DOI: 10.7860/JCDR/2022/55272.16189

Original Article

Ophthalmology Section

Surgical Outcomes of Trabeculectomy alone versus Trabeculectomy with Manual Small Incision Cataract Surgery following Acute Angle Closure Glaucoma: A Comparative Study

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ABSTRACT

Introduction: Acute Angle Closure Glaucoma (AACG) is an ophthalmic emergency and is managed medically. Therapeutic options for the management of the post congestive phase are varied and no procedure has a documented therapeutic superiority over the other. Two established procedures were therefore chosen and compared to determine their therapeutic efficacy.

Aim: To compare the surgical results of combined manual Small Incision Cataract Surgery (SICS) and trabeculectomy with standalone trabeculectomy in patients following an attack of AACG, with a final aim to decide which would be the better therapeutic approach in such a situation.

Materials and Methods: This was a prospective observational comparative study done in Bankura Sammilani Medical College located in West Bengal, India. Sixteen patients presenting with AACG in a 19 months study period from October 2019-April 2021 and having 50% or more synechial angle closure on indentation gonioscopy were selected for this study after obtaining necessary ethical clearance. Eight of them underwent trabeculectomy alone (Group A) and the rest underwent a combined procedure of trabeculectomy and SICS (Group B). They were followed-up for a six-months period and compared on the basis of Intraocular Pressure (IOP) control, Anterior Chamber (AC) depth and the requirement for further surgery.

Results: Mean IOP following surgery at the end of six weeks in Group A was 15.98±1.56 mmHg whereas in Group B it was 12.01±1.18 mmHg. Results were compared by unpaired t-test, and the difference was statistically significant ($p<0.001$). Three out of eight patients (37%) in Group A developed cataract which caused a reduction in visual acuity and needed cataract surgery within the six months follow-up period but none of the patients in Group B needed any additional surgery. One patient in Group A needed additional medications due to uncontrolled IOP after surgery but no such event was noted in Group B. Seventy five percent patients in Group A had Grade 2 angles whereas 87% patients in Group B had Grade 4 angles as estimated by Van Herrick's method.

Conclusion: Combined trabeculectomy and SICS offers a better level of postoperative IOP control than trabeculectomy alone, and perhaps offers a better therapeutic option following AACG. Also, the chances of postoperative cataract formation and associated visual debility are eliminated.

Keywords: Anterior chamber depth, Cataract extraction, Intraocular pressure

INTRODUCTION

The AACG quite often presents to the ophthalmologist with a demand for urgency in attention and intervention. The management on presentation is undoubtedly medical [1,2], but contention exists regarding the subsequent course of action. Approaches have varied from medications and Peripheral Button Hole Iridectomy (PBHI) to filtration procedures. But no definitive clue exists as to which would be the best therapeutic approach for the patient on a long-term basis, because none of the procedures alone can rectify the entire spectrum of structural and functional changes that occur following an attack of acute angle closure. It was therefore felt that only a combination of procedures might give the desired therapeutic results.

The aim of this study, was to find out whether combined manual SICS and trabeculectomy could offer therapeutic benefits to these patients and, at the same time, compare its efficacy to an established surgical procedure like standalone trabeculectomy. This comparison was made on four preset parameters- visual acuity at the end of a follow-up period of six weeks, quality of IOP control, postoperative AC depth as seen by Van Herrick's method and need for further surgery or medications.

MATERIALS AND METHODS

The present study was a prospective observational comparative study conducted in the Department of Opthalmology, Bankura Sammilani Medical College located in the state of West Bengal, India. The study period was approximately 19 months, extending from October 2019-April 2021. Due permission was obtained from the Institutional Ethics Committee (IEC) (Memo No Eye/278/09/2019) prior to commencement of this study. All patients diagnosed with AACG during that period were included in this study after signing the informed consent.

Initial Evaluation

A total of 16 patients were enrolled in this study. All patients on arrival underwent a comprehensive eye evaluation which included slit lamp examination, visual assessment and IOP measurement of the affected eye. The other eye was also evaluated in all the cases, but as that is not a part of this study, those findings are not mentioned here.

All patients received an initial uniform medical management which included 20% solution of intravenous mannitol 1.5 g/kg body weight, oral acetazolamide 250 mg once a day, topical timolol maleate 0.5% two times a day, topical pilocarpine 2% qd and topical

dexamethasone sodium phosphate 0.1% w/v qd. On resolution of the corneal oedema, indentation gonioscopy was performed using a Sussman four mirror gonioscope. Only those patients who had synechial closure of 50% or more of the angle of the AC were selected for surgery [1].

Surgery was taken up between two to three weeks after initiation of medical therapy and ensuring that IOP had returned to a level where surgery was safe to perform.

Surgery was done on an alternate basis- meaning patients with odd serial numbers undergoing trabeculectomy and those with even serial numbers undergoing a combined procedure. The trabeculectomy group was designated as Group A and the patients undergoing combined surgery as Group B.

Surgical Technique

Trabeculectomy was performed by a fornix based flap. The sclera was dissected with a crescent knife and trabeculectomy completed with a Kelly's punch. A PBHI was done and the sclera was apposed with releasable 10'0 monofilament nylon sutures. The conjunctiva was sutured back to the sclera in a water tight manner [2]. No anti-metabolites were used peroperatively in any patient.

A more extensive procedure- combined SICS and trabeculectomy (SICS+Trab) was performed on Group B patients. Following superior limbal peritomy, an 'M' incision was made on the sclera. The AC was entered at the base of the 'M'. The lens cortex and the nucleus were managed in the usual way following a 5.5 mm capsulorexhis. A 6 mm rigid Poly Methyl Meth-Acrylate (PMMA) lens was implanted in the bag. Trabeculectomy was performed using a Kelly's punch, and a PBHI followed. The wound was closed with a single suture applied at the apex of the 'M'. The conjunctiva was closed in the usual water tight manner [3].

Postoperative Period

All patients received topical steroids (moxifloxacin 0.5% w/v + dexamethasone sodium phosphate 0.1% w/v) two hourly and cycloplegics (homatropine 2% w/v) 12 hourly from first postoperative day. Topical steroids were tapered over a period of six weeks. Cycloplegics were omitted by the end of the second week. No anti-glaucoma medications were prescribed initially.

Visual acuity assessment and slit lamp evaluation including AC depth assessment by Van Herrick's method [4] - was done on 1st, 7th, 21st postoperative day and at the end of six weeks. IOP was assessed by Non Contact Tonometry (NCT) during the same visits. Topical medications were stopped at the end of six weeks, refraction was performed and glasses were prescribed. Subsequently, all patients were followed-up monthly for a period of six additional months.

STATISTICAL ANALYSIS

Pre and postoperative IOP changes were compared by paired and unpaired t-test using the Statistical Package for the Social Sciences (SPSS) software version 22.0.

RESULTS

In total, 16 patients were enrolled in this study. The trabeculectomy group was designated as group A and the combined surgery group as group B. The age of the patients ranged between 51-66 years with a mean of 59.3±4.38 years. Twelve patients were females, making the female:male ratio 3:1. The profiles of both the groups are shown in [Table/Fig-1,2], respectively.

Visual Recovery and Sustainability

In group A visual acuity ranged from 6/12 to 6/36, whereas in group B, visual acuity ranged from 6/6 to 6/12. The causes of reduced visual acuity in patients of group A included development of cataract in three patients (37%), persistently raised IOP in one patient (12.5%) and glaucomflecken in one patient (12.5%). The only patient whose visual acuity was reduced in group B had developed posterior capsular opacification (patient 14 of [Table/Fig-2]).

S. No.	Age (years)	Sex	IOP on presentation in mmHg	IOP at 6W in mmHg	VA at 6W	ACD at 6W (Van Herrick)	Course
1	56	F	48.2	12.8	6/12	Grade 2	Uneventful
3	61	M	51.6	13.4	6/36	Grade 2	Cat→Surgery
5	65	F	52.0	13.8	6/24P	Grade 2	Cat→Surgery
7	59	F	49.4	14.6	6/12P	Grade 2	Uneventful
9	60	F	50.1	17.2	6/24	Grade 1	Cat→Surgery
11	62	F	51.0	22.0	6/18	Grade 1	↑Iop→Pilocarpine
13	51	F	48.6	16.2	6/9	Grade 2	Uneventful
15	55	M	51.3	16.4	6/18	Grade 2	Glaucomflecken

[Table/Fig-1]: Showing the demographic attributes, IOP changes and postoperative course of Group A patients.
IOP: Intraocular pressure; VA: Visual acuity; ACD: Anterior chamber depth

S. No.	Age (years)	Sex	IOP on presentation in mmHg	IOP at 6W in mmHg	VA at 6W	ACD at 6W (Van Herrick)	Course
2	65	F	47.4	11.0	6/9	Grade 4	Uneventful
4	58	M	49.0	10.8	6/6P	Grade 4	Uneventful
6	61	F	51.8	12.2	6/6P	Grade 4	Uneventful
8	66	F	52.2	14.2	6/9	Grade 4	Uneventful
10	62	M	50.4	12.6	6/9	Grade 4	Uneventful
12	57	F	48.8	12.4	6/9	Grade 4	Uneventful
14	49	F	49.5	10.6	6/12	Grade 3	Pc Opacification
16	63	F	51.3	11.7	6/9	Grade 4	Uneventful

[Table/Fig-2]: Showing the demographic attributes, IOP changes and postoperative course of Group B patients.

Quality of IOP Control

In group A the preoperative means IOP was 50.20 mmHg and the mean postoperative IOP was 15.98 mmHg. Statistically significant association was observed.

In group B the preoperative mean IOP was 50.05 mmHg and the mean postoperative IOP was 12.01 mmHg. Statistically ($p<0.001$) significant association was observed [Table/Fig-3].

Group	Pre OP Mean IOP in mmHg	Post OP IOP Mean in mmHg	t-value	df	p-value*
Group A	50.20±1.42	15.98±1.56	6.94	15	<0.001
Group B	50.05±1.66	12.01±1.18	5.98	15	<0.001

[Table/Fig-3]: Comparison of preoperative and postoperative mean IOP in Group A and Group B.
*Paired t-test

Both procedures therefore could be considered as viable surgical approaches for patients following AACG. However, the mean postoperative IOP in Group B was much less than in Group A (p-value <0.001) [Table/Fig-4].

	Group A	Group B	t-value	df	p-value
Post op mean IOP in mmHg	15.98±1.56	12.01±1.18	9.2	14	<0.001

[Table/Fig-4]: Comparison of postoperative mean IOP in Group A and Group B.
Unpair t-test

It can therefore be conclusively said the IOP control following combined procedure of trabeculectomy and manual SICS is much better than trabeculectomy alone. As already stated, one patient in group A showed an increase in IOP from the third week onwards which had to be controlled by miotics. This patient with persistently raised IOP was accepted as a surgical failure. No incidences of surgical failure were reported from group B.

Postoperative AC Depth

Six out of the eight patients in group A (75%) had grade 2 angle as estimated by Van Herricks method of angle grading. In contrast, 7 patients (87%) had grade 4 angle as estimated by the same method. This in turn perhaps translated to a better extent of IOP control.

Need for Further Intervention

Three out of the eight patients (37%) in group A needed further intervention in the form of cataract surgery for the cataracts that developed within the six months follow-up period. The patient who had glaucomflecken was prescribed appropriate refractive correction. None of the patients in group B needed any surgical intervention during the six months follow-up period. The only patient with posterior capsular opacification underwent a YAG laser capsulotomy at the end of six months and made a complete visual recovery.

DISCUSSION

One of the earliest studies suggesting the effectiveness of trabeculectomy in Primary Angle Closure Glaucoma (PACG) was reported by Salmon in 1993. In his study, retrospective analysis of 46 eyes of 39 patients showed that trabeculectomy successfully reduced the IOP to less than 21 mmHg in 30 eyes (66.7%) without any additional medications [5]. Since then, trabeculectomy has perhaps remained as a yardstick of surgical management of PACG by which the efficacy of other surgical procedures are measured.

But having said that, trabeculectomy is not without its downsides. It is associated with a reasonable risk of postoperative cataractogenesis. In a study by Sihota R et al., 12 of the 64 eyes (32%) with PACG which had undergone trabeculectomy developed cataracts in contrast to 4 out of 64 eyes (15%) who had undergone trabeculectomy for Primary Open Angle Glaucoma (POAG) [6]. It therefore appeared that the chances of postoperative cataract formation are more in patients with angle closure glaucoma. This adds to the burden of visual debility, for which the patient has to return to the hospital again. Secondly, a progressing cataractogenesis gradually shallows the AC, thereby contributing to the process of angle closure [3]. A cataract extraction would therefore be beneficial in two ways. Firstly, it would eliminate the chance of cataractogenesis, which in turn would avoid visual debility and resultant surgery. Secondly, it would contribute to rectification of one of the basic contributors to the patho-physiologic mechanisms of PACG [3,7,8].

Studies have also focused on cataract extraction alone as a therapeutic approach in closed angle situations [9,10]. Lowe RF et al., had shown that eyes with angle closure have a thicker lens with a steeper anterior curvature and are positioned more anteriorly than controls [11-13]. Theoretically therefore, lens extraction should reverse the anatomical attributes to angle closure. Ultrasound Biomicroscopic (UBM) studies by Park SW et al., has shown that cataract extraction alone increases the AC angle depth from 208 to 468 microns [14]. Based on these optimistic evidences, Wishart PK and Atkinson PL were among the first to recommend cataract extraction as a surgical modality in PACG [15]. Twenty three eyes of 22 patients underwent extra capsular cataract extraction with rigid intra ocular lens implantation. Sixty five percent of the patients achieved a sustainable IOP less than 21 mmHg. Similar results with Phacoemulsification (PE) alone were also reported by Lai JS et al., and Jacob PC et al., [16,17]. However, there is no clinical trial or data which conclusively suggests that crystalline lens extraction alone is a superior therapeutic option over trabeculectomy in the management of PACG.

With multiple structural and functional mechanisms at play in the pathogenesis of PACG, many authors suggested a combination of surgical procedures in its management [3,18]. In this study, the combined surgery group showed some distinct advantages in outcomes. Firstly, the reduction of IOP from the preoperative status was much better in the combined surgery group. In this study, the postoperative mean in group A was 15.98 mmHg, whereas in group B it was 12.01 mmHg. Unpaired t-test showed a p-value <0.001, making this difference statistically significant, thereby proving the supremacy of the combined procedure as far as IOP control is concerned. A similar finding suggesting the benefits of a combined procedure in IOP reduction was intimated by Tham CC et al., where combined phaco-trabeculectomy resulted in an additional 2 mmHg reduction in mean IOP (p=0.08) [19].

Reasons for a better IOP control with a combined procedure are many. Extra capsular cataract surgery deepens the AC, relieves pupillary block and opens up appositional angle closure, thereby contributing to a better level of IOP control. In addition, it also helps in retarding the progression of further angle closure [3,7,8,10,12]. Secondly, removal of the crystalline lens eliminates chances of cataract formation, which offers a better quality of visual outcome. In this study, 37% of the patients in group A developed visually debilitating cataracts over six months follow-up period. A nearly similar incidence of cataractogenesis following trabeculectomy alone was also reported by Tham CC et al., in another study where 33% of patients developed visually debilitating cataracts within a one year follow-up period [20]. This problem was not encountered in group B for obvious reasons. A simultaneous cataract extraction therefore eliminates resultant cataract related visual debility and consequent need for further surgery completely. This, in addition to beneficial effects on IOP control as already mentioned, results in amplified overall patient satisfaction.

Guidelines regarding surgical selection of patients following an attack of acute angle closure are diverse. These include presence of 50% or more angle closure on indentation gonioscopy, unsatisfactory response to medications, and presence of cupping and visual field loss and inadequate facility of outflow on tonography [1]. Monitoring response to medication requires good patient compliance and is time consuming. It also runs the risk of disease progression and irreversible optic nerve damage in non responders. Tonography is a reliable indicator, but unfortunately facility for the same is not available in our institution. Authors therefore decided to follow the gonioscopic guideline to select the patients.

Limitation(s)

One limitation of this study was the small sample size. With increased health awareness and improved access to healthcare, incidence of acute congestive attacks has perhaps reduced over time. Also, all patients with AACG do not need surgical intervention– only those who conform to the above mentioned criteria need so. This explains the long study period and the relatively small number of cases.

CONCLUSION(S)

The authors found both procedures to be rational, simple, cost-effective and safe surgical approaches to patients following an acute congestive attack. On comparison however it was seen that the combined procedure offered superior therapeutic benefits in terms of a better control of IOP which was statistically significant. The combined procedure- if necessary, after analysing a larger series of patients-could be accepted as a standard therapeutic approach following AACG.

Acknowledgement

The authors are profoundly grateful to Prof. Aditya Prasad Sarkar, Professor and Head, Department of Community Medicine, Bankura Sammilani Medical College for his help with the statistical analysis.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Feb 01, 2022
- Manual Googling: Feb 07, 2022
- iThenticate Software: Feb 18, 2022 (19%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jan 27, 2022**
Date of Peer Review: **Feb 12, 2022**
Date of Acceptance: **Feb 26, 2022**
Date of Publishing: **Apr 01, 2022**