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Strabismus Surgery Using the Intraoperative Adjustable Suture Method Under Anesthesia With Propofol

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Purpose: To evaluate the feasibility and efficacy of using the intraoperative adjustable suture method with anesthesia induced by intravenously administered propofol for strabismus surgery.

Methods: Seven adult patients (mean age, 29.7 ± 18.5 years) with different types of strabismus were enrolled in this study. All patients underwent full ophthalmological and general medical examinations before surgery. Surgery was performed after induction of anesthesia using intravenously administered propofol that was titrated to control consciousness.

Results: Arousal of consciousness was observed at approximately 2 minutes after discontinuation of the propofol infusion in each case, and the consciousness level was sufficient to allow accurate cover-uncover testing and intraoperative adjustment of sutures. Minor complications of nausea in three patients and vomiting in one patient were noted after surgery.

Conclusions: Strabismus surgery using the adjustable suture method with propofol intravenous anesthesia appears to be safe and useful for the treatment of adult strabismus. **Jpn J Ophthalmol 1999;43:522–525** © 1999 Japanese Ophthalmological Society

Key Words: Intraoperative adjustable suture, paralytic tropia, propofol, strabismus surgery, total intravenous anesthesia.

Introduction

Adult strabismus is usually caused by a dysfunction of one of the ocular motor nerves or by endocrine myopathy. Patients are intensely disturbed by the resulting double vision, and surgical treatment is required in many cases. However, determination of the degree of surgical correction is difficult,[1–3] and postoperative adjustment of sutures, botulinum toxin injection, and intraoperative adjustment of sutures under intravenous anesthesia with pentazocine have all been used to try to address this issue.

The purpose of the present study was to evaluate the feasibility and efficacy of performing strabismus surgery with intraoperative adjustment of sutures using the new anesthetic agent, propofol. Total intravenous anesthesia (TIVA)[4] was induced with propofol, using half the amount normally used for general anesthesia to keep the breathing spontaneous. The propofol was used in combination with the analgesic, fentanyl.

Materials and Methods

Seven patients (mean age, 29.7 ± 18.5 years) who underwent strabismus surgery at the Department of Ophthalmology, Osaka University Medical School, between February and November 1997, were enrolled. These patients were selected based on the perceived difficulty of the operating surgeon in estimating the angle of strabismus.

This study was approved by the Hospital Committee on Human Research, and informed consent was obtained from all patients before surgery. The diagnoses and clinical characteristics for each patient are shown in Table 1.

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Patients were admitted to the hospital and kept nothing per OS for 6 hours before administration of anesthesia, as is the usual protocol for general anesthesia. No preoperative medications were administered. Electrocardiogram, blood pressure, heart rate, and $Sp0_2$ level were monitored, and oxygen was provided by mask at a rate of 6 L/minute. Atropine sulfate (0.5 mg) and fentanyl (1.0–2.0 μg/kg) were administered intravenously by the anesthesiologist approximately 10 minutes before the start of surgery. An intravenous infusion of propofol was then administered shortly before the first incision at an induction dose of 1.0–1.5 mg/kg. A maintenance dose of 2.0–4.0 mg/kg per hour of propofol was administered as needed.

After confirmation of the depth of anesthesia, 2% lidocaine was administered topically to the eye and surgery was commenced. After incision of the conjunctiva, topical lidocaine was discontinued to prevent direct infiltration of the drug into the extraocular muscles. The depth of anesthesia was controlled in such a way that patients could respond to voice commands by hand grip signals. When pain was severe, 0.5 μg of fentanyl was administered intravenously for additional analgesia. Planned translocation of the muscle was performed first, after which the propofol infusion was stopped and patients were aroused (in approximately 2 minutes). Remaining in the supine position, patients were told to open both eyes, and the position and movements of the eyes were examined (awake testing) by asking the patients to follow a penlight at far (distance of 1 m) and at near (distance of 30 cm).

Anesthesia was re-induced rapidly by resuming the propofol infusion, and suture adjustment was performed. The state of arousal of the patients was controlled by switching the propofol infusion on or off, with repeat examinations until the desired eye position was achieved by suture adjustment (Table 1). Topical vasoconstrictors, such as naphazoline nitrate, were avoided to prevent mydriasis, which would interfere with proper awake testing. Hemostasis during surgery was achieved using a wet-field bipolar cautery. After surgery, patients were monitored for 48 hours before discharge.

Results

The total duration of surgery, including the time taken to wake the patient and perform eye movement testing, averaged 60.7 ± 20.3 minutes. All seven patients were aroused within 2 minutes after discontinuation of the propofol infusion; the level of consciousness after arousal in each case was sufficient to perform accurate prism-cover testing, and the patients were able to answer questions concerning double vision without difficulty. The doses of anesthesia used are summarized in Table 2.

With regard to intraoperative complications, there was no nausea or vomiting observed at the time of awake testing, although one patient (case 4) showed involuntary body movements shortly after the first induction of anesthesia. These involuntary movements ceased after the rate of the propofol infusion was decreased to raise the consciousness level slightly. In

Table 1. Clinical Characteristics of Patients

Case No.	Age (y)	Gender	Diagnosis	Deviation (prism diopters)	Procedure
1	19	F	OS: Duane I with esotropia	ET = 35 (at primary position)	OS: 6 mm medial rectus recession
2	24	F	OD: Duane II with exotropia	XT = 30 (at primary position)	OD: 6 mm lateral rectus recession
3	32	F	OD: hypotropia, esotropia with limitation of abduction (reoperation) OU: coloboma, low vision	ET = 40, hypot = 10 (Krimsky)	OD: lateral rectus suturing to original insertion site
4	33	F	OD: low vision with hypotropia, esotropia, limitation of abduction and adduction (reoperation)	ET = 30, hypot = 10 (Krimsky)	OD: 5 mm medial rectus resection
5	11	F	Esotropia (reoperation)	ET = 25	OD: 6 mm lateral rectus resection
6	68	F	OU: complete VI palsy with large angle esotropia	ET > 90	OU: Jensen and 8 mm medial rectus recession
7	21	F	OD: congenital CN IV palsy with hypertropia, exotropia	XT = 16, hypert = 20	OD: inferior oblique recession and 5 mm lateral rectus recession OS: 4 mm inferior rectus recession

F: female; ET: esotropia; XT: exotropia; CN: cranial nerve; hypot: hypotropia; hypert: hypertropia.

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Table 2. Doses of Anesthesia Used and Complications

Case No.	Total Amount of Propofol (mg)	Total Amount of Fentanyl (μg)	Number of Times Awake Testing Performed	Complications During Surgery	Complications After Surgery
1	235	195	2	None	Nausea
2	252.5	200	2	None	None
3	263	200	2	Mild respiratory suppression	Nausea
4	302.5	200	2	Involuntary body movements, mild respiratory suppression	Nausea, vomiting
5	138	100	2	None	None
6	290	200	2	Transient bradycardia	None
7	240	200	2	None	None

addition, mild respiratory suppression ($SpO_2 < 95\%$) was observed in two patients (cases 3 and 4); however, sufficient respiration was restored immediately when patients were called by name. Transient bradycardia occurred in one patient (case 6). All patients reported that they had no memory of events occurring under anesthesia. Complications observed after returning to the inpatient ward were nausea in three patients (cases 1, 3, and 4), with vomiting in one patient (case 4). These intraoperative and postoperative complications are summarized in Table 2.

Immediately after surgery, marked improvement in eye position and movements were observed in all seven patients. Eye position and movements remained stable upon examination 1 day postoperatively.

Discussion

In strabismus surgery, accurate preoperative assessment of the angle of deviation and eye movements is essential. In many cases of paralytic strabismus and myopathy, however, such preoperative assessment is inadequate for predicting postoperative outcome when using standard formulas for calculating the amount of muscle surgery necessary. To obtain greater surgical accuracy, various techniques have been employed, including the postoperative adjustable suture method,[5,6] botulinum toxin injection,[7–9] and intraoperative adjustment of sutures using intravenous anesthesia with pentazocine.[10] Although the postoperative adjustable suture method appears to have some value because of lower associated rates of reoperation,[6] this method has recently fallen into disfavor. Postoperative suture adjustment is performed several hours to 1 day after surgery, and thus it is usually done in the nonoperating room setting (eg, recovery room or inpatient ward). Such locations are not ideal for performing procedures under sterile conditions, and consequently infection has been a problem. Furthermore, since postoperative suture adjustment is performed under topical anesthesia alone, nausea and bradycardia (resulting from the oculocardiac reflex) often occur.

Botulinum toxin injection has the advantages of being a relatively simple procedure and is easily repeated. However, individual differences in the paralytic effect achieved are great and prediction of efficacy is difficult. Owing to its simplicity, botulinum toxin injection is usually performed on an outpatient basis, although maintenance of sterility at levels comparable to that in the operating room is difficult. In addition, transient blepharoptosis is reportedly observed in 30%–53% of cases, with an increase in vertical deviation observed in approximately 20% of cases.[8,9]

In contrast, during intraoperative suture adjustment under intravenous anesthesia with pentazocine, as first reported by Izaki and colleagues,[10] the presence of double vision can be examined as surgery is being performed under conditions in which the patient's image-fusing function is physiologically intact without muscle paralysis. The advantages of this method used by Izaki and colleagues appear to be equivalent to those of the method we report here, although we believe that levels of intermittent anesthesia can be better controlled using intravenous propofol.

Propofol is known to have antiemetic properties, and the duration of its action is thought to be about 30 minutes after administration.[4,11] In the present 7 cases, intraoperative nausea and vomiting were not observed, although nausea was noted in 3 patients and vomiting in 1 patient up to 12 hours postoperatively. This is a lower incidence compared with the reported 60%–85% of children who experienced nausea and vomiting after undergoing strabismus surgery under general anesthesia without the use of propofol.[12–14] Cheng and colleagues[15] prospectively examined the postoperative incidence of complications in 95 consecutive patients (aged 16 years or

older) who underwent unilateral strabismus surgery under either general anesthesia (43 patients) or local anesthesia (52 patients), and found no difference in the incidence of nausea or vomiting.

In the retrospective study reported by Tramer and coworkers,[16] 112 patients who had a history of strabismus surgery under intubated general anesthesia were divided into a group of adults (18–86 years of age) and children (3–16 years of age). They found that when a combination of thiopental, isoflurane, and nitrous oxide was used as anesthesia in the adult group, bradycardia was found in 11% of patients and postoperative nausea/vomiting in 33%. When a combination of propofol and nitrous oxide was used in the adult group, the rates were 15% and 23%, respectively. When propofol alone was used in the adult group, the rates were 26% and 23%, respectively. Finally, when propofol alone was used in the pediatric group, the rates were 43% and 57%, respectively. The investigators concluded that these differences were attributable to differences in age and surgical technique. Although the number of patients in the present study is small, the rates of nausea and vomiting appear comparable.

In the present study, mild respiratory suppression was observed in two of seven patients (29%), although this was quickly and easily rectified by calling the patient by name. Since propofol has no analgesic effect, fentanyl was used as an analgesic. The only narcotic available in Japan having a short duration of action, fentanyl, has few side effects, and in contrast to pentazocine, has minimal effects on the cardiovascular and respiratory systems. Thus, it is thought to be the best drug for concomitant use with propofol at present. However, fentanyl and propofol themselves have suppressive effects on respiration, and, therefore, careful monitoring of respiration is essential when general anesthesia is performed without intubation, as in the present study. Bradycardia was observed in one of seven patients (14%); however, it resolved quickly after temporary discontinuation of surgical manipulation of the globe.

It is generally difficult to determine the long-term prognosis after strabismus surgery. However, if the short-term goal is to set the eye in the intended position shortly after the operation, the intraoperative adjustable suture method under TIVA, using propofol as in the present study, appears to be a safe and useful method for adult strabismus surgery. This is particularly true when determination of the degree of deviation is difficult. Few side effects were observed, and "quick induction and arousal" and "high quality arousal" as controlled by the anesthesiologist was achieved by using this method.

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