

Treatment outcomes of micropulse cyclophototherapy in uveitic glaucoma

Dear Editor,

We present a case series, describing the utility of micropulse cyclophototherapy in the treatment of uveitic glaucoma.

Prevalence of glaucoma in patients suffering from uveitis was estimated to be 7.6% at 12 months after acute uveitis, and 11.1% at 5 years with chronic uveitis.^{1,2} Uveitic glaucoma is usually associated with a more aggressive disease course characterised by widely fluctuating levels of intraocular pressures (IOP). Traditionally, cyclodestructive procedures like continuous wave transscleral cyclophototherapy (CWTCP) were avoided due to major concerns of grave complications, such as increased inflammation, hypotony, visual loss and phthisis bulbi.³⁻⁸ More recently, the use of newer technology in the form of the micropulse transscleral cyclophototherapy (MPTCP) (IRIDEX Corporation, Mountain View, CA, US) was described in the treatment of glaucoma, with a safer effect of IOP lowering compared with CWTCP.^{9,10} It is a diode laser that transmits infrared 810 nm laser light. However, there is currently a lack of data on the use of MPTCP for uveitic glaucoma.

Our study was a review of all uveitic glaucoma patients who had undergone MPTCP at a tertiary eye care centre between 2013 to 2020 by different surgeons. The records of all patients who underwent MPTCP treatment were obtained from the centre's electronic medical records. Data collected included patient demographics, visual acuity (VA), IOP, number of classes of topical glaucoma medications pre- and post-MPTCP, intraoperative complications, postoperative complications, duration of postoperative steroids required and whether further surgical interventions were required after MPTCP. Data were collected for up to 12 months in the postoperative period. Statistical analyses were performed using SAS 9.4 (SAS Institute Inc, Cary, NC, US). Generalised estimating equation method was used to analyse IOP, VA, mean deviation (MD) and number of glaucoma medications over the 12-month postoperative period, and also to assess the factors affecting the maximal IOP decrease. Treatment success was defined as a decrease of IOP of $\geq 20\%$ from preoperative IOP, with or without glaucoma medications.

Fourteen eyes of 12 patients were included in this study. The median age of the patients was 59.5 years with similar proportions of males (6 eyes) and females (8 eyes). Nine (64.3%) eyes had prior

glaucoma surgery to control their disease—all in the early 2000s, before MPTCP was adopted into clinical practice.

In our centre, MPTCP settings were usually set as: 2 W applied over 100 seconds of treatment time, consisting of micropulses during which the laser was on for 0.5 ms and off for 1.1 ms (duty cycle 31.3%), delivering 62.6 J in total. MPTCP was applied over 360 degrees. In all eyes, the 3 and 9 o'clock meridians were avoided due to anatomical locations of the long ciliary nerves.

Parameters evaluated at the various time points after MPTCP are shown in Table 1. There was no statistically significant change to VA following MPTCP. The effect of IOP lowering was observed in patients as early as postoperative day 1. Pre-MPTCP IOP was high at 27.4 ± 2.3 mmHg, with the post-MPTCP IOP falling to 19.7 ± 2.9 mmHg on postoperative day 1 and 23.0 ± 3.3 mmHg at final follow-up. The number of topical glaucoma medications before and after MPTCP was not statistically different. Median duration of postoperative topical steroids required was 17.5 days. The median follow-up period was 7.5 months. Eyes that required further intervention were excluded after additional interventions were carried out in the postoperative period.

Additional analyses examined the factors affecting maximal IOP decrease. Post-MPTCP lowest IOP was taken as the lowest IOP reading within postoperative 1 month, to assess the maximal IOP decrease following MPTCP. We found that power, area of treatment, age of the patient and preoperative MD were associated with statistically significant effects on maximal IOP decrease. On average, maximal IOP decrease was greater by 0.09 mmHg (95% confidence interval [CI] 0.005–0.17) for every 1 mW increase of power. For every 1-degree increase in the area treated, on average, the maximal IOP decrease was greater by 0.09 mmHg (95% CI 0.02–0.16). The maximal IOP decrease fell by 0.32 mmHg (95% CI 0.11–0.63) for every 1-year increase in the age of the patient treated. It was also found that the mean maximal IOP decrease was greater by 0.30 mmHg (95% CI 0.03–0.58) for every 1-unit increase in preoperative MD.

There were no complications observed, such as hypotony (defined as ≤ 5 mmHg) or prolonged inflammation (defined as ≥ 1 month in duration). Five eyes subsequently required further surgical

Table 1. Evaluated parameters at consecutive follow-up visits.

	Pre-MPTCP	Day 1	Week 1	Week 2	Month 1	Month 3	Month 6	Month 12
No. of eyes that underwent further intervention	-	0	0	0	1	4	5	5
No. of eyes with complications	-	0	0	0	0	0	0	0
IOP, mmHg ^a	27.4 (2.3)	19.7 (2.9)	15.7 (4.2)	24.0 (2.7)	24.7 (2.7)	24.3 (3.0)	20.1 (3.0)	23.0 (3.3)
Treatment success, %	-	55.6	75.0	60.0	50.0	50.0	66.7	28.6
No. of glaucoma medications ^a	1.3 (0.1)	1.2 (0.1)	1.2 (0.1)	1.2 (0.1)	1.2 (0.1)	1.3 (0.1)	1.2 (0.1)	1.2 (0.1)
No. of eyes requiring acetazolamide	2	3	2	2	1	0	0	0
VA, LogMAR ^b	0.81 (0.24)	0.96 (0.24)	1.05 (0.25)	1.01 (0.24)	1.02 (0.24)	1.05 (0.24)	1.08 (0.24)	1.12 (0.25)
MD of HVF, dB ^a	-19.30 (3.03)	-	-	-	-	-	-	-18.90 (2.63)
Duration of postoperative steroids eye drops, days ^{b,c}	-	-	-	-	-	-	-	17.5 (7–365)
Duration of follow-up, months ^c	-	-	-	-	-	-	-	7.5 (0.6–11.4)

dB: decibels; HVF: Humphrey visual field; IOP: intraocular pressure; LogMAR: logarithm of minimum angle of resolution; MPTCP: micropulse transscleral cyclophototherapy; MD: mean deviation; VA: visual acuity

^a Marginal means (standard error).

^b $P < 0.05$ when compared with parameters before micropulse transscleral cyclophototherapy.

^c Median (minimum–maximum).

intervention within 12 months after MPTCP. One underwent repeat MPTCP and 4 others underwent tube surgery. The mean time to further intervention was 2 months.

MPTCP was able to cause a decrease in IOP, despite not reaching statistical significance. While MPTCP enabled cessation of acetazolamide, its IOP-lowering effect was modest, requiring the continuation of all pre-existing topical glaucoma medications. This interpretation of the cessation of acetazolamide should, however, be taken with caution. This is due to potential presence of confounding factors in uveitic glaucoma patients. Some examples are ciliary body shutdown and abated steroid response with the tapering of topical steroids following control of inflammation, which could also contribute to lowering of IOP.

Correlations with IOP decrease were examined in our study and yielded some interesting insights. It was found that IOP decreased more when there was higher power used, larger areas treated and better preoperative MD. We would also interpret the findings of higher power settings with caution as indiscriminate increases to power settings may result in complications, like those seen in CWTCP (e.g. hypotony and phthisis bulbi). Larger prospective studies would be required to examine the relationship between higher power settings and IOP lowering. With better MD, it would suggest that treatment response was blunted when glaucoma was more severe. Hence, when treating patients with advanced uveitic glaucoma, a caution that MPTCP may be less effective. In addition, maximal IOP response was found to be worse with increasing age of the patient. It is uncertain why this may be so, but chronicity of uveitides in older patients, ciliary body function, duration of disease and severity of uveitic glaucoma with increasing age might be contributing factors. Further prospective studies are required to address these questions.

In conclusion, MPTCP is a possible treatment option for uveitic glaucoma eyes. While the IOP lowering effect was modest and transient, it may serve as a possible temporising treatment modality before definitive glaucoma surgery—especially if the patient was medically unfit for surgery, or if the IOP was too high and medically refractory as this increases the risk of decompression maculopathy. This case series adds to the current understanding of MPTCP as a relatively new and safe modality of treatment for uveitic glaucoma eyes.

Disclosure

Author Paul Chew was the inventor of micropulse transscleral cyclophototherapy (MicroPulse P3 laser probe, MP3, IRIDEX Corporation, Mountain View, CA, US). The authors have no financial interest to declare.

Keywords: cyclophototherapy, glaucoma, laser, micropulse, uveitic

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