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RESEARCH ARTICLE **OPEN ACCESS**

TRABECULECTOMY WITH BETA IRRADIATION IN SOUTH WEST, NIGERIA

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ABSTRACT

Background: Trabeculectomy is the most common surgical treatment for glaucoma in which a filtering fistula is created with the aim of lowering the intraocular pressure (IOP). A slow healing response of the surgical wound is important for a successful surgery and Beta irradiation is a rapid, effective and simple treatment to slow down this healing process. This study, evaluates the intraocular pressure lowering effect of beta irradiation as an adjunct to trabeculectomy in Nigerians. **Methods:** A retrospective study of patients aged ≥ 21years with preoperative IOP ≥ 21mmHg who underwent trabeculectomy with beta irradiation for glaucoma between 2012 and 2017 and had a minimum of 2 years follow up at Eleta Eye Institute and Ojulowo Eye Clinic in Ibadan, Nigeria. Seventy-one eyes of 54 patients were analyzed. They underwent trabeculectomy with adjunct beta irradiation which was administered intraoperatively on the conjunctiva overlying the bleb area as a single dose of 2,400cGy using a strontium-90 probe. All the 54 patients were operated on by the same surgeon. **Results:** 64.8% of the patients were males and the mean age for the patient was 45±3.7. 66.2% eyes had preoperative VA ≤ 6/18 while 91.5% eyes were able to maintain the pre-operative VA three months post operation. Mean preoperative IOP was 25.0±4.6mmHg, 10.5±2.3mmHg at 1 month post operation and 14.5±3.5mmHg at 2 years post operation. There was a statistically significant difference in the preoperative and postoperative IOP after 2 years, P value <0.05 **Conclusion:** Trabeculectomy with beta irradiation gives a good control of intraocular pressure and is recommended in patients at risk of developing post-operative conjunctival fibrosis.

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INTRODUCTION

Glaucoma is the leading cause of irreversible blindness (Pascolini *et al.*, 2012). The global prevalence of glaucoma for population aged 40-80years is 3.54% and accounts for 15% of blindness in Africa (Tham *et al.*, 2014; Resnikoff, 2004). Africa has the highest prevalence of primary open angle glaucoma (POAG) worldwide (4.20%) (Tham *et al.*, 2014). The proportion of blindness due to glaucoma was 16.7% in Nigeria among those aged 40years and above (Kyari *et al.*, 2013). Trabeculectomy is the most common surgical treatment for glaucoma in which a guarded filtering fistula is created between the anterior chamber and subtenon space with the aim of lowering the intraocular pressure (IOP) (Razeghinejad *et al.*, 2012). The healing response of the surgical wound is an important process that determines the final post-operative intraocular pressure after trabeculectomy (Mutsch, 2000). Its success rate relies on the continued patency of the filtering fistula and thus, success rate does not only lie on the surgical technique but also in the intraoperative measures to modulate wound healing (Guzman, 2020). Conjunctival and scleral scarring after surgery remains a major limiting factor to the success of trabeculectomy, especially in Africans and black Americans eyes which have a higher risk of scarring compared to Caucasian eyes. There has been an increasing use of various anti-fibrotic agents to modulate the wound healing response (Mutsch, 2000; Guzman, 2021).

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The use of antiproliferative agents such as beta irradiation, antimetabolites, collagen matrix implants (Ologen) and anti Vascular Endothelial Growth Factor (anti VEGF) has revolutionized glaucoma drainage surgery to modulate the wound healing process (Mutsch, 2000; Guzman, 2021). Antimetabolites especially Mitomycin C (MMC) and 5 Flourouracil (5FU) are commonly used in Nigeria (Olawoye, 2017; Nitin, 2012). MMC has showed a better long term IOP lowering compared to 5FU but both were associated with other postoperative complications like shallow anterior chamber, hypheama, conjunctival flap edge-leak in the 5FU group and shallow anterior chamber, hypheama, posterior syneachiae, hypotony, delayed bleb leak in the MMC group (Olawoye, 2017; Nitin, 2012). Beta irradiation is an antiproliferative agent applied on the conjunctiva overlying the scleral bed after completion of surgery by using a radioactive applicator which emits beta rays which has only a very local penetration to a depth of less than one millimeter (Constable, 1998). Cellular p53 which is a neuropeptide that prevents cell replication in the presence of DNA damage have been found to be significantly increased following beta irradiation thereby inhibiting fibroblast proliferation (Constable, 1998). Strontium 90 is the usual source of beta irradiation which is found to be clinically useful because of its long half-life (28.7 years) and emission of only high energy beta particles as it decays (Kirwan, 2003). .The stability and long half-life of strontium 90 means that once obtained, an emitter can have a long working life with only occasional recalibration. The intensity of the emission from the applicator determines the duration it is applied to the surgical site in order to deliver the required dose of radiation which would effectively prevents scar tissue formation (Kirwan, 2006).

Application of beta irradiation is rapid and convenient; the focal nature of application reduces the risk of accidental over-dosage and risk of leakage outside the treatment area. Sources are stable and easily stored, with no refrigeration required, this considerable supply chain provides cost advantages for beta-irradiation (Kirwan *et al.*, 2012; Kirwan, 2006). The aim of this study is to retrospectively evaluate the long-term intraocular pressure lowering effect of beta irradiation as an adjunct to trabeculectomy in Nigerians

METHODS

A retrospective review of the case notes of all primary glaucoma patients aged ≥ 21 years who had trabeculectomy with beta irradiation with preoperative IOP ≥ 21mmHg between January 2012 and December 2017; and had follow-up for minimum of 2 years at Eleta Eye Institute Ibadan and Ojulowo Eye clinic which are both located in Ibadan, Oyo State, Nigeria. Preoperative data retrieved included age, gender, eye operated, preoperative visual acuity which was defined as visual acuity done a day prior to surgery, cup disc ratio, type of glaucoma based on gonioscopy findings and preoperative IOP which was defined as the IOP value measured a day prior to surgery. The post-operative data retrieved included post-operative visual acuity at 3 months, post-operative IOPs at 1 month, 6 months, 1 year and 2 years follow-up. This study included 54 patients, 17 out of the 54 patients had bilateral trabeculectomy with adjunct beta irradiation making a total of 71 eyes.

The adjunct beta irradiation was applied on the conjunctival overlying the bleb area after completion of surgery as a single dose of 2,400cGy using a self-sterilizing strontium-90 probe. All the analyzed cases were performed by a single surgeon They all had primary trabeculectomy under local anesthesia (peribulbar block). They all had postoperative care with Guttae dexamethasone 0.1% four times daily for six weeks which was subsequently tailed off as three timesfor a week, twice daily for a week and once daily for a week, Gutt ciprofloxacin four times daily for a month and Gutt atropine three times daily for two weeks Excluded from the analysis were patients who had primary trabeculectomy with beta irradiation but were lost to follow up within 2years, and eyes who had beta irradiation at repeat trabeculectomy but not at first surgery. Data was analyzed using SPSS version 21(SPSS Inc., Chicago, IL). Descriptive statistics was used in analyzing data, cross-tabulations with Pearson's chi square were used to compare categorical variables and statistical significance was set at $p<0.05$

RESULTS

Seventy–one eyes of 54 patients who had trabeculectomy augmented with beta radiation were included. Thirty-five (64.8%) were males and 19 (35.2%) were females giving a male-female ratio of 1:1.8. Mean age was 45±3.7 (Figure 1). Thirty-six (50.7%) left eyes were included, while 35(49.3%) were right eye.

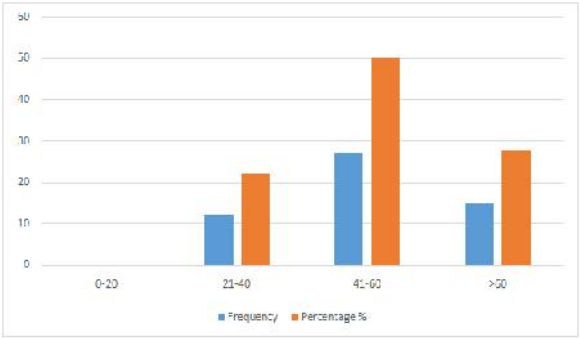

Figure 1. Age distribution of patients

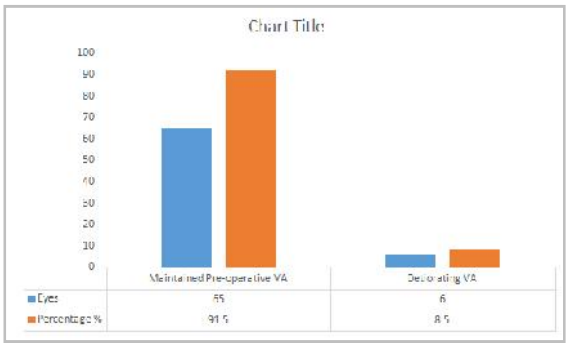

Figure 2. Three months post -operative visual acuity (N=71)

Table 1. Preoperative and two years Post-operative Intraocular pressure (IOP) (N=71)

	IOP(mmHg)						
	<10	11-20	21-30	>30	Total	p value	
			N (%)	N (%)	N (%)	N (%)	N (%)
Preoperative			0(0.0)	0(0.0)	58(81.7)	13(18.3)	71(100.0)
Postoperative(2yrs)			20(28.2)	43(60.5)	8(11.3)	0(0.0)	71(100.0)

Forty-seven (66.2%) out of the seventy-one eyes had preoperative VA ≥ 6/18 while 24 (33.8%) had VA of <6/18-6/60. Baseline preoperative VA was maintained in 65 eyes (91.5%) three months post op while six eyes (8.5%) had deterioration in VA three months post-operation (Figure 2). The 6 eyes with post-operative deterioration in VA had preoperative VA of <6/18-6/60. Mean preoperative IOP was 25.0±4.6mmHg, mean postoperative IOP at one month was 10.5±2.3mmHg and mean postoperative IOP at two years was 14.5±3.5mmHg. There was a statically significant difference in the preoperative and postoperative IOP after 2 years, P value<0.05 (Table 1). There were 8 cases (11.3%) of failed surgery (IOP>21mmHg) two years post operation with IOP success rate of 88.7% at 2years. Cataract occurred less than a year post operation in 9 eyes (12.7%), all of which later had temporal small incision cataract surgery, while 3 eyes (4.2%) had shallow anterior chamber from over filtration which were managed conservatively.

DISCUSSION

Trabeculectomy is still the most effective IOP lowering surgery in which a guarded filtering fistula is created between the anterior chamber and sub tenon space with the aim of lowering the intraocular pressure (Razeghinejad, 2012; Raj. 2018). This is the first study on trabeculectomy with adjunct beta radiation in Nigeria. The mean postoperative IOP at two years in this study was 14.5±3.5mmHg, which gives a 58% reduction from the mean preoperative IOP of 25mmHg. This was a better IOP reduction than the 48.5% reported by Olawoye et al with the use of MMC[8]in a study also carried out in Nigeria. Conjunctival and scleral scarring after surgery remains a major limiting factor to the success of trabeculectomy, especially in African/American eyes which have a higher risk of scarring compared to Caucasian eyes. The use of beta irradiation as adjunct to trabeculectomy would significantly reduce this risk of scarring in these eyes. The main complications encountered in this study were Cataract in 9 eyes (12.7%) and shallow anterior chamber in 3 eyes (4.2%) which were all managed conservatively. Unlike the complications reported with the use of MMC or 5FU which were mainly shallow anterior chamber, hypheama, delayed bleb leak and persistent hypotony (Nitin, 2012). The estimated risk of surgical failure after one year of trabeculectomy with beta irradiation by Kirwan et al[15] in South Africa in his comparative study was 5% as against 30% in trabeculectomy alone at one year while we got 11.3% at two years in our study. A randomized trial of trabeculectomy with beta irradiation compared to trabeculectomy alone found trabeculectomy with beta irradiation has lower risk of surgical failure[12]. Success rate of 60.7% without medication and qualified success rate of 88.4% was achieved at 7 years after trabeculectomy with beta irradiation by Lai et al among Chinese patients. The post-operative visual acuity was preserved in most of our patients as found in other studies that used adjunct beta irradiation with trabeculectomy (Kirwan *et al.,* 2012; Kirwan *et al.,* 2006; Lai, 2003). The irradiation group in the comparative study done in South Africa had higher incidence of operable cataract which is also a noticeable side effects in our patients, invariably from the effect of irradiation on the lens (Kirwan *et al.,* 2016). There is need for more comparative study between trabeculectomy with beta irradiation and trabeculectomy with other adjuncts to delineate the outcomes and risk of other adjuncts in African/Americans.

CONCLUSION

Beta irradiation effectively reduced the risk of surgical failure following trabeculectomy in Nigerian patients with a success rate of 88.7% at 2 years with few and manageable side effects. Therefore, we recommend trabeculectomy with beta irradiation in our patients especially in those at risk of developing conjunctival and scleral related complications.

Limitations: There were no clear-cut indications from the reviewed data, on the number of medication stoppage that was achieved by the patients as this would have been a further boost to our recorded success rate.

Conflicts of interest: None.

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Key points

- Beta irradiation as an adjunct to trabeculectomy significantly reduced the post-operative risk of scarring in African eyes.
- Beta irradiation as an adjunct to trabeculectomy leads to good control of IOP.

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