SURGICAL TECHNIQUES

The use of a "cheese-wire" suture in trabeculectomy

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Aim: To report a preliminary study on the safety and efficacy of the use of a cheese-wire suture in trabeculectomy.

Patients and methods: The case notes of 32 eyes of 25 patients with medically uncontrolled glaucoma who underwent trabeculectomy with cheese-wire suture at Stobhill Hospital, Glasgow, UK, between July 2001 and September 2002 were studied retrospectively. Diagnoses included primary open angle glaucoma (n = 24), normal tension glaucoma (n = 3), angle closure glaucoma (n = 2), ocular hypertension (n = 1), angle recession glaucoma (n = 1) and combined mechanism glaucoma (n = 1). The mean presenting intraocular pressure (IOP) was 29.5 mm Hg and mean intraocular pressure before operation was 23.5 mm Hg.

Outcome measures: Success was defined as lowering of IOP by at least 15% compared with IOP before removal.

Results: A total of 20 eyes (62%) underwent removal of the cheese-wire suture. 17 eyes (85%) underwent removal for therapeutic reasons (failing/failed blebs) and three eyes (15%) underwent suture removal as the suture loops were exposed. The timing of removal was between 2 weeks and 12 months following surgery. A successful outcome was seen in 12/17 (70%) eyes in the eyes that had therapeutic suture removal. 15 eyes had undergone previous surgical interventions (trabeculectomy n = 12, extracapsular cataract extraction n = 1 and laser peripheral iridotomies n = 2). Mean IOP before removal was 23.66 mm Hg and mean IOP immediately following removal was 11.33 mm Hg. Of the 32 eyes that underwent trabeculectomy with cheese-wire suture, 24 eyes had intraoperative mitomycin C and one eye had 5-fluorouracil. The remaining seven eyes did not have any antimetabolites. Early complications related to the surgical procedure included conjunctival haematoma in one eye (3%), corneal abrasion in one eye (3%), wound leak in five eyes (15%), shallow anterior chamber in one eye (3%), hyphaema in six eyes (18%), choroidal effusion in six eyes (18%) and raised IOP in two eyes (6%). Late complications of suture exposure occurred in three eyes (9%). Complications related to removal of the cheese-wire suture included suture breakage in two eyes (10%), hypotony in one eye (5%) and transient hyphaema in one eye (5%).

Conclusion: The use of cheese-wire suture in trabeculectomy appears to be safe and may provide an alternative strategy in the management of bleb failure.

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Bleb failure remains a common problem following complicated filtering surgery despite the use of antimetabolites. The rate of bleb failure has been reported to be as high as 10–20%.^{1–3} Early bleb failure (within the first postoperative month) is related to wound healing at the level of the scleral flap or occlusion of the sclerostomy. In contrast, late bleb failure (after the first postoperative month) is usually a result of subconjunctival/episcleral fibrosis and this represents the commonest type of bleb failure.⁴

Current treatment modalities for failing/failed blebs include bleb massage, topical steroids, needling, topical antimetabolites, releasable sutures, laser suture lysis and laser sclerostomy.^{4–5} The choice of treatment depends mainly on the timing of bleb failure and the level of pre-existing glaucomatous damage. These treatment options each have varying degrees of success and some of them are associated with significant complications.^{6–11}

We describe the use of a "cheese-wire" suture which is effectively a loop of 8-0 nylon suture placed under the scleral flap at the time of carrying out a trabeculectomy. This suture provides the option of subsequently rescuing failing or failed blebs, especially flat fibrotic blebs, by mechanically breaking down subscleral flap, subconjunctival/episcleral scar tissue.

PATIENTS AND METHODS

Thirty two eyes of 25 patients with medically uncontrolled glaucoma underwent trabeculectomy with insertion of a

cheese-wire suture at Stobhill Hospital, Glasgow, UK, between July 2001 and September 2002. All patients were specifically informed that an additional suture would be placed during surgery to provide an option for releasing scar tissue if this became necessary.

The case notes of these patients were studied retrospectively. Patient characteristics and initial observations in our study group are summarised in tables 1 and 2. The diagnoses included primary open angle glaucoma (n = 24), normal tension glaucoma (n = 3), angle closure glaucoma (n = 2), ocular hypertension (n = 1), angle recession glaucoma (n = 1) and combined mechanism glaucoma (pseudo-exfoliation with neovascular glaucoma, n = 1) (table 3). Fifteen eyes had undergone previous surgical interventions (trabeculectomy n = 12, extracapsular cataract extraction n = 1 and laser peripheral iridotomies n = 2). The mean presenting intraocular pressure (IOP) was 29.5 mm Hg and the mean IOP prior to removal of the cheese-wire suture was 23.5 mm Hg.

Of the 32 eyes that underwent trabeculectomy with a cheese-wire suture, 24 eyes had intraoperative mitomycin C and one eye had 5-fluorouracil. The remaining seven eyes did not have any antimetabolites.

Abbreviation: IOP, intraocular pressure

Table 1 Patient demographics

No of patients	25
Male	11
Female	14
Race	All white Caucasian
Age range (y)	43–90

Table 2 Initial observations

Total No of eyes	32
Laterality	
Right eye	18
Left eye	14
Mean presenting IOP (mm Hg)	29.5
Mean preoperative IOP (mm Hg)	23.5
Mean preoperative medications	2.03
Previous surgery	15 eyes (47%)

IOP, intraocular pressure.

Table 3 Diagnoses of the patients

Primary open angle glaucoma	24 (75%)
Normal tension glaucoma	3 (9.4%)
Angle closure	2 (6.3%)
Combined mechanism	1 (3.1%)
Angle recession	1 (3.1%)
Ocular hypertension	1 (3.1%)

RESULTS

Surgical technique

All procedures were carried out by a single surgeon (DM). A subtenon injection of a 50:50 mixture of lignocaine 2% and bupivacaine 0.5% was used.

A corneal traction suture is used to rotate the globe downwards and achieve adequate exposure. A fornix based conjunctival flap is created by cutting conjunctiva and Tenon's capsule flush with the limbus over a circumference of 8 mm at the 12 o'clock position. Blunt dissection is carried out under the flap and the mobilised conjunctiva is held back with a sponge or forceps. Gentle wet field cautery is used to achieve haemostasis.

A triangular partial thickness scleral flap (about one-half of the scleral thickness) is created with a diamond knife. The

Figure 2 Slit-lamp photograph showing a cheese-wire suture in situ.

scleral flap is extended to the limbus hinged anteriorly (fig 1A). A sclerostomy is made with a punch and this is followed by a peripheral iridectomy.

An 8-0 nylon suture is passed through the conjunctiva from the external aspect to enter the subconjunctival space (fig 1B). The point of needle entry is approximately 3 mm from the lateral edge of the future bleb site and 3–4 mm away from the limbus. The suture is taken under the scleral flap. The direction of the suture is then reversed and the needle is passed through the conjunctiva from inside outwards. This is adjacent to the point of entry. The scleral flap is secured with a single 10-0 vicryl suture. The cheese-wire suture is then cut flush to the conjunctiva with Vanas scissors and the cut ends allowed to retract slightly under the conjunctiva. The conjunctival flap is then secured with 2× 10-0 vicryl sutures at either ends at the limbus and a single 10-0 vicryl mattress suture in the middle (Fig 1C).

A single drop of cyclopentolate 1% and a subconjunctival injection of betamethasone and cefuroxime is given at the end of the procedure. Figure 2 is a slit lamp photograph of an eye that underwent trabeculectomy with placement of a "cheese-wire".

Postoperative management

All patients were commenced on a standard regimen of G Betnesol-N QDS for a period of 4 weeks. Patients were examined on the day following the operation, 1 week, 1, 3, 6, 9, 12, 18 and 24 months after surgery. Additional visits were arranged depending on the individual course.

Figure 1 Technique of cheese-wire-suture placement.

Table 4 Early complications

Nature of complication	No of eyes (%)
Conjunctival haematoma	1 (3%)
Corneal abrasion	1 (3%)
Exposed loop	3 (9%)
Bleb leak	5 (15%)
Raised IOP	2 (6%)
Hyphaema	6 (18%)
Shallow AC	1 (3%)
Hypotony	7 (21%)
Choroidal effusion	6 (18%)

AC, anterior chamber; IOP, intraocular pressure.

Complications

Table 4 lists the complications encountered in our study. None was sight threatening. The subconjunctival haematoma was localised and it resolved spontaneously. One eye (which underwent a phaco-trabeculectomy) developed a pressure spike of 44 mm Hg which settled with medical therapy. IOPs were 11 and 14 mm Hg in the two eyes that developed exposure in the early postoperative period. One eye developed exposure at 1 week and the other 2 weeks postoperatively. The eye that developed exposure 4 months following surgery had an IOP of 15 mm Hg prior to removal. IOP immediately after removal was 12 mm Hg. The problems of exposed loops were in eyes that had long loops fashioned. This was in the early part of our series and this complication was subsequently eliminated by fashioning a shorter loop.

Technique for removal of the cheese-wire suture

The first few removals were done in the operating theatre but, once confidence had been gained, subsequent removals were carried out at the slit lamp in the outpatient clinic. The eye is prepared with betadine. A small incision is made in the conjunctiva overlying the two ends of the cheese-wire suture under topical anaesthesia (G amethocaine 0.1%). Both ends of the suture are grasped with fine suture removal forceps (fig 3). Gentle tangential traction is exerted initially and gradually increased to the required amount to cheese-wire through the scar tissue.

All eyes had an injection of 5-fluorouracil at the time of removal of the cheese-wire suture. Additional injections of 5-fluorouracil (1–3 injections) were used in the early period after removal at weekly intervals.

Patients were commenced on G Betnesol-N for a period of 1–4 weeks depending on the individual course.

Figure 3 Technique of cheese-wire suture removal.

Immediate results of cheese-wire suture removal

The procedure was straightforward in the majority of eyes. We encountered suture breakage in two eyes and transient hyphaema occurred in one eye.

A total of 20 eyes (62%) underwent removal of the cheese-wire suture. Seventeen eyes (85%) underwent removal for therapeutic reasons (failing/failed blebs) and three eyes (15%) underwent suture removal as the sutures were exposed. The timing of removal was between 2 weeks and 12 months following surgery.

Of the 17 eyes that showed signs of bleb failure, five eyes developed encapsulation of the bleb. In the remaining 12 eyes, the blebs showed signs of progressive fibrosis and flattening and most of the eyes demonstrated a gradual raise in IOP. Three eyes underwent removal of the cheese-wire suture despite a normal appearance of the blebs and normal IOPs as these eyes required a very low target pressures. These eyes were, however, included in the therapeutic removal group for the purposes of our study.

Success was defined as a reduction in IOP (IOP immediately after suture removal) of at least 15% compared with IOP before removal of the cheese-wire suture. Table 5 outlines the immediate success rates. A successful outcome was seen in 12/17 (70%) eyes in the eyes that had a suture removal. Mean IOP before removal was 23.66 mm Hg and mean IOP soon after removal of the cheese-wire suture was 11.33 mm Hg (IOP immediately after suture removal).

Long term results of cheese-wire suture removal (tables 6–8)

In order to ascertain the longer term efficacy of the procedure, we analysed IOP control at 1 year. Unqualified success was defined as IOP <21 mm Hg without additional medical therapy. Qualified success included eyes achieving IOP <21 mm Hg with additional medical therapy.

At 1 year mean IOP was 17.75 mm Hg in the group that had therapeutic suture removal (for failing/failed blebs). The 1 year unqualified and qualified success rates for this group were 41.5% and 71.5%, respectively.

Table 5 Immediate results of removing the cheese-wire suture

Mean pre-removal IOP (mm Hg)	23.66
Mean post-removal IOP (mm Hg)	11.33
IOP lowering	12/17 (70%)
Visible bleb formation	11/17 (65%)

IOP, intraocular pressure.

Table 6 One year results in the suture removal group

Mean pre-removal IOP (mm Hg)	21.80
Mean post-removal IOP (mm Hg)	17.75
Unqualified success	7/17 (41%)
Qualified success	12/17 (70.5%)

IOP, intraocular pressure.

Table 7 One year results in the suture in situ group

Mean IOP (mm Hg)	15.41
Unqualified success	8/12 (67%)
Qualified success	10/12 (83.5%)

IOP, intraocular pressure.

Table 8 One year results for the entire study group

No of eyes	32
Mean IOP (mm Hg)	15.65
Unqualified success	16 (50%)
Qualified success	24 (72%)

IOP, intraocular pressure.

The 1 year unqualified and qualified success rates for the suture in-situ group were 67% and 83%, respectively. Mean IOP in this group was 15.41 mm Hg.

IOP was within the normal range at 1 year in all three eyes which had suture removal following erosion/exposure of the suture. IOPs were 17 mm Hg (on one topical medication), 7 mm Hg and 20 mm Hg, respectively.

The 1 year unqualified and qualified success rates for the entire study group were 50% and 72%, respectively, with mean IOP being 15.65 mm Hg.

Complications related to removal of the cheese-wire suture

The eyes in which we encountered suture breakage had a significant degree of scarring, thereby warranting the use of considerable tractional force while attempting to remove them. Hypotony, defined as an IOP of ≤ 5 mm Hg, developed in one eye following removal of the cheese-wire suture but was transient, resolving spontaneously. One eye developed a transient hyphaema following removal of the cheese-wire suture.

DISCUSSION

Trabeculectomy remains the most widely used treatment for medically uncontrolled glaucoma. The success of this procedure is influenced significantly by scarring in the postoperative period. Prompt identification and active management of failing/failed blebs is vital in achieving successful external filtration of aqueous.

Early bleb failure (within the first postoperative month) is related to wound healing at the level of the scleral flap or occlusion of the sclerostomy. In contrast, late bleb failure (after the first postoperative month) is usually a result of subconjunctival/episcleral fibrosis and this represents the commonest type of bleb failure.⁴

The currently available treatment modalities for bleb failure are efficacious but their effectiveness depends on the timing of failure (and intervention), as the underlying pathophysiological mechanisms are different.⁴⁻⁵ They are effective mainly in the management of early bleb failure.

Pharmacological agents such as topical steroids and 5-fluorouracil are effective in the management of early bleb failure but are not very effective in cases of late bleb failure which is primarily due to subconjunctival/episcleral scarring. Similarly, digital massage is useful mainly in the early postoperative period when bleb function is compromised by occlusion at the level of the sclerostomy or scleral flap by the presence of blood, fibrin or pigment.

Releasable sutures and laser suture lysis^{6-7, 12-14} are again only effective in the early postoperative period before scleral fibrosis has occurred.

Needling is commonly used to rescue encapsulated blebs. It is not, however, applicable in cases of fibrosis of the scleral flap unless the surgeon is prepared to insert the needle under the flap into the anterior chamber (sometimes referred to as "aggressive needling"). It is a relatively invasive procedure and it may have to be repeated a few times in some eyes. Sight threatening complications have been reported following needling.⁸⁻¹⁰

Gross previously described the use of a "dissecting seton" in trabeculectomy in a small series of nine cases.¹⁶ He proposed that the altered composition of aqueous in the immediate postoperative period might encourage fibroblastic proliferation and bleb failure and that the delayed creation of a filtering bleb might therefore be beneficial to the success of the operation. He used various suture materials with loops extending under the scleral flap and into the anterior chamber. The primary indication for surgery was cataract in all except one eye in which glaucoma was the primary indication for surgery. All the eyes in his series underwent combined phacoemulsification and trabeculectomy. There were no cases of definitive bleb failure in his series and all sutures were removed electively between 8 and 27 days postoperatively. In contrast our technique is standardised in that we used a single loop of 8-0 nylon under a triangular scleral flap in all our cases. We placed the suture over the sclerostomy but not within the anterior chamber for fear that it might become entangled in peripheral iris. We removed the suture only in cases of impending bleb failure or conjunctival erosion. While the incorporation of the cheese-wire suture at the time of trabeculectomy and its subsequent removal have been demonstrated to be relatively safe and effective, we have identified a number of potential improvements with the technique that we plan to evaluate.

- Suture material: nylon may not be the optimum choice as it tends to degrade with time, and loss of tensile strength may result in breakage on attempted removal. We are currently looking at alternative suture materials to minimise this risk
- Needle design: a loop of material suaged to a long spatulated needle would enable the cheese-wire suture to be placed more easily at the time of trabeculectomy. The needle could then be tunnelled through superficial sclera before emerging through the conjunctiva. Once trimmed, the cut ends could be retracted into the tunnel thereby minimising the likelihood of future conjunctival erosion.

The UK National Survey of Trabeculectomy reported 1 year unqualified and qualified success rates of 66.6% and 71%, respectively, for first time trabeculectomy for open angle glaucoma.¹⁶ The lower unqualified success rate in our study group is probably due to a relatively complex case mix with almost 50% of the eyes having had previous intraocular surgery.

The high incidence of suture removal (62%) in our study group might lead to speculation that the sutures themselves may potentiate bleb scarring. Although this is plausible, we are unable to draw any firm conclusions from this preliminary work and this is an issue that will have to be addressed in a future randomised controlled comparative study.

CONCLUSION

The use of cheese-wire suture in trabeculectomy appears to be safe and provides the option of mechanically breaking down the subscleral flap and subconjunctival scarring that are the main causes of bleb failure. When combined with an appropriate antifibrotic regimen it has the potential to provide an alternative effective strategy in the management of bleb failure. Further refinement of the technique will be followed by a randomised controlled trial.

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