Early Postoperative Intraocular Pressure Profile after Micropulse Versus Continuous Wave Transscleral Diode Cyclophotocoagulation

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Introduction

- Glaucoma is the leading cause of irreversible blindness worldwide.[1]
- The treatment of glaucoma is focused on lowering intraocular pressure (IOP) with topical medications, laser procedures, or surgical interventions.[2]
- Transscleral cyclophotocoagulation (CPC) is a destructive procedure of the ciliary body processes that aims to reducing aqueous humor production.[3]
- In contrast to the continuous wave CPC (CW-CPC) where a continuous train of high intensity energy is delivered, micro pulse CPC (MP-CPC) delivers a series of repetitive short pulses of energy with rest periods in between pulses.[4]

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Introduction

- Transient intraocular pressure (IOP) spikes in the immediate postoperative period may occur following many glaucoma laser and surgical procedures which could inflict further damage to the already compromised optic disc leading to vision loss.[5]
- Razeghinejad et al studied the immediate IOP elevation after CW-CPC and found that significant IOP elevation in almost all eyes immediately occurs.[6]
- This could be dangerous in patients with advanced glaucomatous optic nerve damage and may result in further optic nerve injury, temporary central retinal artery occlusion, and ischemia-reperfusion retinal injury.

Purpose

The aim of this study was:

- To compare the immediate and short-term risk of IOP spikes after CW-CPC versus MP-CPC.

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Patients and Methods

- **Study Design:**
  - Prospective comparative non-randomized study at a single tertiary care center (Wills Eye Hospital).
- **Inclusion and Exclusion Criteria:**
  1. Patients with refractory glaucoma planned for MP or CW-CPC. .
  2. Age ≥ 18 years.
  3. Patients with prior CPC or significant corneal opacity were excluded.

Patients and Methods

- **IOP Measurements**:
  - IOP was measured using iCare tonometer in the sitting position at 4 time points:
    1. Immediately before the CPC
    2. Immediately after the CPC
    3. One hour after the CPC.
    4. Postoperative day 1 (using both iCare and Goldmann applanation tonometers)
  - The average of 3 consecutive IOP measurements at each time point were used for analysis.

Patients and Methods

- **CPC Technique**:
  - **MP-CPC:** 2000-2500 mW, 60-80 seconds per quadrant, 4 quadrants, sparing 3 and 9 o'clock and any prior surgical sites.
  - **CW-CPC:**
    1. Slow Coagulation Technique based on the degree of iris pigmentation: 1250-1500 mW, 3500-4500 mS, 14-21 spots
    2. Titration technique: 2000mW, 2000mS, titrate down or up until 250mW less than when pops were heard, 14-21 spots.

Patients and Methods

- **Main outcome measures**:
  - The primary outcome measure was the rate of IOP spikes after MP and CW-CPC.
  - IOP spikes were defined as **30%** IOP elevation with preoperative **IOP ≥ 30** mmHg, or **40%** IOP elevation with preoperative **IOP < 30** mmHg immediately after or 1 hour after the CPC.
  - Patients with IOP spikes received IOP lowering agents (topical or oral).

Results

Table 1. Baseline Characteristics in the CW-CPC and MP-CPC Groups

		CW-CPC	MP-CPC	Total	P-value
Number of Eyes		12	10	22	
Number of Patients		12	10	22	
Age (years)		64.3±0.5	64.5±1.8	64.4±16.2	0.983
Sex (females), N (%)		5 (41.7)	6 (60.0)	11 (50.0)	0.670
Race, N (%)	White	2 (16.7)	3 (30.0)	5 (22.7)	0.112
	Black	0 (0.0)	3 (30.0)	3 (13.6)	
	Hispanics	1 (8.3)	0 (0.0)	1 (4.5)	
	Other	9 (75.0)	4 (40.0)	13 (59.1)	
Operative Eye: (right), N (%)		9 (75.0)	2 (20.0)	11 (50.0)	0.030
Glaucoma Type, N (%)	POAG	1 (8.3)	4 (40.0)	5 (22.7)	0.269
	PACG	1 (8.3)	1 (10.0)	2 (9.1)	
	PXG	0 (0.0)	1 (10.0)	1 (4.5)	
	NVG	6 (50.0)	2 (20.0)	8 (36.4)	
	Traumatic	0 (0.0)	1 (10.0)	1 (4.5)	
	Malignant	1 (8.3)	0 (0.0)	1 (4.5)	
	Axenfeld Riegers	1 (8.3)	0 (0.0)	1 (4.5)	
	Silicone Oil Induced	1 (8.3)	0 (0.0)	1 (4.5)	
	Post-injection	0 (0.0)	1 (10.0)	1 (4.5)	
	Melanoma	1 (8.3)	0 (0.0)	1 (4.5)	
Glaucoma Severity, N (%)	Mild	1 (8.3)	1 (10.0)	2 (9.1)	0.632
	Moderate	6 (50.0)	3 (30.0)	9 (40.9)	
	Severe	4 (41.7)	6 (60.0)	11 (50.0)	

Results

Table 1 (continued). Baseline Characteristics in the CW-CPC and MP-CPC Groups

		CW-CPC	MP-CPC	Total	P-value
Number of Eyes		12	10	22	
Number of Patients		12	10	22	
Prior Glaucoma Surgery, N (%)		8 (66.7)	8 (80.0)	16 (72.7)	0.373
Prior Vitrectomy, N (%)		2 (16.7)	1 (10.0)	3 (13.6)	1.000
Visual Acuity (logMAR)		1.7±1.2	1.1±1.0	1.4±1.1	0.283
Intraocular Pressure (mmHg)		32.5±11.5	24.6±10.7	28.9±11.6	0.113
Glaucoma Medications (#)		3.4±1.7	4.2±0.8	3.8±1.4	0.191
Oral Diamox		6 (50.0)	6 (60.0)	12 (54.5)	0.691
Cup-to-Disc Ratio		0.8±0.2	0.7±0.3	0.7±0.2	0.324
Lens Status, N (%)	Phakic	6 (50.0)	5 (50.0)	11 (50.0)	0.517
	Pseudophakic	6 (50.0)	5 (50.0)	11 (50.0)	
Gonioscopy, N (%)	Open angle	1 (8.3)	6 (60.0)	7 (31.8)	0.070
	Narrow angle	8 (66.7)	3 (30.0)	11 (50.0)	
	Silicone Oil	1 (8.3)	0 (0.0)	1 (4.5)	
	Hazy View	2 (16.7)	1 (10.0)	3 (13.6)	

Results

Table 2. Main Outcome Measures in the CW-CPC and MP-CPC Groups

		CW-CPC	MP-CPC	P-value
Intraocular Pressure Spikes, N (%)		1 (8.3)	2 (20.0)	0.571
Intraocular Pressure (iCare-mmHg)	Immediately Before	30.8±9.1	23.5±7.5	0.055
	Immediately After	23.9±11.0	16.5±6.5	0.075
	1-Hour After	26.8±11.9	25.1±7.7	0.695
	Postoperative Day 1	17.5±5.5	21.1±7.3	0.254

3 eyes (**13.6%**; 1 CW, 2 MP) experienced IOP spikes (**P=0.571**) at 1-hour post-CPC and responded to topical and/or oral medications.

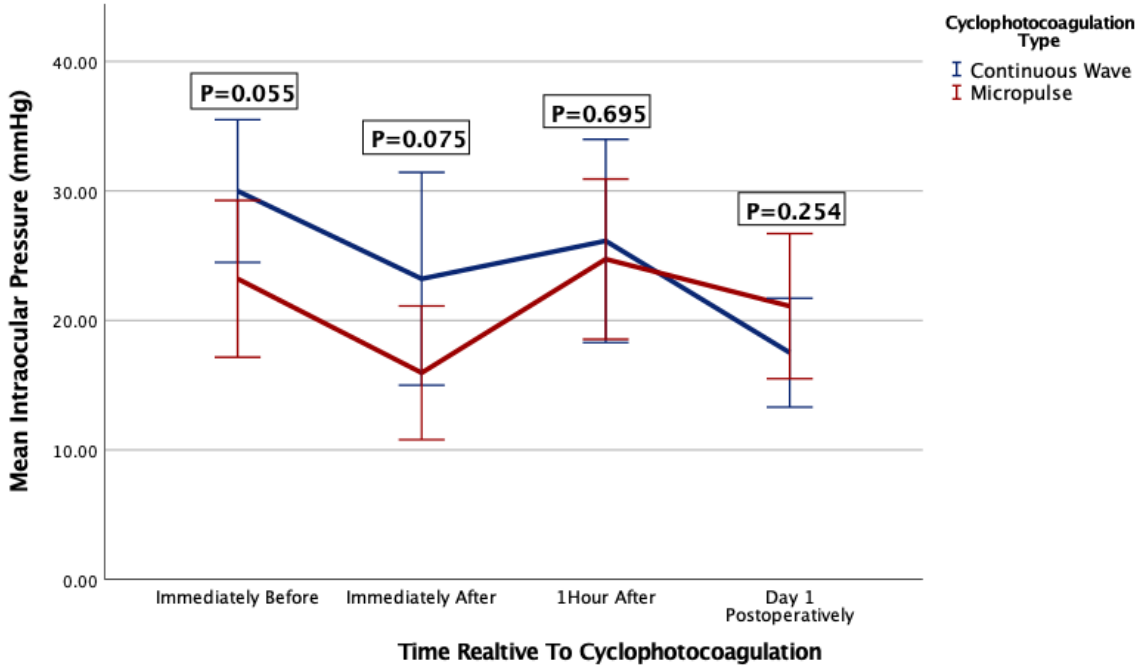

Figure 1. IOP changes over time in the CW-CPC and MP-CPC groups

Results

Table 3. Postoperative Day 1 Outcomes in the CW-CPC and MP-CPC Groups

	Baseline	Day 1	P-value
CW-CPC			
Visual Acuity (logMAR)	1.7±1.2	1.6±1.1	0.194
Intraocular Pressure (mmHg)	32.5±11.5	16.4±5.5	0.010
Glaucoma Medications (#)	3.4±1.7	3.3±1.6	0.724
MP-CPC			
Visual Acuity (logMAR)	1.1±1.0	1.1±1.0	0.748
Intraocular Pressure (mmHg)	24.6±10.7	20.3±8.2	0.193
Glaucoma Medications (#)	4.2±0.8	4.0±1.2	0.443

At day 1, mean mmHg IOP reduction as compared to baseline was **16.0±14.3** mmHg in CW eyes (**P=0.01**), and **4.3±9.1** mmHg in MP eyes (**P=0.193**).

Discussion

- The laser-induced coagulative necrosis and disruption of ciliary processes during CPC may increase intraocular volume by creating air bubbles and lead to immediate IOP rise.[7]
- This immediate IOP elevation may not be handled properly due to the impaired trabecular meshwork in glaucoma patients and could induce more damage in patients with advanced glaucomatous disease.
- Our study found a low rate of postoperative IOP spikes following CPC (13.6%), and this rate was similar in both CW and MP groups (P=0.571).
- This was in contrast to Razeghinejad et al study that showed a significant IOP elevation in almost all eyes immediately after CW-CPC.[6]

Discussion

- The difference between both studies may be related to the criteria used to describe postoperative IOP spikes. In the current study we preferred the relative increase in IOP as compared to the baseline rather than using a cutoff point of high IOP.

- Additionally, preoperative diamox was used in more than 50% of patients in our study which may have had a protective role against the occurrence of IOP spikes.

- At postoperative day 1, significant IOP reduction as compared to the baseline (using Goldmann tonometer) was achieved in the CW group. On the other hand, IOP reduction in the MP group did not reach the statistical significance. However, these results need to be confirmed by long term follow-up.

Conclusion

- MP and CW-CPC have low and similar risk of early postoperative IOP spikes.
- Significant early IOP reduction was better achieved after CW-CPC.
- In certain patients, early postoperative IOP spikes may be detrimental; there may be a role for prophylactic acetazolamide or IOP monitoring in such cases.

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