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Case Report

Full-Thickness Macular Hole Following Selective Laser Trabeculoplasty

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Introduction

Glaucoma is the second leading cause of blindness worldwide and is predicted to affect nearly 80 million people globally by the end of the decade [1]. Characterized by progressive optic nerve damage and visual field loss, the cornerstone of glaucoma treatment involves reduction of intraocular pressure (IOP) by means of topical therapy, lasers or surgery in a bid to slow or prevent further progression of optic nerve damage and visual loss [1].

While lasers were first introduced to reduce IOP in the 1970s, early iterations of laser trabeculoplasty were met with limited success [1]. But since selective laser trabeculoplasty (SLT) was introduced by Latina and Park in 1995, it has increasingly been used as first line treatment or adjunctive therapy among open angle glaucoma and ocular hypertensive patients [2]. SLT utilizes a 532 nm Q-switched, frequency doubled Nd-Yag laser delivered at shorter pulse duration to target the pigmented trabecular meshwork (TM) while preventing the dissipation of heat outside the pigmented TM thereby sparing the adjacent tissue and maintaining the anterior chamber angle architecture [3].

While SLT is known to increase aqueous outflow through the TM, the mechanism by which this occurs remains ambiguous. Studies have shown that there are minimal coagulative and mechanical changes in the TM which supports the notion that changes to the TM are more likely to be of a chemical nature.(3)Several possible theories have been postulated including TM monocyte recruitment which aids in the phagocytosis of TM debris and promotion of healthy TM cells to optimize outflow, cytokine and matrix metalloproteinase production resulting in extracellular matrix remodeling which in turn increases aqueous outflow and changes in gene expression related to 'cell motility, extracellular matrix production, membrane repair and reactive oxygen species production' [1].

The benefits of SLT are multifold as it is a short outpatient procedure with relatively rapid recovery. Moreover, it is an effective and cost-efficient treatment for a wide range of glaucoma subtypes [4]. However, while it has a relatively good safety profile, some studies have shown a varying range of complications particularly among patients with deeply pigmented TM [4]. Since SLT has increasingly been employed to lower intraocular pressure, clinicians must be aware of these potential complications. These complications include IOP spikes, uveitis, corneal haze, macular oedema and foveal burns burns [4,5]. The following case describes an atypical complication where the patient developed a macular hole following routine SLT.

Case

A 64-year-old patient presented to the glaucoma clinic in December 2017. Vision in the right eye was stable at 6/7.5 (Snellen's chart). Incidental finding was lamellar hole and epiretinal membrane in the right eye, confirmed on OCT Scan (See Figure 1). It was noted that despite topical treatment with latanoprost and brinzolamide, the patient's IOP remained above the target range. The patient was consented and underwent SLT treatment in the right eye. Following treatment, the patient noted deterioration in their central vision and metamorphopsia approximately 2-3 week's post-SLT. Following a visit with the optician, an urgent referral was made to the eye unit

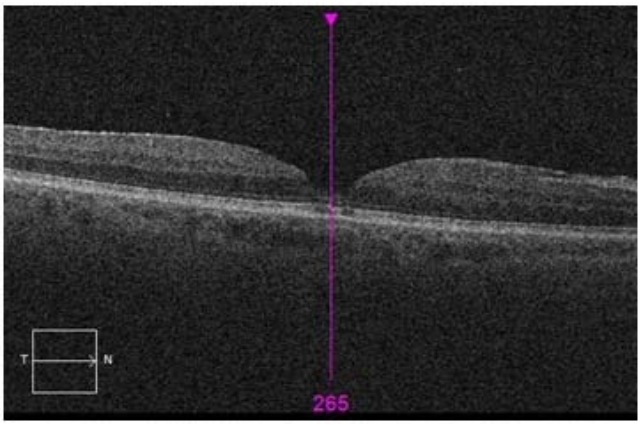

Figure 1: OCT indicating lamellar macular hole prior to undergoing SLT in the right eye.

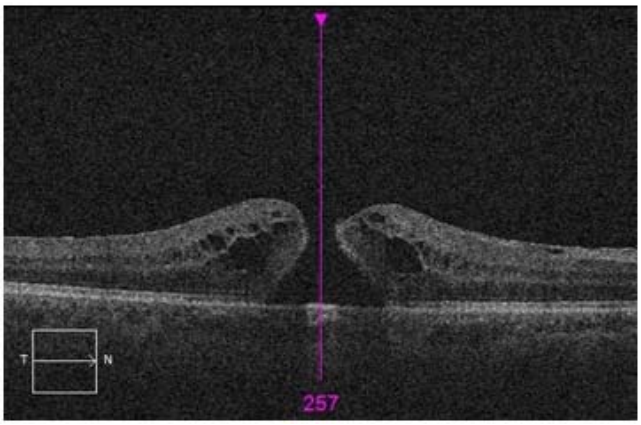

Figure 2: OCT indicating full thickness macular hole 4 weeks after undergoing SLT in the right eye.

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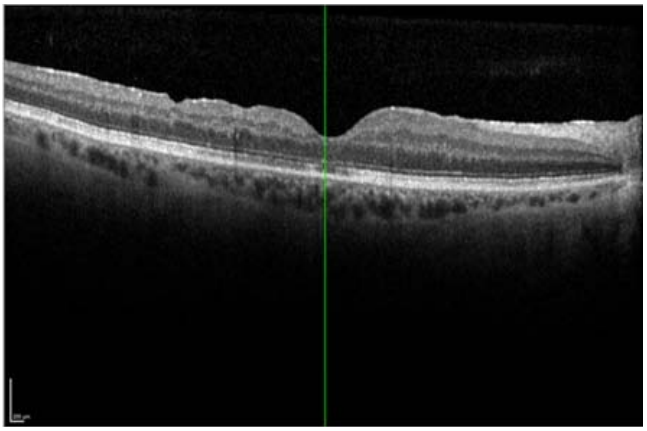

Figure 3: OCT indicating resolution of full thickness macular hole in the right eye following vitrectomy and epiretinal membrane peel.

with a primary diagnosis of full-thickness macular hole which was noted on OCT at the optician's practice. The patient was then seen in the eye unit on February 2018 and the diagnosis of a full-thickness macular hole was confirmed (Figure 2).

A referral was made to the tertiary vitreo-retinal team where the patient underwent a vitrectomy and epiretinal membrane peel in the right eye. This resulted in resolution of symptoms and return of visual acuity to baseline (Figure 3).

Following careful review of patient notes and a literature search, it is assumed that the SLT indirectly caused the development of the full-thickness macular hole. Reference was made to one such incident occurring Raigmore Hospital (Inverness) [6]. The patient in this study presented with similar symptoms and duration and was believed to be a rare retinal complication following SLT laser.

Discussion

SLT is generally a well-tolerated procedure with relatively few complications, the majority of which tend to be transient and self-limiting [5]. Indeed, patients may commonly develop transient IOP spike, anterior chamber inflammation and corneal oedema [1]. While retinal complications such as macular oedema and foveal burns have been reported, these are relatively rare [5]. SLT induced macular holes such as the one reported here is also a rare entity with only one other case reported in literature.

Since SLT induced macular holes are rare, the mechanism by which SLT induces a full thickness macular hole is not well understood. However, laser induced macular holes with hand-held or industrial devices have been widely reported [7]. Moreover, laser induced macular holes have also been reported following Yag capsulotomy, iridotomy and LASIK [8-11]. Several theories have been proposed to explain the formation of such laser induced macular holes. Hand-held devices employing high powered lasers are thought to produce retinal damage through photocoagulation [12]. Thus, the pathogenesis in macular holes caused by handheld lasers is thought to be photodisruptive and photothermal in nature [12]. On the contrary, Nd-Yag lasers are thought to induce macular hole through photomechanical disruption and retinal dissolution [8,10,12]. Interestingly, in such cases, several studies have identified certain risk factors such as pre-existing vitreomacular adhesion that predispose to Nd-Yag laser induced macular holes [8,10].

Since SLT does not utilize high powered lasers such as that used in handheld lasers, it is less likely that photo disruptive and photothermal damage contributes to macular hole formation following SLT. Indeed, the OCT scans in this case indicated no RPE damage or choroidal ischaemia typically seen in handheld laser induced macular hole [13]. It is postulated that SLT induced macular hole results from photomechanical disruption and resultant retinal dissolution. The depositof melanin in the TM is more intense in a darkly pigmented iris and is often concentrated inferiorly in the anterior chamber due to gravity. Since SLT is well absorbed by the pigment, treatment needs to be titrated accordingly for each patient. The inferior margin of the trabecular meshwork would have required increased power to attain the "champagne bubble" effect representing the appropriate level of treatment to attain therapeutic effect [3,14]. This minimal increase in power may have been precipitated the formation of macular hole. Indeed. The patient also had an epiretinal membrane and a lamellar macular hole which may have predisposed the patient to the development of laser induced macular hole.

In this case, much like the other reported case of SLT induced macular hole at Raigmore Hospital, the patient did not experience a decline in vision initially and began to only notice discrepancies up to two months post-SLT treatment [6]. It is also important to note that neither patient had previously received SLT treatment [6]. According to Stein et al, laser induced full thickness macular holes may close spontaneously if the initial size of the hole is small and in the presence of haemorrhage that may function as tissue glue [9]. However, most cases of laser induced full-thickness macular hole (FTMH) require surgical repair [9]. Since there are only a few reports of vitrectomy to repair laser induced FTMH, there is a lack of certainty regarding the factors that contribute to visual recovery. Nevertheless, Stein et al concluded that a long interval between time of injury and surgical repair as well as persisting damage to the outer retinal structures postoperatively contribute to poor visual prognosis [9]. In the case reported at Raigmore Hospital,the patient decided against macular hole repair and was only monitored despite poor vision [6]. To our knowledge, this is the first case where the affected eye was treated together with the vitreo-retinal team with good recovery of vision.

SLT remains an excellent method of lowering IOP to satisfactory levels whilst being cost effective, safe and aids in reducing the healthcare burden. As with all treatments, management should be tailored for each patient. Before beginning SLT treatment there should beadequate review of patient history including potential predisposing risk factors including vitreomacular anatomy, response to current treatment and appropriate consultation with patients to help reduce the risk of unwanted complications. We recommend further studies to analyse the effect of the SLT laser on the retina and uveal tract to optimize risk factors and personalize patient care.

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