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Original Research Article

A PROSPECTIVE, LONGITUDINAL, OBSERVATIONAL STUDY ON EFFICACY OF FOCAL LASERS IN CENTRAL SEROUS CHORIORETINOPATHY

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ABSTRACT

Background: Central Serous Chorioretinopathy (CSR) is a retinal disorder characterized by the accumulation of subretinal fluid and can significantly impact vision. The condition's management and outcomes vary with treatment approaches and patient demographics. This study aimed to evaluate the efficacy of laser treatment in CSR and analyze the associated risk factors, patient demographics, and visual outcomes.

Materials and Methods: This randomized controlled trial was conducted at a tertiary care hospital. Sixty patients with CSR, meeting specific inclusion and exclusion criteria, were enrolled. Patients were randomly assigned to receive either laser treatment or were placed in a control group. The study involved baseline, 4-week, and 12-week assessments of central macular thickness (CMT) and best-corrected visual acuity (BCVA) using optical coherence tomography (OCT) and fundus fluorescein angiography (FFA). Risk factors and demographic data were collected through comprehensive patient history.

Results: At baseline, the mean CMT for the control group was 414.6 ± 83.47 µm, while the laser group had a mean of 422.3 ± 92.36 µm ($p = 0.736$). At 4 weeks, the laser group showed a significant reduction in CMT (257.97 ± 63.61 µm) compared to the control group (309.83 ± 47.71 µm, $p = 0.001$). At 12 weeks, CMT further decreased in the laser group (215.10 ± 22.08 µm) versus the control group (260.57 ± 38.07 µm, $p = 0.000$). BCVA also improved significantly in the laser group at both 4 weeks and 12 weeks. Risk factors identified included recent mental stress (38.3%), type A personality (28.3%), and smoking (26.7%). Systemic steroid use was notably linked to bilateral CSR.

Conclusion: Laser treatment for CSR significantly reduces central macular thickness and improves visual acuity compared to the control group, with no adverse effects reported. The study underscores the role of managing modifiable risk factors such as stress and steroid use to optimize treatment outcomes in CSR.

Keywords: Central Serous Chorioretinopathy, Laser Treatment, Central Macular Thickness, Best-Corrected Visual Acuity, Optical Coherence Tomography.

INTRODUCTION

Central Serous Chorioretinopathy (CSR) is an idiopathic condition marked by serous detachment of the sensory retina at the macula due to leakage from the choriocapillaris through hyperpermeable Retinal Pigment Epithelium (RPE) sites.[1] Typically, CSR affects the central macula and has an age- and sex-adjusted incidence of 5–6 per 100,000 people. Predominantly occurring in middle-aged individuals (20–50 years), CSR shows a higher prevalence in men, with a male-to-female ratio of 3:1. The condition is more common in Caucasians, Hispanics, and Asians, while being relatively rare in African Americans.[2]

Various risk factors have been identified for CSR. Individuals with type A personalities and those experiencing significant mental stress are at higher risk. This was highlighted by Yannuzzi, who showed a higher prevalence of CSR in individuals with type A personalities.[3] Endogenous and exogenous hypercortisolism, including the use of corticosteroids and psychotropic medications, has also been linked to CSR. Other contributing factors include antibiotics, pregnancy, untreated hypertension, allergic respiratory diseases, and alcohol consumption.[4]

CSR symptoms primarily include vision reduction and distortions such as micropsia, metamorphopsia, scotomas, and chromatopsia.[5] Visual acuity usually ranges from mildly reduced to severely affected in recurrent cases, and the condition tends to be unilateral in younger patients and bilateral in older ones.[5]

Clinical presentation of CSR can vary, including classic acute chorioretinopathy, chronic diffuse retinal pigment epitheliopathy (DRPE), and bullous retinal detachment. Acute CSR, the most common form, manifests as a well-circumscribed neurosensory detachment at the macula with a characteristic halo. Retinal Pigment Epithelial Detachments (PEDs) are also frequently observed.[6]

Investigations for CSR include Fundus Fluorescein Angiography (FFA), which reveals hyperfluorescent leakage spots at the RPE level in acute cases, with patterns such as ink blot and smokestack leakage. Fundus Autofluorescence imaging helps assess the status of the RPE and outer retina, indicating increased autofluorescence in acute CSR due to heightened metabolic activity of the RPE.[7] Optical Coherence Tomography (OCT) provides anatomical details, detecting subretinal fluid and associated PEDs. Indocyanine Green Angiography (ICG) highlights areas of choroidal vascular hyperpermeability, especially in DRPE cases.[8]

Most CSR cases resolve spontaneously within three months, with significant visual recovery. However, some patients may continue to experience symptoms like reduced color vision, relative scotomas, and metamorphopsia due to photoreceptor damage or subretinal fibrosis. Recurrences are common and can lead to persistent or recurrent leaks, with a small percentage of cases progressing to DRPE or secondary choroidal neovascularization (CNV).[9]

Treatment typically involves observation, lifestyle modifications, and discontinuation of corticosteroids. In persistent cases, various treatments aim to hasten subretinal fluid resolution and reduce choroidal hyperpermeability. These include medical therapies like mineralocorticoid antagonists, laser photocoagulation, and photodynamic therapy (PDT).[9] Laser photocoagulation is effective for focal leaks, while PDT, a newer modality, shows promise for chronic CSR by inducing ischemia in the choriocapillaries to reduce fluid leakage and serous detachment.[10] So, the present study aimed to evaluate the efficacy of focal laser in patients diagnosed as CSR with extrafoveal leakage, in terms of visual acuity and central macular thickness and comparing it with the control group.

MATERIAL AND METHODS

Study Setting and Design

This study was conducted at a tertiary care centre, focussing on 60 patients with CSR attending the Ophthalmology OPD for a period of 2 years. It was designed as a randomized controlled trial to evaluate the efficacy of laser treatment for patients diagnosed with Central Serous Chorioretinopathy (CSR).

Study Participants and Sample Size

A total of 60 patients diagnosed with CSR were included in the study. Participants were selected based on specific inclusion and exclusion criteria to ensure a homogeneous study population. The inclusion criteria were: presence of subretinal fluid involving the fovea for 3 months or longer, as observed in optical coherence tomography (OCT) images; CSR-induced leakage 500 µm away from the fovea, as demonstrated in fundus fluorescein angiography (FFA); history of CSR in the other eye with an unfavorable outcome; and visual acuity of 6/12 (logMAR 0.3) or worse. Exclusion criteria included serous retinal detachment unrelated to CSR; eyes with a history of previous photodynamic therapy or laser photocoagulation; and patients with ocular infections or inflammatory diseases.

Data Collection

Data were collected through a comprehensive set of ophthalmic evaluations and imaging techniques. This included thorough history taking to identify potential risk factors for CSR; visual acuity testing using automated refractometry and subjective best-corrected visual acuity measurements; Amsler Grid assessment for visual distortion; slit lamp examination; slit lamp biomicroscopy with a 90D lens; indirect ophthalmoscopy; fundus fluorescein angiography (FFA); and optical coherence tomography (OCT).

Study Procedure and Follow-Up

Patients who met the inclusion criteria were randomly assigned to either the laser treatment group or the control group. In the laser treatment group, pinpoint leaks were treated with focal laser photocoagulation, using parameters of a spot size of 100 µm, power of 100 mW, and duration of 100 ms. Each leak was treated with 3 confluent burns. Follow-up assessments were scheduled at 4 weeks and 12 weeks post-laser treatment. During each visit, visual acuity was reassessed, and slit lamp examination, dilated fundus examination with a 90D lens, and indirect ophthalmoscopy were performed. OCT was repeated to monitor changes in central macular thickness and subretinal fluid status.

Statistical Analysis

Statistical analysis was conducted using IBM SPSS version 26.0., (IBM Co., Armonk, NY, USA) Data

were presented as arithmetic means (standard deviation) and frequency (%). Statistical comparisons between the laser treatment group and the control group were conducted using paired sample t-test to determine the efficacy of the intervention, with results considered statistically significant at a p-value of <0.05.

RESULTS

The study population consisted of 60 patients with Central Serous Chorioretinopathy (CSR). The age distribution was as follows: 11.7% of patients were between 21-30 years, 55.0% were between 31-40 years, 25.0% were between 41-50 years, and 8.3% were over 50 years. The majority of patients were male, accounting for 73.3% of the study population, while females comprised 26.7%. Regarding risk factors, recent mental stress was reported by 38.3% of patients, type A personality was noted in 28.3%, smoking was observed in 26.7%, sleep disturbance in 21.7%, alcoholism in 15.0%, steroid usage in 13.3%, hypertension in 11.7%, and diabetes in 8.3% of patients. A history of steroid use was present in 13.3% of patients, with 10.0% using oral steroids, 1.7% using topical steroids, and 1.7% using nasal spray steroids. The remaining 86.7% of patients had no history of steroid use. [Table 1]

The study analyzed various clinical characteristics of patients with Central Serous Chorioretinopathy (CSR). Laterality assessment showed that 83.3% of patients had unilateral involvement, while 16.7% had bilateral involvement. Best-corrected visual acuity (BCVA) was categorized as follows: 5.0% of patients had a BCVA of 6/6 to 6/12 (logMAR 0–0.3), 66.7% had a BCVA of 6/18 to 6/24 (logMAR 0.5–0.6), and 28.3% had a BCVA of 6/36 to 6/60 (logMAR 0.8–1). In terms of complaints, 73.3% of patients reported experiencing central scotoma, while 26.7% reported metamorphopsia. Recurrence data showed that 18.3% of patients experienced recurrence in either eye, with 11.7% experiencing recurrence in the same eye and 16.7% in the other eye. Meanwhile, 71.7% had no recurrence. The fluorescein angiography (FFA) pattern revealed an ink blot pattern in 65.0% of patients and a smoke stack pattern in 35.0%. Additionally, retinal pigment epithelium (RPE) changes were noted in 28.3% of patients, and pigment epithelial detachment (PED) was present in 25.0% of patients. The site of leakage was identified as STQ in 20.0% of patients, ITQ in 25.0%, SNQ in 40.0%, and INQ in 15.0% of patients. [Table 2 and Figure 1]

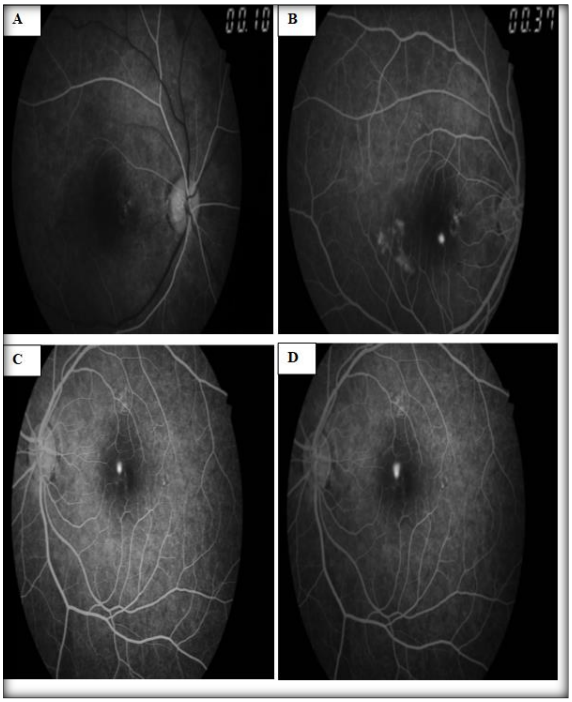

Figure 1: A and B: Fundus fluorescein angiography of right 50-years old patient showing ink blot pattern of leakage. C and D: Fundus fluorescein angiography of 39-years old patient showing smoke stack pattern of leakage

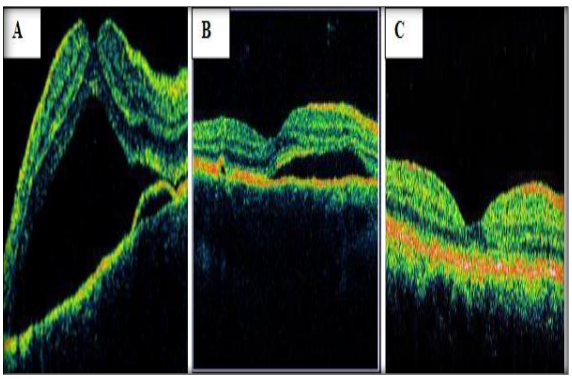

Figure 2: 20-years old patient from study group showing resolution of the detachment on OCT. A: At Baseline. B: At 4 weeks. C: At 12 weeks

Based on the results from the study, the baseline measurements showed no significant difference between the control and laser groups in terms of Central Macular Thickness (CMT) and Best-Corrected Visual Acuity (BCVA), with p-values of 0.736 and 0.188, respectively. At 4 weeks, there was a statistically significant reduction in CMT in the laser group compared to the control group (257.97 ± 63.61 vs. 309.83 ± 47.71, p = 0.001), and a significant improvement in BCVA (0.20 ± 0.16 vs. 0.43 ± 0.21, p < 0.001). By 12 weeks, the laser group continued to show a more significant reduction in CMT (215.10 ± 22.08 vs. 260.57 ± 38.07, p < 0.001) and greater improvement in BCVA (0.08 ± 0.11 vs. 0.22 ± 0.17, p = 0.001) compared to the control group. There was a 25.3% decrease in the central macular thickness of the

control group and and 38.3% decrease in the study group. There was a 37.3% decrease in central macular thickness at 12 weeks from the baseline in the control group. This was statistically significant ($p<0.01$) by paired t test. The decrease in CMT of the laser group at 12 weeks was a 49% which was statistically significant ($p <0.01$). [Table 3 and Figure 2]

Since the difference between the laser groups and control groups in terms of visual acuity and Central Macular Thickness is significant by paired t test, the effect size analysis is done to assess the usefulness of the intervention. As depicted in the table the effect between baseline and the 12 months for CMT is 0.76 for the control group however the effect for the study group is 0.84. Similarly, the r= 0.78 for the control group whereas it is 0.88 for the laser group. This shows that the focal laser has a significant effect in the reduction of the central macular thickness and improvement in visual acuity when compared with the control group. [Table 4]

Table 1: Baseline characteristics of the patients diagnosed with Central Serous Chorioretinopathy (CSR)

Variables	Number	%
Age (in years)		
21-30	7	11.7
31-40	33	55.0
41-50	15	25.0
>50	5	8.3
Sex		
Male	44	73.3
Female	16	26.7
Risk factors		
Recent Mental Stress	23	38.3
Type A Personality	17	28.3
Smoking	16	26.7
Sleep Disturbance	13	21.7
Alcoholism	9	15.0
Steroid Usage	8	13.3
Hypertension	7	11.7
Diabetes	5	8.3
History of steroid use		
Present	8	13.3
Route		
Oral	6	10.0
Topical	1	1.7
Nasal Spray	1	1.7
Absent	52	86.7

Table 2: Clinical presentation among patients diagnosed with Central Serous Chorioretinopathy (CSR)

Variables	Number	%
Laterality		
Unilateral	50	83.3
Bilateral	10	16.7
Bilateral	10	16.7
BCVA (logMAR)		
6/6 - 6/12 (0 – 0.3)	3	5.0
6/18 – 6/24 (0.5 – 0.6)	40	66.7
6/36 – 6/60 (0.8 – 1)	17	28.3
Complaints		
Central Scotoma	44	73.3
Metamorphopsia	16	26.7
Recurrence		
Eye	17	18.3
Same Eye	7	11.7
Other Eye	10	16.7
No	43	71.7
FFA pattern		
Ink Blot	39	65.0
Smoke Stack	21	35.0
RPE Changes	17	28.3
PED	15	25.0
Site of leakage		
STQ	12	20.0
ITQ	15	25.0
SNQ	24	40.0
INQ	9	15.0

Table 3: comparison of CMT and BCVA of laser and control groups at presentation, 4 weeks, and 12 weeks

Variable	Group	Mean ± SD	P value
Baseline Measurements			
CMT	**Control**	414.6 ± 83.47	0.736
	Laser	422.3 ± 92.36	
BCVA	**Control**	0.64 ± 0.18	0.188
	Laser	0.58 ± 0.15	
4 Weeks Measurements			
CMT	**Control**	309.83 ± 47.71	0.001
	Laser	257.97 ± 63.61	
BCVA	**Control**	0.43 ± 0.21	0.000
	Laser	0.20 ± 0.16	
12 Weeks Measurements			
CMT	**Control**	260.57 ± 38.07	0.000
	Laser	215.10 ± 22.08	
BCVA	**Control**	0.22 ± 0.17	0.001
	Laser	0.08 ± 0.11	

Table 4: Cohen's d and correlation coefficient (r) values for CMT and BCVA in both the control and laser groups

Group	CMT (Cohen's d)	r (CMT)	BCVA (Cohen's d)	r (BCVA)
Control Group	2.37	0.76	2.52	0.78
Laser Group	3.08	0.84	3.8	0.88

DISCUSSION

This study was conducted on 60 eyes of 60 patients diagnosed as CSR were included in the study. The mean age in our study was found to be 38.7 years. Previous studies conducted by Spaide et al., and Tittl et al., found the mean age to be 51 years in individuals with Central Serous Chorioretinopathy. The mean age in our study is lower than in these previous studies. This may be due to the increasing incidence of stress and other risk factors like hypertension and smoking in younger individuals. The male-to-female ratio in our study was found to be 2.75:1, indicating a male preponderance. Previous studies by Spaide et al., and Tittl et al., also show a male preponderance with ratios up to 6:1. The increased incidence in males may be due to the higher prevalence of risk factors among them.

A recent history of mental stress was identified as the most common risk factor, with 38.3% of patients reporting this history. The next most prevalent risk factor was type A personality, present in 28.3% of patients. Smoking was noted in 26.7% of patients, compared to alcoholism, which was observed in 15% of patients. Additionally, 11.7% of patients had hypertension, and 8.3% had diabetes. These findings align with the risk factors cited by Haimovici et al.

Among the 60 patients, only 13.3% had a history of steroid usage. However, among patients with bilateral CSR, 50% reported a history of systemic steroid usage. Of these, one patient who was using topical steroids had unilateral CSR. This suggests that systemic steroid usage is a significant risk factor for bilateral CSR. In patients with a bilateral condition, it is important to inquire about steroid use and advise patients to discontinue steroids. Instead, they should be transitioned to other steroid-sparing agents as required by their disease condition. A study conducted by Bouzas et al., found that steroids can cause bilateral, atypical CSR in patients. Therefore, steroids should not be used in the treatment of CSR.

The ink blot pattern was present in 65% of our patients, while the smoke stack pattern was observed in only 35%. Additionally, 25% of patients had an associated pigment epithelial detachment, and retinal pigment epithelial changes were present in 28.3% of patients. In our study, leaks were more common in the superonasal quadrant, with 40% of patients experiencing leakage in this area. Patients with foveal leakage were excluded from our study. In a study conducted by Shahin et al., 35% of patients had multifocal leaks, with the macula being the most common site of leakage in 79% of patients. Extrafoveal leakage was seen in 14% of patients, and peripapillary leakage was observed in 12% of patients. The ink blot pattern was found in 53% of patients, and RPE atrophic changes were present in 84% of patients.

Two distinct patterns of OCT findings have been documented in previous study by Montero et al. An optically empty elevated area of variable dimensions can be seen, corresponding to fundus fluorescein angiography. Highly characteristic small bulges can be observed protruding from the retinal pigment epithelium, corresponding to the leaking spots in fundus fluorescein angiography. In the other variant, semicircular spaces beneath the RPE with retinal thinning can be seen.

In our study, we documented a significant decrease in central macular thickness at 4 weeks and 12 weeks post-laser, with a reduction of 38.3% at four weeks and 49% at 12 weeks. This was statistically significant ($p<0.001$) when compared with the control group. In the control group, the central macular thickness reduced only by 25.3% at 4 weeks and 37.3% at 12 weeks. There was also a significant improvement in visual acuity at 4 weeks and 12 weeks in the laser group, which was statistically significant when compared with the control group ($p<0.01$). No side effects of the laser

were documented in our study subjects during the study period. This indicates that laser treatment reduces the duration of CSR along with a significant improvement in visual acuity. A study conducted by Robertson et al., showed that direct laser photocoagulation reduced central macular thickness and significantly reduced the duration of CSR when compared to patients undergoing sham laser, and reduced the recurrences of CSR. In contrast, the study conducted by Ficker et al., showed that Argon laser does not reduce the recurrences of CSR, which may develop due to leakage in sites other than the previously lasered site in the retina.

CONCLUSION

In conclusion, our study reveals significant findings regarding the demographics, risk factors, and treatment outcomes of Central Serous Chorioretinopathy (CSR). The mean age of patients in our study was notably younger than in previous research, suggesting a shift towards younger individuals possibly due to increasing stress and lifestyle factors such as hypertension and smoking. The male-to-female ratio, while showing a male preponderance, is consistent with prior studies but less pronounced than some reports. Our data highlights recent mental stress as the most common risk factor, followed by type A personality and smoking, aligning with established risk factors. Notably, systemic steroid use was identified as a significant risk factor for bilateral CSR. Treatment outcomes demonstrated that laser therapy significantly reduced central macular thickness and improved visual acuity compared to the control group, with no reported side effects. These results underscore the effectiveness of laser treatment in managing CSR and emphasize the importance of addressing modifiable risk factors to improve patient outcomes.

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