lamp biomicroscopy
- Fundus evaluation with direct ophthalmoscope, indirect ophthalmoscope, and 90D lens
- Optical Coherence Tomography (OCT) (Cirrus HD-OCT 5000, Carl Zeiss Meditec, Germany)
- Fundus Fluorescein Angiography (FFA) (TRC-50DX, Topcon Corp., Japan) performed at baseline, 2 weeks, 6 weeks, and 12 weeks

Follow-up was scheduled at 2 weeks, 4 weeks, 6 weeks, and 12 weeks post-treatment. At each visit, BCVA and fundus findings were recorded, and metamorphopsia was assessed using the Amsler grid.

Statistical Analysis

BCVA values from Snellen's chart were converted to the logarithm of the minimum angle of resolution (logMAR) for statistical analysis. Data were expressed as mean ± standard deviation (SD). Comparison of mean change in visual acuity across time points within and between groups was performed using Student's unpaired t-test. Statistical significance was set at $p<0.05$, while $p<0.001$ was considered highly significant. Software used: SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

Outcome Measures:

- **Primary Outcome:** Time to visual improvement and change in BCVA
- **Secondary Outcomes**: Presence of metamorphopsia, treatment-related complications, and recurrence rate at 12 months

Reproducibility:

All procedures, including OCT and FA interpretation, were performed and verified by two independent retina specialists to ensure diagnostic reliability. Randomisation, drug administration, and laser delivery were performed according to standard, reproducible protocols documented in departmental operating procedures.

RESULTS

A total of 48 patients completed the study. They were equally divided into three groups: Group A (Observation), Group B (Acetazolamide), and Group C (Laser Photocoagulation), with 16 patients in each group.

Among the 48 patients, 41 were male (85.4%) and 7 were female (14.6%). The sex distribution was comparable across all three groups (Table 1).

Table 1: Sex Distribution of Participants

Sex	Group A (n=16)	Group B (n=16)	Group C (n=16)	Total (n=48)
Male	14	13	14	41 (85.4%)
Female	2	3	2	7 (14.6%)

The most common age group was 31–35 years across all three groups (Table 2).

Table 2: Age Distribution of Study Participants

Age Group (years)	Group A	Group B	Group C	Total
21–25	2	1	2	5
26–30	4	3	2	9
31–35	7	8	8	23
36–40	2	3	3	8
41–45	1	1	1	3

Group A (Observation) exhibited only minimal improvement in visual acuity at 2 and 4 weeks, with statistically significant improvement becoming evident only from 6 weeks onward. In contrast, Group B (Acetazolamide) demonstrated a statistically significant improvement beginning at 2 weeks ($p<0.05$), which became highly significant at 4, 6, and 12 weeks ($p<0.001$), indicating a sustained and progressive benefit of medical therapy. Group C (Laser) showed a highly significant improvement as early as 2 weeks, and this effect remained consistently significant at all subsequent follow-ups ($p<0.001$)(Table & Figure 3)

Table 3: Mean logMAR Visual Acuity at Follow-up in All Groups

Week	Group A (Observation)	Group B (Acetazolamide)	Group C (Laser)
0	0.30 ± 0.04	0.30 ± 0.05	0.30 ± 0.04
2	0.28 ± 0.05	0.21 ± 0.03	0.12 ± 0.02
4	0.27 ± 0.04	0.15 ± 0.02	0.10 ± 0.01
6	0.21 ± 0.03	0.11 ± 0.01	0.08 ± 0.01
12	0.10 ± 0.02	0.08 ± 0.01	0.06 ± 0.01

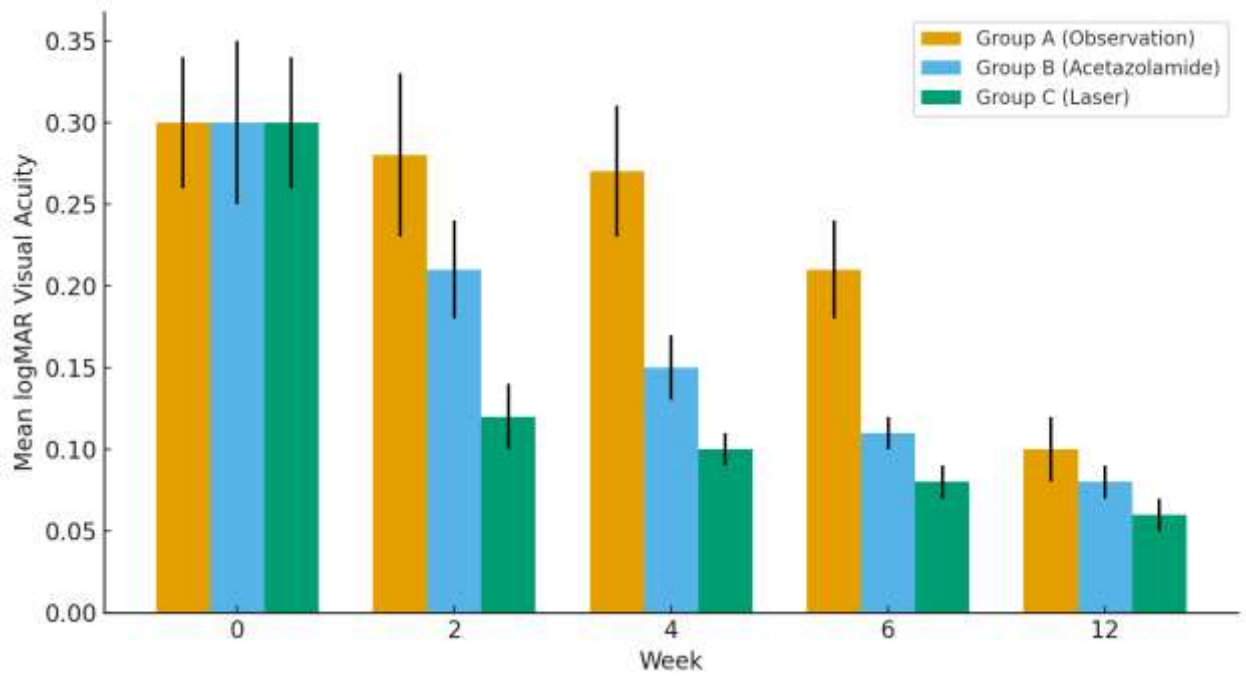

Figure 1: Line Graph Showing Change in Mean logMAR Over Time in Group A, B, and C

When comparing intergroup differences in visual acuity improvement, a statistically significant difference was observed between Group A (Observation) and Group B (Acetazolamide) at the 4th and 6th weeks. In contrast, no significant difference was noted at the 12th week. Between Group A and Group C (Laser), a highly significant difference was found at 2, 4, and 6 weeks. Similarly, comparison between Group B and Group C revealed a highly significant difference at 2 and 4 weeks, which reduced to a moderately significant level by 6 weeks and became non-significant at the 12-week follow-up (Table 4).

Table 4: Intergroup Comparison of BCVA Improvement at Follow-up Intervals

Time Point	A vs B	A vs C	B vs C
2 weeks	0.12 (NS)	<0.001 (HS)	<0.001 (HS)
4 weeks	<0.05 (S)	<0.001 (HS)	<0.001 (HS)
6 weeks	<0.01 (HS)	<0.001 (HS)	<0.05 (S)
12 weeks	>0.05 (NS)	>0.05 (NS)	>0.05 (NS)

At the 12-week follow-up, residual metamorphopsia was reported in 6 patients (37.5%) in Group A, 5 patients (31.25%) in Group B, and 6 patients (37.5%) in Group C. The distribution was comparable across all groups, with no statistically significant difference observed in the incidence of residual metamorphopsia (Table 5).

Table 5: Presence of Residual Metamorphopsia at 12 Weeks

Group	Number of Patients with Metamorphopsia	Percentage (%)
Group A	6	37.5%
Group B	5	31.25%
Group C	6	37.5%

In Group B, 5 patients (31.25%) experienced mild paresthesia and numbness as adverse effects related to oral acetazolamide therapy. In contrast, no adverse effects were observed in Group C; specifically, there were no cases of choroidal neovascularisation, foveal distortion, central scotoma, or subretinal fibrosis following laser photocoagulation (Table 6).

Table 6: Treatment-Related Complications

Group	Type of Complication	Number of Patients	Percentage (%)
Group B	Paresthesia	5	31.25%
Group C	None reported	0	0%

During the one-year follow-up period, recurrence of CSCR was observed in 2 patients (12.5%) in each of Groups A and B. In contrast, no recurrence was reported in Group C, indicating sustained resolution in patients treated with laser photocoagulation (Table 7).

Table 7: Recurrence Rate Across Groups at 1-Year Follow-up

Group	Number of Recurrences	Percentage (%)
Group A	2	12.5%
Group B	2	12.5%
Group C	0	0%

DISCUSSION

This study investigated and compared the visual outcomes of three different management approaches for Central Serous Chorioretinopathy (CSCR): observation, oral acetazolamide therapy, and focal laser photocoagulation using a double-frequency Nd:YAG laser. The results revealed that both

acetazolamide and laser therapy significantly hastened visual recovery compared to observation alone, particularly within the first 6 weeks of treatment. At 12 weeks, however, the visual acuity outcomes across all groups were statistically similar, indicating that CSCR is fundamentally a self-limiting disease in the majority of cases.

The early response observed in Group C (laser) is in concordance with the findings of Samy et al. (1994), who reported that laser photocoagulation induced rapid resolution of subretinal fluid and improved visual acuity within the first few weeks of intervention [8]. Similarly, the highly significant improvement in visual acuity by 2 weeks in our study supports the efficacy of early focal laser treatment in expediting anatomical and functional recovery in acute CSCR. Notably, no complications, such as central scotoma, choroidal neovascularisation, or foveal distortion, were reported, aligning with the safety profile demonstrated by Lim et al. (2011), who found that subfoveal leak treatment with navigated laser showed no significant adverse events [9].

Acetazolamide therapy (Group B) also showed statistically significant improvements in visual acuity, beginning at 2 weeks, with sustained benefits throughout the follow-up period. This supports earlier studies by Cox et al. (1988), which demonstrated that carbonic anhydrase inhibitors improve RPE pump function and accelerate subretinal fluid absorption [10]. Furthermore, Wolfensberger et al. (2000) highlighted that acetazolamide alters RPE polarity and facilitates fluid reabsorption, corroborating our findings of sustained visual gain [11]. Nonetheless, 31.25% of patients in this group experienced paresthesia and numbness—side effects consistent with those previously reported for systemic acetazolamide use.

Interestingly, by the 12-week mark, the difference in visual acuity between the three groups was no longer statistically significant. This suggests that while pharmacological or laser intervention accelerates recovery, spontaneous resolution is likely in most cases within three months—a phenomenon well documented by Klein et al. (1974) and corroborated in our observational group [12]. However, from a functional and socioeconomic standpoint, early resolution may be critical in patients whose occupations depend on optimal visual acuity, especially monocular individuals or those involved in visually demanding tasks.

Regarding recurrence, laser-treated patients showed no relapses during the one-year follow-up period, while 12.5% of patients in both observation and acetazolamide groups experienced recurrences. This recurrence rate is comparable to that reported by Loo et al. (2015), who found higher recurrence in untreated or medically managed CSCR than in laser-treated patients [13].

A key strength of our study lies in its randomised design and prospective follow-up. The consistency in BCVA assessment protocols and the use of objective imaging techniques enhance the reliability of the findings. However, the study has several limitations. Firstly, the sample size is modest, limiting the generalizability of the results. Secondly, the short-term follow-up (12 weeks) may not accurately reflect long-term visual stability or recurrence. Thirdly, the exclusion of chronic CSCR patients limits the extrapolation of the findings to recurrent or persistent disease.

Another potential limitation is the absence of a placebo control in the medical therapy arm. Additionally, the study did not include alternative treatment modalities such as eplerenone or photodynamic therapy, which are emerging options in the management of CSCR and might yield different outcomes.

CONCLUSION

In conclusion, this study demonstrates that both acetazolamide and laser photocoagulation are effective in accelerating visual recovery in acute CSCR compared to observation alone. Laser treatment offers the fastest improvement but requires technical expertise and equipment, while oral acetazolamide remains a practical and accessible choice for general ophthalmologists. Given the self-limiting nature of the disease, intervention should be considered based on the patient's visual needs, risk of recurrence, and occupational demands. Future studies with larger sample sizes and longer follow-up are warranted to explore the long-term outcomes and comparative effectiveness of newer therapeutic agents.

ABBREVIATIONS

- **CSCR** – Central Serous Chorioretinopathy
- **BCVA** – Best Corrected Visual Acuity
- **RPE** – Retinal Pigment Epithelium
- **OCT** – Optical Coherence Tomography
- **FFA** – Fundus Fluorescein Angiography
- **SRF** – Subretinal Fluid
- **Nd: YAG** – Neodymium-Doped Yttrium Aluminium Garnet (laser)

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this study.

SOURCES OF FUNDING

None.

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