Indwelling Temporary Retrobulbar Catheter for Long-Lasting Titratable Local Anesthesia

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Objective: To evaluate an indwelling temporary retrobulbar catheter for repeatable injections of local anesthetics for long-lasting and titratable retrobulbar anesthesia in intraocular surgery.

Participants: The prospective clinic-based study included 153 patients who underwent vitreoretinal surgery (n=111) or buckling procedures with cryocoagulation (n=34). The mean duration of surgery was 84.7 ± 49.5 minutes (range, 25-310 minutes). Using commercially available retrobulbar needles with a diameter of 0.60 or 0.80 mm and a length of 38 mm, 5 mL of 2% mepivacaine hydrochloride was injected. Through the same needle, a 28-gauge commercially available flexible catheter was introduced into the retrobulbar space. The needle was withdrawn and the catheter was fixed. When the patients started to feel pain during surgery, 2 mL of mepivacaine hydrochloride was reinjected through the catheter.

Results: Ten to 240 minutes after the start of the operation, 96 patients needed an intraoperative reinjection of mepivacaine after which they felt comfortable again. Forty-two patients needed a second reinjection of mepivacaine 30 to 270 minutes after the start of the operation, and 13 patients needed a third reinjection 45 to 145 minutes after the start of surgery. Removal of the catheter after surgery was unremarkable. No infections were observed. Microbiologic examination results of the catheter tip were negative for organisms. Diplopia or other motility problems were not detected. Introduction and fixation of the catheter took less than 5 minutes in all patients.

Conclusions: An indwelling temporary retrobulbar catheter for repeatable intraoperative injections of local anesthetics is simple, effective, and useful, and in comparison with general anesthesia, it is a time-saver for long-lasting and titratable local anesthesia in intraocular surgery.

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Intraocular Surgery of the anterior segment of the eye has usually been performed using local anesthesia because of the feasibility of retrobulbar or parabulbar injection of local anesthetics in adult patients who are not highly myopic. In retinal and vitreoretinal surgery, however, general anesthesia is preferred since the surgical procedures take more time and the intraoperative course can be more unpredictable than in anterior segment surgery. The purpose of our study was to describe and evaluate a modification of retrobulbar anesthesia, which may allow retinal and vitreoretinal procedures to be undertaken using local anesthesia.

Patients and Methods

The study included 153 patients (81 women and 72 men; 69 right eyes and 84 left eyes) with a mean ± SD age of 65.4 ± 10.3 years (range, 34-91 years). One hundred eleven patients underwent pars plana vitrectomy for one of the following: rhegmatogenous retinal detachment with proliferative vitreoretinopathy (n=29), persistent vitreous hemorrhage and tractional retinal detachment due to diabetic proliferative retinopathy or retinal vein occlusion (n=51), macular hole surgery (n=16), removal of epiretinal membranes (n=5) and luted intraoctal artificial or crystalline lenses out of the vitreous space (n=4), rupture of the globe after trauma (n=1), and acute postoperative endophthalmitis with marked vitreous and retinal infiltration (n=5). In 8 patients, we performed cataract surgery and posterior chamber lens implantation combined with transpupillary silicone oil removal through a planned posterior capsulorhexis. Thirty-four patients underwent a scleral buckling procedure with excyclocoagulation because of a rhegmatogenous retinal detachment. All pa-
tients who were seen at our institution for pars plana vitrectomy during a period of 19 months, and who were operated on by the same surgeon (J.B.J.) while under retrobulbar anesthesia, were consecutively included in the study. Exclusion criteria were an axial length of the globe longer than 26 mm, myopia of more than −6 diopters, and inability of the patient to lie down for the operation for more than 2 hours. These patients were operated on under general anesthesia.

Depending on the clinical diagnosis and the intraoperative situation, surgery included use of an encircling band, membrane peeling, relaxing retinotomies, endolaser coagulation, temporary injection of perfluorocarbon liquids, and silicone oil injection or removal. Retinal exo-cryocoagulation at the end of the operation was performed on 81 patients. Mean ± SD duration of surgery was 84.7 ± 49.5 minutes with a minimum of 25 minutes and a maximum of 5 hours 10 minutes. The patients did not receive any analgesic or sedative medication preoperatively.

Using a commercially available 23-gauge single-use Atkinson retrobulbar needle (23 g × 1½ in [3.81 cm]; Visitec, Sarasota, Fla) with a diameter of 0.60 mm and a length of 38 mm (49 patients), or using a commercially available custom-made retrobulbar needle of 38 mm in length with an outer diameter of 0.80 mm (Geuder GmbH, Heidelberg, Germany) (104 patients), 5 mL of 2% mepivacaine hydrochloride mixed with hyaluronidase was transcutaneously injected into the retrobulbar space. Through the same needle, a 28-gauge catheter (Kendall GmbH, Neustadt, Germany) was introduced into the retrobulbar space (Figure 1) and the needle was withdrawn. The stylet of the catheter was removed, a bacterial filter was attached, and the catheter was taped to the skin (Figure 2). One milliliter of 2% mepivacaine hydrochloride was injected through the catheter to evacuate the air from the lumen. During the study, we switched from the retrobulbar needle with a diameter of 0.60 mm to the retrobulbar needle with a diameter of 0.80 mm because in some patients difficulties were encountered in introducing the catheter through the smaller needle. The commercially available catheter is normally used for spinal anesthesia. The retrobulbar location of the tip of the catheter in the retrobulbar space within the muscle cone was sonographically controlled in the first 5 patients included in the study. As with other patients undergoing intraocular surgery with local anesthesia, infiltration or block anesthesia of the orbicularis oculi muscle was not carried out. We used the transcutaneous approach for the retrobulbar injection to facilitate stabilization of the catheter with skin patches during surgery and to keep the catheter out of the field of operation.

When surgery started (about 10 minutes after the injection of mepivacaine) the eyes of all patients were immobile. There was no discomfort experienced by the patients when we pinched the conjunctiva with a microforceps in all 4 quadrants and cut the conjunctiva to prepare the pars plana sclerotomies. During surgery, the patients were monitored and were asked every 10 minutes whether they were comfortable or experienced pain. For this purpose, we had explained a pain scale to the patients, with 0 for no pain and 10 for maximal pain as in cardiac infarction or during childbirth. Each time patients started to feel painful sensations of grade 3 or higher on the pain scale, a nurse or an assistant outside of the sterile operation field injected 2 mL of 2% mepivacaine hydrochloride through the catheter. The procedure had been approved by the ethics committee of the medical faculty at the University Erlangen-Nürnberg in accordance with the Declaration of Helsinki.

RESULTS

Ninety-six of 153 patients needed a reinjection of 2 mL of 2% mepivacaine hydrochloride after which they felt pain free and comfortable again, according to a grade of 0 to 2 on the pain scale. The interval between the start of the operation and the first reinjection ranged between 10 and 240 minutes. Forty-two patients needed a second reinjection 30 to 270 minutes after the start of surgery; 13 patients needed a third reinjection 45 to 145 minutes after the start of the operation. The rate of reinjections...
increased significantly (P < .001) with a longer duration of surgery. A reinjection was performed in 66 (81.5%) of 81 patients with a duration of surgery longer than 60 minutes, in 64 (87.7%) of 73 patients with a duration of surgery longer than 70 minutes, and in 50 (92.6%) of 54 patients with a duration of surgery longer than 80 minutes. The maximum amount of mepivacaine hydrochloride given during the whole period of surgery was 12 mL.

In 81 patients, transcleral exocryocoagulation of the peripheral retina was performed at the end of the operation. In those patients who reported pain of grade 3 or higher after the first coagulation spot was set, a reinjection of 2 mL of 2% mepivacaine hydrochloride relieved the patients from pain (grade 2 or less on the pain scale). After suturing of the conjunctiva at the end of the operation, a subconjunctival injection of gentamicin sulfate was given, which did not cause pain (grade 3 or higher) in any patient.

In 2 patients, the surgery had to be interrupted since the patients developed increasing stenocardiac symptoms. A postoperative cardiology workup did not reveal signs of cardiac infarction. These 2 patients were reoperated on under general anesthesia within 1 week after the first surgery. In 2 other patients, the reinjections had to be repeated every 20 to 30 minutes, probably because of a parabulbar, in contrast to a retrobulbar, location of the tip of the catheter. Removal of the catheter after surgery was unremarkable. The catheter entry was regularly inspected up to 3 days after surgery, and local or systemic infections or irritations were not detected. Results of a microbiologic examination of the catheter tip performed in 15 randomly selected patients were unremarkable. Postoperative diplopia or other ocular motility problems were not detected. During surgery, swelling of the eyelids or the conjunctiva was not observed, and the globes were immobile.

In all patients, it took less than 5 minutes to introduce and fix the catheter. All 11 patients who had previously undergone vitreoretinal surgery while under general anesthesia remarked that if another operation became necessary they would prefer local anesthesia with the retrobulbar catheter technique.

**COMMENT**

For many surgical interventions in ophthalmology, local anesthesia has usually been preferred compared with general anesthesia. During long procedures such as complicated pars plana vitrectomies, however, the effect of the retrobulbar anesthetic can diminish with time, leading to discomfort and pain for the patient. Intravenous sedation helps, but it does not relieve all ocular and orbital pain in these situations, and it may be associated with paradoxical reactions in older patients. Long-acting anesthetic agents such as bupivacaine reduce, but do not solve, the problem of decreasing analgesia in lengthy ocular surgery performed using local anesthesia. Repeated retrobulbar or parabulbar injections during surgery are cumbersome while the patient is draped. As with any other retrobulbar injection, they may result in accidental perforation of the globe or lead to other complications. An alternative to retrobulbar anesthesia is peribulbar anesthesia, which, however, can also be difficult to repeat during surgery with a similar array of complications.

The results of our study suggest that an indwelling flexible temporary retrobulbar catheter may solve some of the problems associated with repeated injections of local anesthetics during lengthy ocular surgery. In all patients included in the study, the repeated injections through the retrobulbar catheter were painless, relieved the patients from ocular or orbital pain within 1 to 2 minutes, and were performed without any observed complications. Correspondingly, introducing the retrobulbar catheter through the commercially available retrobulbar needle after injection of 5 mL of 2% mepivacaine hydrochloride into the retrobulbar space was unremarkable and did not cause pain for the patients. Sonographic control of the position of the tip of the catheter, performed for the first 5 patients of the study, showed a retrobulbar location within the muscle cone. The experiences gathered so far with this new technique suggest that an indwelling flexible retrobulbar catheter can be a safe and efficient technique for prolonged and titratable retrobulbar anesthesia in ocular surgery, including potentially painful retinal destructive procedures such as exocryocoagulation. When considering its safety, one has to take into account that owing to the relatively low rate of complications, a large number of patients need to be evaluated before a final statement about the complications of the retrobulbar catheter technique can be made. The major concern may be how long patients are able to tolerate lying beneath the surgical drape and how long their back and knees will allow them to do so. Psychological stress might have contributed to the development of stenocardiac symptoms in the 2 patients in our study in whom the surgery had to be stopped and eventually continued under general anesthesia.

A similar catheter to the one described in our study was used for retrobulbar sub-Tenon anesthesia by Dantas et al. The authors injected 3 mL of an anesthetic solution through a flexible catheter that was inserted through a small blunt dissection of the conjunctiva, Tenon capsule, and intermuscular septum in the inferior nasal quadrant into the retrobulbar space. All 50 patients felt that this procedure was comfortable and painless. The position of the catheter in the retrobulbar space was controlled by ultrasound. The authors concluded that their direct sub-Tenon technique was simple, effective, and safe since it avoided introducing sharp or metallic instruments into the orbit. Other authors used different retrobulbar or peribulbar catheters. After peribulbar anesthesia by standard percutaneous approach, Bernard and Hommeril inserted a 19-gauge Tuohy needle backward in the sagittal plane and parallel to a 5° slope of the orbit floor, to a distance of less than 3 cm, at the junction of the middle to lateral third of the lower orbital rim. A 23-gauge smooth catheter was advanced up to the tip of the needle, which was withdrawn, keeping less than 3 cm of catheter in the inferotemporal compartment. This technique was
applied in 217 consecutive patients undergoing retinal and vitreoretinal surgery without encountering major problems. Tamai\textsuperscript{10} used an angiocatheter that was retrobulbarly retained for repeated injections of local anesthetics. Mein and Flynn\textsuperscript{11} and Mein and Woodcock\textsuperscript{12} described another technique to augment local anesthesia in lengthy ocular surgery. After a limbal peritomy, the globe quadrants were bluntly disected, and a 19-gauge irrigating cannula was passed posteriorly to the globe to irrigate the recti muscle and the retrobulbar space with 4\% lidocaine hydrochloride. Using this technique, Mein et al\textsuperscript{11,12} were able to perform even prolonged vitreoretinal surgery using local anesthesia with minimal patient discomfort. To maintain the efficacy of retrobulbar anesthesia and to minimize the risk associated with the passage of a needle behind the eye, Friedberg et al\textsuperscript{13} placed local anesthetics into the sub-Tenon space posteriorly using a blunt irrigating cannula in 100 patients undergoing vitreous or retinal procedures. The posterior Tenon capsule was opened by blunt dissection, allowing the irrigating cannula to be passed into the posterior sub-Tenon space for the anesthetic injection. This technique was effective in 98 of 100 patients, and no morbidity was reported with its use. The difference between the techniques mentioned above and the technique applied in our study is that the catheter used in our investigation is thinner, more flexible, and longer so that its tip, despite a transcutaneous approach, can be located in the retrobulbar space, allowing repeated retrobulbar injections from outside of the sterile surgical field.

The catheter technique described in our study has made local anesthesia our preferred anesthetic method for pars plana vitrectomy. It can be regarded as further refinement of peribulbar techniques in which catheters have already been inserted into the retrobulbar space to maintain anesthesia.\textsuperscript{14,15} Peribulbar block, however, fails to achieve complete akinesia in up to 50\% of patients,\textsuperscript{16} and peribulbar anesthesia is normally used in ocular anterior segment surgery, which is usually less painful than vitreoretinal surgery including excryocoagulation of the retina. With the thin flexible 28-gauge catheter not having caused any detected damage in the retrobulbar space, and with excellent patient acceptance, this new technique may offer the possibility to use regional anesthesia even for relatively lengthy ophthalmic surgical procedures. The possibility of accidental globe perforation during the intraoperative reinfusion is almost eliminated because the retrobulbar catheter is not moved when the anesthetic is injected. By making local anesthesia safer and more effective for long operations, the catheter technique has allowed us to perform even complicated pars plana vitrectomies using retrobulbar anesthesia. These include reoperations for proliferative vitreoretinopathy with resuturing of an encircling band, relaxation of episcleral scars, retinal excryocoagulation, and other potentially painful episcleral procedures. No surgical intervention that we had performed using local anesthesia with the retrobulbar catheter required conversion to general anesthesia because of intolerable pain. That includes a pars plana vitrectomy of 5 hours for treatment of a traumatic expulsive hemorrhage after accidental rupture of the globe. We therefore recommend use of the retrobulbar catheter for retrobulbar anesthesia in potentially lengthy intraocular surgery, such as retinal and vitreoretinal interventions. This also includes combined anterior and posterior segment operations such as cataract surgery combined with silicone oil removal, in which the necessity of a second pars plana intervention due to an intraoperative retinal detachment cannot be predicted preoperatively.

As a limitation of our study, one may argue that a long-acting local anesthetic agent such as bupivacaine could have been given instead of mepivacaine. This might have made intraoperative reinfusions and the use of the retrobulbar catheter unnecessary in some patients. One has to take into account, however, that the duration of bupivacaine anesthesia as well as the probable duration of surgery are sometimes difficult to predict; so that the use of a retrobulbar catheter could make patients and surgeons more confident. Furthermore, the goal of our study was not to evaluate the usefulness of mepivacaine in combination with a retrobulbar catheter vs the use of bupivacaine without a catheter for retrobulbar anesthesia in vitreoretinal surgery. The goal of the study was to examine the practicability of an indwelling temporary retrobulbar catheter for prolongation of local anesthesia. The potential of the retrobulbar catheter may, of course, be increased if bupivacaine or a mixture of mepivacaine with bupivacaine instead of mepivacaine alone is used for the primary injection as well as for the reinfusions. Another limitation of the study may be that it is a noncomparative investigation since the study group was not compared with a control group. However, we have had personal experience in clinical situations where an operation lasted considerably longer than had been expected, and where transcutaneous reinfusions of local anesthetics into the retrobulbar space were difficult or not effective, or where reinfusions into the sub-Tenon space were not sufficient in relieving patient pain. Because of this experience, we did not want to reenter a clinical situation where transcutaneous reinfusions of local anesthetics during the surgery did not relieve patient pain. This, however, might have occurred in the patients of the control group where a retrobulbar catheter was not used. Future studies may address other uses of a temporary indwelling retrobulbar catheter, such as the possibility of postoperative reinfusions for prolonged postoperative analgesia,\textsuperscript{17,18} continuous delivery of drugs into the orbit or the retrobulbar space for treatment of diseases in the orbit and posterior segment of the eye,\textsuperscript{14,15} measurement of the retrobulbar tissue pressure, and the addressing of experimental questions in animals.\textsuperscript{19}

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REFERENCES


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A look at the past . . .

The minimum size of the graft should be 6 mm. The graft must be large enough to substitute for all, or as much as possible, of the conus; otherwise the deformity is liable to advance. When the conus is off center, the graft should be displaced accordingly in order to remove as much as possible of the protruding area.