POSTOPERATIVE COMPLICATIONS AND INTRAOCULAR PRESSURE IN 943 CONSECUTIVE CASES OF 23-GAUGE TRANSCONJUNCTIVAL PARS PLANA VITRECTOMY WITH 1-YEAR FOLLOW-UP

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Background: To report the rate of postoperative complications in 943 consecutive eyes operated on with 23-gauge transconjunctival pars plana vitrectomy.

Methods: Single-center, retrospective, noncomparative, interventional case series. Nine hundred forty-three eyes underwent 23-gauge transconjunctival core and peripheral vitrectomy with peripheral laser at the sclerotomy sites from May 2005 through April 2008. The main outcome measures were intraocular pressure at 1 day and at 1 week and intra- and postoperative complications with at least 6-month follow-up.

Results: Eight hundred thirty-one eyes (88%) did not have either significant intra- or postoperative complications. Sclerotomy leakage requiring suture occurred in 37 eyes (3.9%). One choroidal detachment (0.1%) spontaneously resolved 1 week after surgery. At postoperative Day 1, 31 eyes (3.3%) experienced transient hypotony. Forty-five eyes (4.8%) presented a subtle vitreous hemorrhage that resolved spontaneously. Two retinal detachments (0.2%) occurred, one at 1 month and one at 3 months. They resolved with one further vitrectomy. Seven hundred forty eyes completed the 12-month follow-up and presented no further complications.

Conclusion: Twenty-three–gauge complete vitrectomy and peripheral laser seem safe for a variety of vitreoretinal surgical procedures. The rate of post- and intraoperative complications compares favorably with 25-gauge and with the standard 20-gauge vitrectomy.

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Vitreoretinal surgeons have long been interested in sutureless surgery. Chen[1] first described sutureless self-sealing sclerotomies for pars plana vitrectomy in 1996, and many subsequent studies have reconfirmed the advantages of self-sealing sclerotomies.[2–5]

De Juan and coworkers[6] in 2002 introduced sutureless 25-gauge vitrectomy with a transconjunctival approach. It was intended to be the largest size that could be self-sealing. The main advantages of 25-gauge incisions, when compared with standard 20-gauge sclerotomies, were faster wound healing, diminished conjunctival scarring, improved patient comfort, decreased postoperative inflammation, and reduced postoperative astigmatic change.[6–11] Sclerotomies in 25-gauge vitrectomy require no suturing because they are only 0.5 mm in diameter, whereas the sclerotomies in 20-gauge vitrectomy are 1.15 mm wide. However, some negative aspects of 25-gauge vitrectomy have appeared over time: a higher incidence of hypotony, endophthalmitis, flexibility of the instrumentation, and lower cutter efficiency.[7–12]

In 2005, Eckardt[13] published a sutureless transconjunctival approach using 23-gauge trocars with the aim of combining the advantages of using trocars with no sutures and the advantages of a larger caliber, in particular stiffer instruments, and more efficient cut-

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ters and illumination probes. The 23-gauge wound can be self-sealing, but attention needs to be paid to construction of the sclerotomies. In fact, if the instruments are used with perpendicular incisions, sclerotomies will be too large and require suturing.[13] Some authors have confirmed the efficacy of this new technique.[14–17]

The purpose of this study was to assess the rate of hypotony and the rate of intra- and postoperative complications of a complete vitrectomy performed for a variety of posterior segment pathologies with a 23-gauge system in a large group.

Materials and Methods

All subjects signed an informed consent document before surgery. The study included all surgical cases performed with 23-gauge vitrectomy by three surgeons (G.P., B.P., and F.R.) at a single site from May 2005 through April 2008. Vitrectomy cases were retrospectively identified through a search of the computerized database of the hospital's surgical records. Data abstracted from these consecutive charts included patient age, indication for surgery, intraocular pressure (IOP) at postoperative Days 1 and 7, and intra- and postoperative complications up to 12 months. In particular, safety data included the incidence of wound leakage and need for suture placement, hypotony, choroidal detachments, intra- or postoperative retinal tears and detachment, endophthalmitis, and the need for conversion to 20-gauge instrumentation.

Intraocular pressure was defined as "low" if it was ≤6 mmHg and "high" if it was ≥24 mmHg. Patients agreed to either general or local anesthesia depending on their personal choice. Local anesthesia consisted of a retrobulbar injection of 5 mL Naropine. Supplemental retrobulbar injection was administered, if needed.

All eyes received three preoperative ofloxacin drops starting 1 hour before the operation. They also received drops of ofloxacin, tobramycin, and betamethasone at the end of the operation and as postoperative therapy four times a day. None received oral antibiotics.

As routine preoperative eye preparation, periorbital skin and lashes were scrubbed with povidone–iodine solution using sterile gloves and sterile gauze soaked in a povidone–iodine 10% solution (Betadine, Purdue Frederick Co., Norwalk, CT) applied in a progressively outward circular motion before preparing the sterile operating field. Patients were draped, everting and covering lashes from the operative field. The conjunctival surface was left in contact with a cotton swab soaked in povidone–iodine solution applied for 1 minute taking care not to touch the cornea. The solution was carefully washed out with balanced salt solution before starting the operation.

The conjunctiva was moved aside from the sclerotomy site with forceps, both posteroanteriorly and laterally, and then held with a pressure plate (Dutch Ophthalmic Research Corporation [DORC], Zuidland, The Netherlands). A 0.72-mm wide tunnel incision was made with an angled stiletto blade positioned at a 20° to 30° angle to the entry site, and then the sclera was entered with the trocars. A central as well as an extended peripheral vitrectomy was performed for each case.

A wide-angle visualization system (Binocular Indirect Opthalmo-Microscope [BIOM]) was used. Peripheral vitrectomy was completed with scleral depression performed by the surgeon under direct visualization through the microscope or through the BIOM with a supplemental 23-gauge light placed into the free trocars. Visualization aids such as Triamcinolone were not used.

Peripheral laser, limited to the sclerotomy sites, or bordering rhegmatogenous retinal lesions when present, was administered in each case. The peripheral laser was used in each case, placing two to three rows of spots on the retinal side of the vitreous base around the sclerotomy sites or bordering rhegmatogenous retinal lesions when present to lower the risk of iatrogenic retinal breaks because of traction and residual vitreous incarceration. The same maneuver can also be performed in phakic eyes with peripheral scleral depression, being careful not to direct the cannulas toward the lens.

If phacoemulsification had been planned, it was performed after the central vitrectomy and the maneuvers on the posterior pole before the peripheral vitrectomy and laser. At the end of the procedure, the cannulas were removed and each sclerotomy site was immediately massaged using a cotton swab and the tip of a forceps. Possible wound leakage was monitored at normal and high IOP. The site was smoothed with the tip of a forceps to press and flatten the external side of the sclerotomy. Pressure was applied using a cotton swab. The aim of this maneuver was to press the external flap of the scleral tunnel, which is stretched during the insertion of the cannulas, toward the inner part of the tunnel to facilitate the sealing of the sclerotomy. The formation of a small bleb that, after additional massage of the sclerotomy site, did not increase in size and maintained a digitally acceptable IOP. Persistent leakage was treated with suture. The DORC and Oertli (Berneck, Switzerland) instrumentation were used for all surgical procedures.

Results

Data of 943 eyes were collected. The minimum follow-up time was 6 months. The age range of the patients was 14 years to 92 years.

Indications for surgery were epiretinal membrane, macular hole, lamellar hole, rhegmatogenous retinal detachment, nonclearing vitreous hemorrhage, diabetic macular edema, cystoid macular edema, proliferative diabetic retinopathy, endophthalmitis, vitreous opacities and posterior uveitis, and retained lens fragments.

Final tamponade media was fluid in 572 eyes (60.7%), air in 242 (25.7%), sulfur hexafluoride gas in 119 (12.6%), and silicone oil 1,000 centistokes in 10 (1%) eyes.

None of the cases was converted to 20-gauge vitrectomy. Eight hundred thirty-one eyes (88%) had no significant intra- or postoperative complications. Three hundred fifty-eight eyes received combined surgery on the anterior segment.

At postoperative Day 1, 31 eyes presented IOP <7 mmHg. The reported hypotony resolved spontaneously within 1 week. Among the eyes with hypotony, 47% were filled with air or gas and 53% were filled with fluid.

Sclerotomy leakage requiring suture occurred in 37 eyes (3.9% of the entire group). Of these, 28 eyes had been filled with fluid (4.9% of the group of fluid-filled eyes), 7 eyes had been filled with air or gas (1.9% of the eyes filled with air), and 2 eyes with silicone oil (20% of the eyes filled with silicone oil). Sclerotomy leakage was, therefore, less likely with air or gas. By using the chi-square test, this association between sclerotomy leakage and final tamponade was found to be statistically significant (chi square = 12.1, df = 2, $P = 0.002$). Five eyes requiring sclerotomy suture were in patients <30 years.

One choroidal detachment occurred during surgery because of slippage of the cannula under the choroid. At 1-week postoperatively, 45 eyes showed a subtle vitreous hemorrhage, which resolved spontaneously within 3 weeks. Two retinal detachments occurred, one at 1 month and one at 3 months, postoperatively. No endophthalmitis occurred in this series. Seven hundred fifty-three eyes completed the 12-month follow-up and presented no further postoperative complications.

Discussion

Because of its well-known intra- and postoperative advantages, small-gauge transconjunctival surgery is gaining wide acceptance. However, compared with traditional 20-gauge systems, the rate of postoperative wound leakage, hypotony, and choroidal detachment with 25-gauge systems seems to be higher.[6–12] Furthermore, intra- and postoperative retinal tears and detachments have been reported, perhaps as a result of less adequate peripheral vitrectomy with the more flexible instruments and excessive vitreoretinal traction at the sclerotomy sites.[9–12]

The introduction of 23-gauge vitrectomy systems was intended to overcome the flaws of the 25-gauge technique, thus providing sutureless transconjunctival surgery with stiffer instruments, better able to perform complicated maneuvers on the peripheral retina and the vitreous. Some authors have recently proposed 23-gauge surgery for complex cases.[18] Particular attention needs to be paid to the construction of the scleral tunnel. In fact, if 23-gauge trocars were inserted perpendicular to the sclera, the sclerotomies would be too large to avoid suture, whereas if the incision was angled and the sclerotomy was tunnel-shaped, it could self-seal. Angled sclerotomy construction can make self-sealing of 23-gauge and even 20-gauge vitrectomy more likely than even 25-gauge vitrectomy.[19]

In this study, 858 eyes (91%) encountered no significant intra- or postoperative complications. Thirty-one eyes (3.3%) of our patients had postoperative transient hypotony. These eyes did not show evident wound leakage at the end of surgery and were not sutured postoperatively. They spontaneously reached normal IOP within 10 days. We observed that 47% of the eyes with hypotony were filled with air or gas, whereas 53% were filled with fluid. We concluded, therefore, that the type of tamponade did not affect the incidence of postoperative hypotony.

Hypotony has been reported[12] after 25-gauge vitrectomy, requiring additional gas or air tamponade. In Fine et al's series[14] of 23-gauge vitrectomy, only 2.8% had an IOP of ≤ 5 mmHg on the first postoperative day. In the present study, IOP was classified as "low" when <7 mmHg. Therefore, the incidence of hypotony is likely to be similar in ours and in Fine et al's series, but the groups are not comparable. Hypotony can be responsible for suprachoroidal hemorrhage and endophthalmitis. However, in the present series, no serious complications derived from hypotony.

Sclerotomy leakage requiring suture occurred in 37 eyes (3.9%). The final tamponade may play a causative role in the need for suturing at the end of surgery. In fact, suturing was more frequent after fluid tamponade than after air or gas and was most frequent when silicone oil was the tamponade. Moreover, improved wound closure has been noted by surgeons using a gas fill to push the internal lip of the scleral tunnel against the external part of it.[12] Nontunneled 25-gauge sclerotomies frequently do not self-seal. In a review of 140 consecutive 25-gauge cases, Lakhanpal et al[7] reported that 7.1% of eyes required a suture for adequate closure and 3.8% demonstrated postoperative choroidal detachment. The authors observed that

in some cases in which an additional 25-gauge light source was used, this sclerotomy was leaking at the end of surgery. In Fine et al's[14] series, 77 patients underwent vitrectomy with 23-gauge instrumentation and only one (1.2%) suture was placed because of wound leak concerns intraoperatively. Our rate of wound leakage is higher than Fine et al's but similar to Tewari et al's[15] series. It may be noted that in some eyes of the present series, sutures could have been avoided by prolonging both the wait time at the end of surgery and the sclerotomy massage. Surgeons observed that implementing an improved sclerotomy closure technique led to reduced need for suturing. We also found that the two-step opening technique with a stiletto blade produces a linear wound and a long tunnel. Because the stiletto is extremely sharp, ragged wound edges are avoided. The stiletto also permits a more tangential and angled approach, which is useful in the nasal area because of the eye and in eyes that are not well exposed. We personally compared the one-step and the two-step techniques in the same eye and found that the wound cut is more rounded in the one-step technique. Furthermore, we noted a more frequent need for sclerotomy suture in younger patients. Seventeen patients were ≤30 years; five of them (30%) required sclerotomy sutures.

Intraoperative choroidal detachment occurred in one eye (0.1%) because of inadvertent slippage of a cannula under the choroid; this resolved spontaneously 1 week after surgery.

It is noteworthy that no endophthalmitis occurred in this large series. The following critical steps were taken to reduce the risk of endophthalmitis in sutureless vitrectomy, as already described in a previous paper[20]; disinfection and displacement of the conjunctiva before initiating surgery; tunnel-shaped sclerotomy; prevention of vitreous incarceration at the sclerotomy sites; and careful check for possible wound leakage at the end of surgery after removal of the cannula. Therefore, removing the vitreous as completely as possible may reduce the incidence of endophthalmitis.

The most frequent postoperative complication (4.8%) was a light vitreous hemorrhage, which cleared spontaneously in 1 week to 3 weeks. The bleeding responsible for the vitreous hemorrhage likely derived from the sclerotomy sites, which were not cauterized. Eckardt[13] reported the same observation. The entity of vitreous hemorrhage was moderate, and it was always possible to inspect the fundus.

The incidence of retinal detachment in the present series was 0.2%. This very low incidence may be ascribed to two main factors: first, to the peripheral vitrectomy with the consequent careful cleaning of the vitreous at the entry sites that prevents vitreous incarceration and second, to the peripheral laser at the sclerotomy sites. This study did not undertake a direct comparison between 23-gauge and 25-gauge techniques. However, the rate of retinal detachment in Ibarra et al's[9] study and Fujii et al's[6] study was 2.2% and 2%, respectively. Ibarra et al[9] noted that a "more prominent residual vitreous skirt could cause significant anterior vitreoretinal traction and subsequent retinal tears or detachment." It is possible that the more flexible instruments hinder a thorough cleaning of the peripheral vitreous. In addition, most surgeons believe that minimal vitrectomy is more suitable to macular surgery. Our study did not undertake as well a direct comparison between 23-gauge and 20-gauge techniques, in which the possibility of complete vitreous removal is more easily shared. Wimpissinger and Binder[21] report a 4.5% rate of sclerotomy site-related retinal detachment and recommend an extended vitreous base cleaning of the entry site. In the previous literature,[22,23] the incidence of retinal detachment after 20-gauge vitrectomy varies between 1.8% and 14%. Boeyden et al[24] reported vitreous base shaving with scleral depression and 360° prophylactic laser coagulation in the course of all macular surgery. None of their 365 patients had a retinal break or detachment in the follow-up period of 18 months. Another study[25] performed dynamic in vivo examination using ultrasound biomicroscopy on the sclerotomy sites of 22 eyes after pars plana vitrectomy, comparing the study group (in which the vitreous was completely shaved) with the control group (in which no vitreous shaving was performed). As a result, vitreous incarceration into sclerotomy sites was significantly less in the study group compared with the control group.

Our vitrectomy procedure aimed to shave as much of the vitreous base as possible and separate it from the retina so as to prevent incarceration of any vitreous strands attached to the retina. The vitreous of the pars plana is not removed and incarcerates into the sclerotomy; however, if not connected to the retina, the incarceration should not lead to retinal breaks. Moreover, because the vitrectomy may not be successful, peripheral spot laser is applied.

The peripheral removal of the vitreous and, in particular, the removal at the sclerotomy sites could limit cases of postoperative retinal detachment. Two cases of retinal detachment occurred in the present series 1 month and 3 months, respectively, after initial vitrectomy. The first case was a highly myopic eye, which underwent lensectomy, vitrectomy with difficult peeling of the vitreous cortex, and injection of sulfur hexafluoride. The second eye underwent vitrectomy, peeling of internal limiting membrane, and sulfur hexafluoride injection for macular hole. Two months

after vitrectomy, the second patient underwent phacoemulsification. One month later, retinal detachment with proliferative vitreoretinopathy was observed. When these two patients underwent surgery for retinal detachment, residues of vitreous skirt and vitreous incarceration into the sclerotomy site were found and removed, and the retina was successfully attached.

At 12 months, no eyes presented further postoperative complications. Twenty-three–gauge vitrectomy systems present limitations not unlike those of 25-gauge systems, mainly the lack of curved instruments. However, the transconjunctival 23-gauge vitrectomy approach appears effective for sutureless posterior segment surgery with a very high safety profile. Rates of sclerotomy leakage, hypotony, and intra- and postoperative complications such as hypotony, choroidal detachment, retinal detachment, and endophthalmitis were favorable compared with previously published rates in 25-gauge and 20-gauge systems.

Key words: vitrectomy, 23 gauge, complications, sutureless, transconjuctival, intraocular pressure.

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