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Research article

Outcomes of non-penetrating deep sclerectomy in the control of intraocular pressure in patients with advanced glaucoma

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Abstract

Objectives: *Advanced glaucoma patients are at a high risk of total visual field loss and poor quality of life. Although trabeculectomy with antimetabolites is the preferred surgery in such patients to achieve the desirable target IOP, it carries a high risk of wipeout following entry into the anterior chamber. Non-penetrating deep sclerectomy (NPDS) can be used as an alternative surgery in these patients. This study assessed the early postoperative outcomes of patients who underwent NPDS.*

Methodology: *A descriptive study was carried utilizing clinical records of RD unit patients at the National Eye Hospital, Colombo from March to July 2023. Consecutive records of all eyes with advanced glaucoma which underwent NPDS during that period were included. Data regarding demographics, comorbidities of patients, baseline characteristics, control of glaucoma, and outcomes including postoperative IOP control and complications were evaluated.*

Results: *Six eyes of 6 patients (4 males, 2 females) were included in the study. Mean age was 56 years (42-71). POAG was present in 4 patients and 2 patients had chronic ACG. Pseudophakia was noted in 2 patients, whilst all others were phakic. Mean preoperative IOP was 30.4mmHg on maximum tolerable topical and oral medications. All eyes underwent NPDS by a single surgeon under sterile conditions. One patient developed self-limited ocular hypotony postoperatively. Mean postoperative IOP on first post-surgical day was 12.8 mmHg. Mean IOP reduction was 17.6 mmHg (p=0.08).*

Conclusion: *NPDS is an excellent alternative with good safety for IOP control in patients with advanced glaucoma.*

Key words: Non-penetrating deep sclerectomy, advanced glaucoma, IOP

Introduction

The disease burden of glaucoma in a lower-middle income country such as Sri Lanka is not limited only to the estimated 5% of the population affected, but also encompasses the caregiver population as well[1]. In a community where there is poor access to low vision aids and where public health measures for accessibility to the blind is scarce, prevention of irreversible blindness associated with glaucoma is of paramount importance. Primary open angle glaucoma, the most common type, is particularly diagnosed late due to its paucity of symptoms early in the disease and the lack of awareness among the general population. Therefore, a significant proportion of patients are at an advanced stage of glaucomatous optic neuropathy at the time of the initial diagnosis.

Traditionally, penetrating glaucoma surgery is considered the gold standard for lowering the intraocular pressure (IOP) to the low teens and even up to a single digit. Augmented trabeculectomy with anti-metabolites is the commonest penetrating surgery performed. However, trabeculectomy exposes the patient to a high degree of risk of surgical complications to reap its reward. At the other end of the glaucoma surgery spectrum lie the minimally invasive glaucoma procedures (MIGS) which offer a higher degree of safety, but only a modest reduction in IOP.

Non-penetrating deep sclerectomy (NPDS) is a surgical procedure which aims to gain the desired IOP lowering effect of a trabeculectomy whilst minimizing its associated risks such as hypotony and endophthalmitis. This procedure has gained traction among glaucoma specialists mainly in Europe[2]. The surgical process of NPDS has undergone modifications since its initial description by Kozlov and Fyodorov in 1989[3]. By deroofing the Schlemm canal and exposing the juxtacanalicular meshwork directly to drain into the subconjunctival space, NPDS tries to address the purported site of maximal resistance for drainage of aqueous humor through the conventional pathway.

NPDS has its advantages over trabeculectomy especially in patients who have a lower threshold for tolerance of surgical complications, such as monocular patients, myopic eyes with thin sclera, young patients with less scleral rigidity, and patients with congenital glaucoma[4]. NPDS has been shown to be superior to

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trabeculectomy in patients with uveitic glaucoma as it may cause less inflammation due to less intraocular tissue manipulation and dissection[5].

This study aims to retrospectively evaluate patients who underwent NPDS as a routine glaucoma surgical procedure and demonstrate the short term outcomes in these eyes.

Materials and methods

A descriptive study was carried utilizing clinical records of the RD unit at the National Eye Hospital, Colombo from March to July 2023 to gather data regarding patient demographics, stage and control of glaucoma, other relevant associated co-morbidities, details of the surgical procedure, post-surgical follow-up and surgical outcome measures of success. Data regarding postoperative IOP control and surgical complications were also collected. Consecutive records of all eyes with advanced glaucoma which underwent NPDS during the study period were included.

Surgical Technique

All surgeries were done by a single surgeon. Informed written consent for the surgical procedure was obtained after explaining the risks and benefits. The patient was taken to the operating theatre and sterile prepping and draping was done using 5% povidone iodine. Sub-tenon anesthesia was given with 10% lidocaine sterile solution with topical drops applied as needed. A superior fornix based conjunctival pocket was fashioned similar to a superior trabeculectomy and 0.4 mg/mL mitomycin C soaked sponges were applied for 3 minutes in the subconjunctival space.

A partial thickness scleral flap was created with a crescent blade to about 50% of scleral depth. Then a deep scleral flap was created with identification of Schlemm canal under direct visualization at the limbus. De-roofing of the Schlemm canal was done with toothed forceps and slow egress of aqueous was noted. The deep scleral flap was excised creating a reservoir of aqueous and the superficial scleral flap was closed with 10-0 interrupted nylon sutures to the four corners of the flap. A watertight conjunctival closure was done and checked for any leaks at the end of the procedure.

Postoperatively, the patient was started on topical prednisolone acetate 1% 4 hourly and topical moxifloxacin 6 hourly. The steroid dose was increased or tapered according to the healing response. The antibiotic was stopped after 1 week of use as prophylaxis.

Results

A total of six eyes of 6 patients had undergone NPDS during the study period and all clinical records were available for analysis. The study therefore included 4 males and 2 females. Mean age was 56 years with the ages ranging from 42 to 71 years. Primary open angle glaucoma was present in 4 patients and 2 patients had chronic angle closure glaucoma. Pseudophakia was noted in 2 patients, whilst all others were phakic. Mean preoperative IOP was 30.4mmHg on maximum tolerable topical and oral anti-glaucoma medications. The average number of preoperative topical anti-glaucoma medications was 3.5. The preoperative mean deviation of the visual fields on 24-2 standard automated perimetry using the Humphrey Visual Field Analyzer was 14.75 dB.

The average postoperative follow-up was 5.3 weeks. One patient developed self-limited ocular hypotony postoperatively which resolved at 4 weeks postop. No other complications were observed in any patient, including wipeout or infection. Mean postoperative IOP on first postsurgical day was 12.8 mmHg. Mean IOP reduction was 17.6 mmHg (57%). Average number of postoperative anti-glaucoma drops was 0.3, which represented a 91% reduction of the topical drop burden.

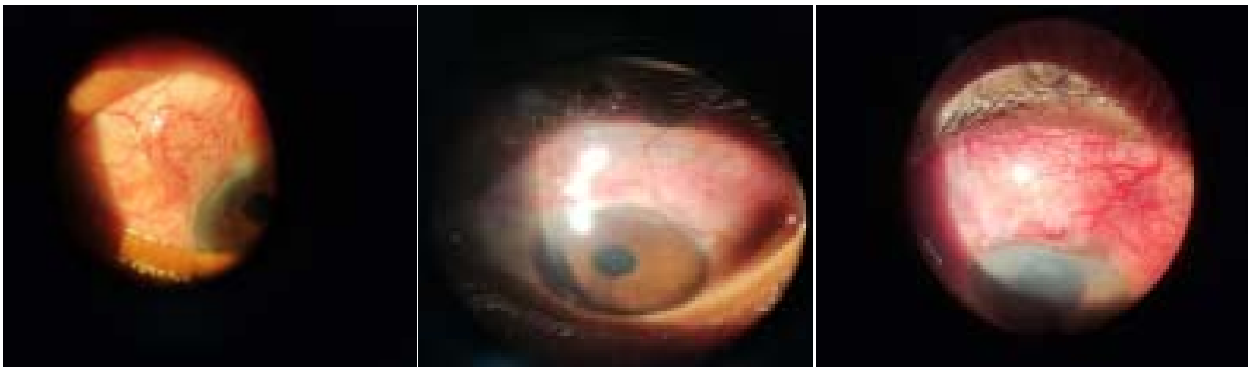

Figure 1. *Appearance of the filtering blebs on postoperative follow-up of 3 patients who underwent non-penetrating deep sclerectomy.*

Discussion

Non-penetrating deep sclerectomy appears to be gaining popularity as an effective surgical procedure for IOP control in uncontrolled glaucoma. Long term outcomes of NPDS in a large study showed 62% reached the target IOP (<16mmHg) with no medications and 71% reached the target IOP with medications at 5 years follow-up[6]. However, the extent of IOP lowering is less than that would be expected of an augmented trabeculectomy with mitomycin C and only about 10% of patients achieved an IOP of 12 mmHg or lower at 5 years[7]. Laser goniopuncture and NPDS with porous collagen implant have been described as further refinement procedures to increase the success of the surgery, but outcomes are still comparably lower than with a mitomycin augmented trabeculectomy[8]. Despite its limitations, NPDS offers the glaucoma surgeon a varied tool with better success in carefully selected patients where a trabeculectomy is risky or likely to fail[9].

The limitations of our study were that it was a non-comparison trial to trabeculectomy, which is the current gold standard for filtering surgery, the small number of patients included in the study and the limited follow-up. We had only 2 patients each with chronic angle closure and pseudophakia. When considering the proposed mechanism of action, only patients with open angles would likely benefit from NPDS as any obstruction would preclude aqueous accessing the trabecular meshwork and Schlemm canal. However, the degree of peripheral anterior synechiae and closure of the angle may influence the success of the procedure and therefore is an important factor to be considered.

The field of glaucoma surgery is moving away from the traditional approach of obtaining the lowest possible IOP despite the risks to a more tailored approach where some degree of glaucoma progression may be tolerated if the patients' quality of vision and quality of life is maintained throughout their life expectancy. A stepladder management, where patients with mild glaucoma being good candidates for MIGS procedures and patients with moderate to severe glaucoma being good candidates for more invasive procedures, is a better approach to treatment in the current era. Therefore, deep sclerectomy will undoubtedly find its significance in the spectrum of glaucoma surgery.

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