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Choroidal Hemorrhage, Pre-placed Sutures, and Host Over Donor Keratoplasty
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A video file is not available, please refer to the detailed medical illustrations.
Abstract

An old and currently seldom used technique, true pre-placed sutures, is described in a case that was high risk for choroidal hemorrhage. A penetrating keratoplasty technique, termed host over graft, was employed allowing the surgeon to expeditiously close the eye in the event of choroidal hemorrhage. After partial thickness trephination, true pre-placed sutures through the corneal host tissue were passed. After complete trephination, the corneal donor graft was placed under the host and sutured in a controlled fashion. The pre-placed sutures had been drawn immediately, giving a broad secure cover allowing controlled permanent suturing of the graft while selectively removing the preplaced sutures. Should a choroidal hemorrhage occur, the pre-placed sutures allow the surgeon to quickly close the eye securely.
A choroidal hemorrhage (CH) is one of the most feared complications of intraocular surgery, especially penetrating keratoplasty (PK). One may anticipate it, as risk factors have been ascribed which include: increased blood pressure, older age, ocular inflammation, previous complicated intraocular surgery, hypotony, sudden change in vascular gradient, anterior chamber intraocular lenses (AC IOL), and arguably prior CH.\textsuperscript{1,2,3,4,5} However, it is truly an unpredictable and potentially catastrophic event.

When a CH is first suspected or noticed, it is imperative to close all wounds as soon as possible to prevent extrusion of intraocular contents and normalize the eye pressure. If a CH occurs at the wrong moment during a PK it can be catastrophic. This is most likely to occur during the “open sky” phase when the donor button is removed and the eye is most hypotonic, with an open hole of roughly 30-40 mm\textsuperscript{2} that one needs to cover or close immediately. The closure choices in preference order are with donor cornea, host cornea, or pollical (the surgeon’s sterile gloved thumb) while trying to figure out how to accomplish either of the two aforementioned choices.

With PK if the patient has known risk factors or one expects a more difficult procedure, the surgeon may employ surgical techniques that provide an extra measure of safety to leave the eye open and hypotonic as briefly as possible and to execute an ultra fast donor placement should the worst case occur. CHs associated with PK occur at about 0.5-0.75% frequency.\textsuperscript{3,4,6} Since this is fortunately a rare occurrence, there are no large evidence based large series from which to draw firm conclusions.
When assessing the risk of CH, one should take pre-operative and operative precautions including normalization of blood pressure, slight Reverse Trendelenburg head position, pre-operative ocular massage or Honan Balloon, and when anticoagulation is needed, keeping warfarin within the therapeutic range, and using only a single anticoagulation/anti-platelet medication.2,3,5,7

In cases of a high risk PK, there have been reports that nicely describe useful surgical PK extra-safety techniques: Price Graft Over Host (GOH) described by Loden and Price8 with variations thereof9,10 described as a “sandwich” technique and Hinge Keratoplasty (HK), described by Weiss.11 In the case described herein we used an old suturing technique, true pre-placed sutures, commonly used 50 years ago when cataract surgery wounds were large. We utilized the pre-placed sutures in a patient in whom the unique circumstances poised us to employ this mostly forgotten technique that we believed would enhance safety and control. We term the procedure, Host Over Donor keratoplasty (HOD), and because of its mechanical similarity to camping and travel vehicles, “pop top” keratoplasty.

Case Report
A 67 year old man presented with a history of two prior choroidal hemorrhages in his right eye, the first during routine cataract surgery, and the second during secondary placement of a posterior chamber intraocular lens (PC IOL). He gave a history of exchange of the PC IOL for an AC IOL in combination with several retinal detachment repairs, the last of which succeeded in attaching the retina leaving a fill of silicone oil.
The patient reported that the surgeon told him the eye should have no more surgery and the oil should stay forever. Old records were not available to us.

The visual acuity in the right eye was Light Perception (LP), and in the left eye 20/20. He had a large right exotropia but full eye movements. The cornea in the right eye was totally opaque. One could not see into the eye to evaluate in detail the anterior chamber, angle, AC IOL, or posterior segment. A b-Scan showed no obvious cyclitic membrane, and the retina was attached. The full examination of the left eye was normal, with a PC IOL. The intraocular pressure of the right eye with a number of instruments was in the normal range, and similar to his left eye.

The patient felt that he could “almost see some forms with the right eye” on his right temporal side, and wanted to pursue more surgery to see if he could obtain more vision. He received a strong message that it would be ill advised, and thereafter detailed and robust informed consent was given on several occasions. He said he “could not live with himself if he didn’t try to retrieve some vision, even if it meant loss of the eye”.

Since he had LP vision with good projection and good color discrimination (colored filters over a muscle light) we decided to attempt a PK with a guarded approach.

Surgical Technique

The procedure was performed under general anesthesia due to anxiety and claustraphobia. Pre-operative eyedrops including a non-steroidal anti inflammatory and
4th generation fluoroquinolone antibiotic were given x3. A Honan balloon was applied over the eye at 30 mmHg for 30 minutes and the patient was treated with intravenous mannitol.

A combination speculum-stabilizing ring to prevent scleral collapse was affixed to the globe. The horizontal corneal diameter was measured with calipers and using them, the geographic center was determined. An eight incision radial keratotomy (RK) marker with minimal sterile dye was used as a template for future 10-0 nylon suture placement. Prior to permanent sutures we planned to use true pre-placed sutures (through a partial, not full thickness incision) in a temporary fashion. Perpendicular to each other and at oblique axis from the usual 12-6,3-9 cardinal suture marks, we marked the cornea for pre-placement of 6-0 silk sutures deep in a trephined corneal groove in the host. A Hessburg-Barron trephine (7.5 mm) was centered and dialed to achieve an estimated 70 % depth trephination.

True pre-pre-placement of 6-0 silk sutures at the depth of the wound was performed at the previous oblique marks, not the RK marks. The donor button was harvested in the traditional way endothelial side up 0.25 mm oversized to the host and placed in a covered sterile petri dish.

The temporal pre-placed suture was looped out of the groove, and the anterior chamber was entered with a blade through the groove, cohesive viscoelastic (1.0% sodium hyaluronate, HealonR) injected, and cornea scissors were introduced through this opening and beneath the pre-placed suture to cut an arc of cornea in standard fashion. (Figure 1) The looped suture was pulled taught and the next arc was cut after looping out the next
pre-placed suture and entering at the end of the previous arc. The same sequence was performed to achieve a $360^\circ$ host full incision. Additional viscoelastic was added based on any extrusion. Before pulling the pre-placed suture taught at each arc, the host button edge was everted and inspected for peripheral anterior synechiae (PAS) or wound adhesion.

The surgeon placed a loose single throw tie in the silk sutures. The donor was placed on a Paton spatula endothelial side up with viscoelastic on the endothelium, and held adjacent to the temporal side of the cornea. The assistant loosened and looped the two temporally located pre-placed sutures, superiorly and inferiorly, to allow room for host lift and donor placement. Additional viscoelastic was injected into the anterior chamber. The temporal edge of the host button, still seated, was grasped with toothed forceps, lifted followed by immediate inversion of the Paton spatula and placement of the donor in the cornea bed, the Paton spatula was held briefly in place as a tamponade, as the host corneal button was lowered and all the preplaced sutures were quickly secured.

We now had the donor button in proper orientation, endothelium facing anterior chamber, the host secured on top of the donor. The donor was then sutured without undue haste in the usual fashion with 10-0 nylon at the 12, 6, 3, 9 o’clock positions and the resulting quadrants bisected thereafter to achieve the usual 16 interrupted suture status. The pre-placed sutures were removed when the area adjacent to them was secure with 10-0 nylon sutures.
Before complete closure, viscoelastic was irrigated from the anterior chamber, but some silicone oil was noted coming around the intraocular lens. We elected not to remove more than what came out with the viscoelastic.

Results

At 5 months post operatively the vision was counting fingers (CF), and the sensory right exotropia surprisingly resolved. The patient reports that he navigates better although he has intermittent diplopia which he overcomes. The graft is clear, the anterior chamber is shallow to moderate depth with one small bubble of silicon oil noted centrally. The intraocular pressure remains normal, and the retina is attached. At 12 months the graft remains clear and the patient reports continued subjective improvement in vision quality.

Discussion

When one anticipates a possible complicated case or a patient presents with a number of risk factors for CH, non-traditional surgical approaches may be employed. This is especially important with PK with a huge opening in the eye that must be secured quickly. The Price GOH, and HK described by Weiss have been used to advantage. The hinge technique could apply to all cases with only a relatively small additional encumbrance. However, these two excellent techniques have a disadvantage if there is a sudden high pressure CH: GOH would be akin to sliding a lid on to an overflowing bottle, and the HK has only two immediate points of security, and would be akin to a taco with pressure under each side. Additionally, with GOH the donor endothelium is
subjected to similar sliding stress forces that occurred with early DSEK insertion techniques. The authors also considered a plan for a deep anterior lamellar keratoplasty (DALK) where a graft could be secured over deep stroma or intact Descemet membrane followed by intraocular removal of the host stroma and or Descemet’s membrane. This approach would have maintained a mostly closed chamber, but would still have been a donor on host approach, tedious, and technically challenging given the corneal opacification and presence of an ACIOL.

True pre-placed sutures placed through a partial, not full thickness incision, were used over a half century ago to give faster, more accurate, and secure wound apposition in the days before operating microscopes and fine sutures, when cataract wounds were large. Early post-placed sutures (after a full thickness incision, but before other surgical manipulations) gave some measure of safety and were less cumbersome, but inferior to true pre-placed for speed of closure, wound apposition, and security.

By using true pre-placed sutures with our HOD technique, the donor is broadly, firmly, and almost instantly fully secured to the eye by the overlying host and preplaced sutures while routine 10-0 nylon suturing may be completed as the situation permits. The preplaced silk sutures can be drawn tight quickly and cover all arcs of the host and donor cornea minimizing the hypotony risk of CH, and are able to withstand high pressure should one occur. They are strong and secure even with a single loop pull, before a complete temporary tie. It should also be noted that with HOD, the donor does not sit on a bed of viscoelastic that sits on the host cornea as in GOH. In HOD the donor
endothelium only comes into contact with viscoelastic and the anterior chamber. It fits and sits securely into the round opening in the host rim without tissue attached to the rim as in HK. Since good intraocular pressure can be achieved almost immediately with the pre-placed sutures and broad cover/tamponade of the host, permanent sutures may be placed in a less stressful methodical manner and maintained throughout suturing, avoiding hypotony, a universally accepted CH precipitating event. While good endothelial cell survival has occurred with the sliding donor over host techniques, we believe our technique is potentially safer for the endothelial cells while allowing for controlled suturing of the donor.

To our knowledge we believe this is the first description of the Host Over Donor (HOD) graft or “pop top” technique. We acknowledge that surgeons who have not published it, may have employed techniques like we discussed herein, although it is unlikely, as pre-placed sutures have generally not been used for over 40 years.12 The downside of pre-placed sutures is that they are a bit more difficult to place, may get in the way when looped out, and be inadvertently cut.

When employed for a PK, the disadvantage to our procedure is that the full opening may be arguably a spit second longer and perhaps not as controlled than the other guarded sliding techniques, and it requires a skilled knowledgeable assistant. However, intraocular pressure is almost instantly achieved and maintained with a broad and secure tamponade, avoiding any additional uncontrolled hypotony. It also takes a bit more surgical time. However, when scheduling higher risk procedures, it is usually helpful to have a skilled assistant and allot ample surgical time.
In the belief that ophthalmic surgeons can never have too many tools or techniques in their toolboxes, we revived an old technique but used in a new way and describe another variation of a “guarded” PK that may be useful in selected cases.

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Value Statement

WHAT WAS KNOWN
- A choroidal hemorrhage (CH) is an unpredictable and potentially catastrophic complication of ophthalmic surgery, especially penetrating keratoplasty (PK).
- Hypotony is a known risk factor for CH.
- Traditional PK has a period of uncontrolled hypotony.
- Unconventional techniques have been described to slide the host out from under an overlying partially secured donor, risking donor endothelium damage.

WHAT THIS PAPER ADDS
- Pre-placed sutures secure the overlying host corneal button with placement of the donor graft tissue underneath in the intended ultimate position within the host corneal rim.
- This technique enables a reduced period of hypotony during penetrating keratoplasty, avoids potential endothelial damage and allows controlled suturing of the donor; which may be worth considering in cases at higher risk for CH.
References


9. Chen, Wei MD; Ren, Yueping MS; Zheng, Qinxiang MD; Li, Jinyang MD; Waller, Stephen G. MD Securing the Anterior Chamber in Penetrating Keratoplasty: An


Figure Legends

Figure 1

A. 360° trephination at 70-80% depth (arrow). Pre-placed loose 6-0 silk sutures with a single throw, but are not knotted or pulled taught until the donor is in the bed and host sits on top.

B. Full thickness incision is created and the host cornea is lifted temporally (arrow). As the host corneal button is lifted the Paton spatula pictured with the donor endothelium side up, is quickly inverted and donor inserted.

C. 6-0 silk knots pulled taught. New donor cornea underneath old host cornea with taught 6-0 silk sutures (arrow).

D. Side view. Forceps used to lift one edge of the host cornea after 6-0 silk is loosened in that area. 10-0 nylon is used to tie down donor cornea. Other points of 6-0 silk are kept taught to keep donor cornea in place and control IOP. Steps repeated 360° to tie down donor cornea.

E. Donor cornea attached. 6-0 silk sutures cut and host cornea removed.