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Optimizing Anesthesia Techniques for Pediatric LASIK Procedure

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Abstract: Background: Refractive surgery in children requires general anesthesia to ensure that the procedure is performed safely. There are some problems in using general anesthesia for refractive procedures. Aim: to find a suitable technique to provide effective anesthesia with minimal risks to the pediatric refractive patient. Methods: A randomized study of 20 child patients undergoing LASIK using SCHWIND AMARIS, under general anesthesia was done with patients allocated into two groups, each group consisted of 10 patients (10 eyes). Group A in which the patients received Ketamine/Propofol (K/P), and group B in which the patients received Ketamine/Midazolam (K/M). Time of recovery was measured by Modified Aldrete Score, and time of discharge was recorded and measured by Post Anesthesia Discharge Score System (PADSS). Complications as desaturation, occurrence of post operative agitation, post operative vomiting, need for jaw thrust, O2 supplementation, and occurrence of any significant nystagmoid eye movements were recorded. Results: There was a significant statistical difference between both groups ($P<0.001$) regarding duration as it was shorter for the Ketamine/Propofol group, and the presence of significant nystagmoid eye movements which was present in 50% of cases in the Ketamine/Midazolam group with a $P<0.001$. Postoperative agitation and vomiting were significantly more frequent in the Ketamine/Midazolam group ($P<0.001$). Conclusion: Using a combination of Propofol/Ketamine may be a useful technique to use to provide adequate anesthesia in pediatric refractive surgery.

Key words: Lasik, Schwind, Amaris, pediatric, general anesthesia.

INTRODUCTION

The use of excimer lasers in ophthalmic surgery was first described by Trokel (1983), and first phototherapeutic keratectomy (PTK) procedure was performed in 1988 by Gartry (1991). Refractive surgery in children has been used primarily to treat asymmetrical or unilateral high myopia with amblyopia refractory to conventional treatment with spectacles, contact lenses and penalization therapy(Astle, W.F., 2002; Paysse, E.A., 2003). It has also been used to treat anisometropic myopia where the difference between the 2 eyes 4 dioptres or more(Singh, D., 1995). Topical anesthesia is used in adults having refractive surgery because it allows the patient to self-fixate, reducing the likelihood of decentered corneal ablation. In pediatric patients, general anesthesia is required to ensure that the procedure is performed safely(Hutchinson, A.K., 2003). There are some problems in using general anesthesia for refractive procedures. They include that the excimer laser operating room is not equipped with an anesthesia machine or monitors for monitoring the patient's vital signs during the procedure, with limited space available for patient's recovery after anesthesia. Also, the operating table has limited movements along the longitudinal and transverse axes, and a fixed microscope above the expected position of the patient's head making the interference of the patient's airway difficult. There is one report of nitrous oxide interfering with laser machine causing it to shut-off in a pilot study conducted by Davis (2001). It is critical to minimize the leak of anesthetic gases into the Laser environment to avoid the Laser malfunction. This occurs because the wavelength of the Argon-Fluoride excimer beam is within the absorption spectrum of anesthetic gases. Therefore if the anesthetic gas escapes into the path of the excimer beam, attenuation of the beam will occur. The Laser will attempt to increase voltage to maintain influence, but if treatment time is prolonged, the Laser will stop firing and an error message, such as influence out of range, will appear (Cook, D.R., 2001).

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MATERIAL AND METHODS

After obtaining parental consent, and ethical committee approval, this comparative study was conducted at the Research Institute of Ophthalmology, Giza, Egypt. The patients were randomly allocated into two groups, each group consisted of 10 patients (10 eyes), and the patients' age ranged from 5 to 12 years old. Group A in which the patients received Ketamine/Propofol (K/P), and group B in which the patients received Ketamine/Midazolam (K/M). All patients had a preoperative evaluation that included physical examination and careful screening of the patients for potential airway obstruction (ASA 1). No laboratory investigations were required. Patients with known history of allergy to any of the investigated drugs were excluded from the study. Instructions were given to the patients not to have any solid food for 6 hours, yet encouraged to take clear fluids (water, apple juice….) until 4hours before the scheduled procedure's time. No premedication was given to any of the patients. The patient and one parent arrived at the excimer operating room, and an I.V catheter (22G) was inserted to the patient. In group A, Ketamine/Propofol were given to patients intravenously without any sedation. Ketamine was first given at 1mg/Kg with Atropine 0.02mg/Kg and Propofol at 2-3mg/Kg.

Anesthetic equipments were transported to the excimer laser operating room, they included: an ambubag and an O2 cylinder, suction device with aspiration catheters, LMA and airways all of suitable sizes. Also monitoring devices as Dinamap, ECG and pulse oximetery Hemodynamic variables of the patient were recorded before induction of anesthesia, during the whole procedure and during recovery. A drop of Benoxate Hydrochloride (0.4%) was instilled in the operated eye as pre emptive analgesia after loss of consciousness. Duration of the procedure was recorded, time of recovery was measured by Modified Aldrete Score* and time of discharge was recorded and measured by Post Anesthesia Discharge Score System (PADSS)**. Complications as desaturation (if spo2 decreases below 92%), occurrence of post operative agitation, post operative vomiting, need for jaw thrust, O2 supplementation, and occurrence of any significant nystagmoid eye movements were recorded. In group B, the patients received Ketamine (1mg/kg), Atropine (0.02mg/kg) and Midazolam (0.05) I.V. Same monitoring, preparation of the excimer laser operating room were done, and same measurements were taken as in group A. All patients had been treated by LASIK using SCHWIND AMARIS, true 500Hz pulse frequency, 0.54mm laser spot, 1050Hz Turbo five dimensional eye tracking and aspheric ablation profiles to prevent induction of aberrations were used.

Modified Aldrete Recovery Score:

Respiration
0= apnea
1= dyspnea
2= able to deep breathe and cough
Activity
0= unable to move any extremities
2= able to move 2 extremities voluntary or on command
Level of consciousness
0= nonresponsive
1= responsive to stimuli
2= awake
Circulation
0= systolic blood pressure > 20% above pre anesthetic values
1= systolic blood pressure within 11%-20% above pre anesthetic values
2= systolic blood pressure within 10% of pre anesthetic values
Temperature (axillary or equivalent site)
0= axillary temperature <35C or >37.5C
1= axillary temperature 35C-35.5C
2= axillary temperature 35.6C-37.5
Adequate recovery is achieved if modified Alderet score is > 8

Modified Post Anesthesia Disharge Score Scale:

1-Vital signs: B.P – H.R – R.R – Temperature.
2= within 20% of preoperative value.
1= within 20%-40% of preoperative value.
0= 40% of preoperative value.

2-Ambulation:
2= steady gait (no dizziness)
1= within assistance
0= no ambulation (dizziness)
3-Nausea and vomiting:
2= minimal
1= moderate
0= severe
4-Pain:
2=minimal
1=moderate
0=severe
5-Surgical bleeding:
2= minimal
1= moderate
0= severe

Patients who achieved a score of 9 or more are considered fit for discharge.

Results:

Both groups were comparable regarding age, weight, sex, duration of anesthesia and surgery (Table 1). For hemodynamic parameters (Table 2), there was no clinical significant difference between the two groups regarding H.R (Fig. 1), MAP (Fig. 2) and SPO2 (Fig. 3) (P<0.05). Regarding recovery and discharge times, there was a significant statistical difference between both groups (P<0.001) as it was shorter for the Ketamine/Propofol group. Also, there was a significant statistical difference between both groups regarding presence of significant nystagmoid eye movements which was present in 50% of cases in the Ketamine/Midazolam group with a P<0.001 (Table 3).

Table 1: Demographic and clinical data.

Parameters	Propofol group	Midazolam group	P value
Age	9.30±2.25	9.15±2.48	0.934
Weight	33.00±7.31	32.45±7.25	0.913
Duration	277.50±20.93	276.50±16.79	0.845
Recovery	7.40±1.47	19.00±3.08	0.000*
Discharge	29.30+_9.31	60.00+_0.00	0.000*

Means ±SD; *Significant

Table 2: Hemodynamic data

Parameters	Propofol group	Midazolam group	P value
HR before	104.30±4.99	104.80±5.93	0.703
HR during	120.30±5.29	120.85±5.09	0.658
HR end	118.70±4.86	120.05±4.43	0.208
MAP before	77.60±2.80	75.25±2.75	0.005*
MAP during	80.70±3.18	83>10±1.71	0.002*
MAP end	80.50±3.15	82.60±1.96	0.021*
Spo2 before	100.00±_0.00	100.00±0.00	1.000
Spo2 during	98.70±0.66	98.40±0.50	0.143
Spo2 end	99.20±0.77	99.80±0.41	0.006*

Means+_SD; *Significant

Table 3: Presence of significant nystagmoid eye movement.

Parameters	Propofol group	Midazolam group	Total	P value
Present -Count	0	10	10	
% within group	0.0%	50.0%	25.0%	0.000*

*Significant

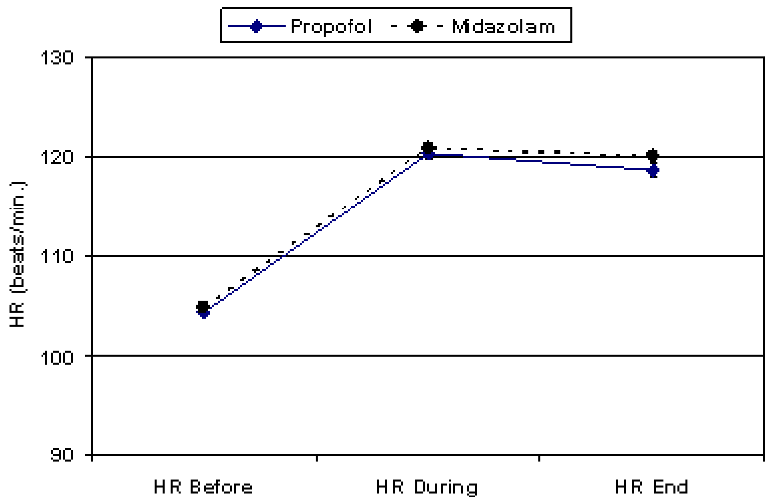

Fig. 1: Comparison of H.R changes in Midazolam/Ketamine group, and Propofol/Ketamine group.

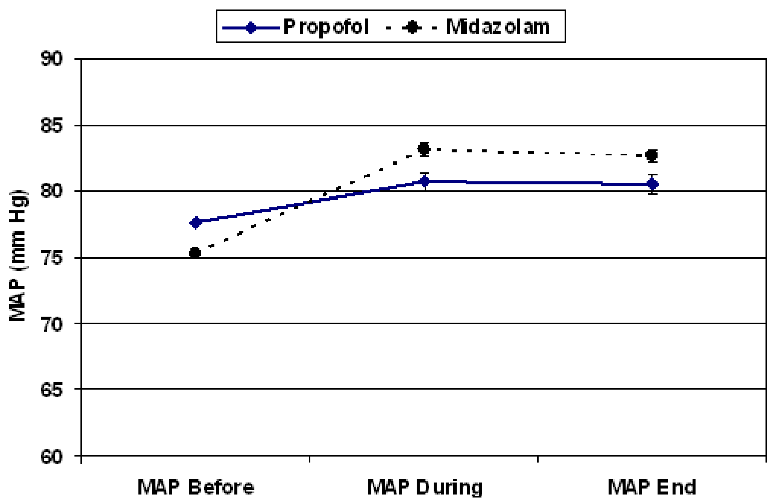

Fig. 2: Comparison of MAP changes in Midazolam/Ketamine group, and Propofol/Ketamine group.

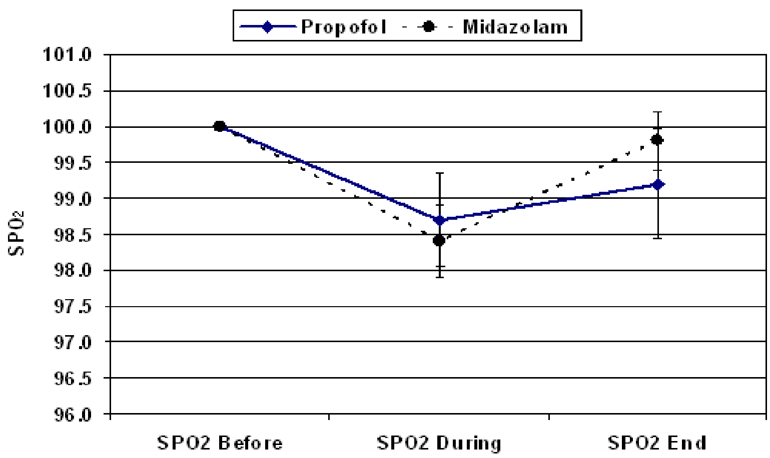

Fig. 3: Comparison of SPO2 changes in Midazolam/Ketamine group, and Propofol/Ketamine group.

Postoperative agitation (Table 4) and postoperative nausea and vomiting were significantly more frequent in the Ketamine/Midazolam group (P<0.001) (Table 5). Surgeon satisfaction was equal in both groups.

Table 4: Occurrence of agitation.

Parameters	Propofol group	Midazolam group	Total P value
Mild-Count	2	0	20.00*
-% within group	0.0%	0.0%	5.0%
Moderate-Count	0	20	200.00*
-% within group	0.00%	100.0%	50.0%

*Significant

Table 5: Occurrence of PONV.

Parameters	Propofol group	Midazolam group	Total P value
Present -Count	0	11	110.00*
% within group	0.00%	55.0%	27.5%

Discussion:

Pediatric refractive surgery is one of the new interventional treatment modalities that require anesthesia, sedation and monitored anesthesia care outside the traditional operating room, which represents a challenge for the anesthesiologist (Gullo, 2005). An understanding of the procedure, the technology involved and the expected complications is crucial for the anesthesiologist to choose the optimal anesthesia and monitoring techniques (Gullo, 2005 and Mazurek, 2004). Equally important is how to react in the event of a major complication safety aspects and patient satisfaction are also important (Tang, 1999).

Cook and coauthors reported that it is critical to minimize the leak of anesthetic gases into the laser environment to avoid the laser malfunction (Cook, 2001). So, in this study, only intravenous anesthesia techniques were used to avoid the effect of inhalational anesthetic agents on the laser machine, in group A (K/P) we combined both Ketamine and Propofol in sub-hypnotic doses to get all the advantages with minimal or no side effects, and in group B (K/M) Ketamine and Midazolam were used. In a previous study conducted by Mahfouz and coauthors, they compared Propofol/Fentanyl with Ketamine/Midazolam in pediatric refractive procedure. They concluded that Propofol offers unique advantage for brief procedures outside the traditional OR. It is short acting and has a rapid offset, resulting in shorter postoperative monitoring and smoother recovery profile. But it has a greater potential for respiratory depression compared with Ketamine, hence, greater vigilance and experience with the pediatric airway are suggested with its use.

Also they concluded that although Ketamine preserves the airway reflexes with no respiratory depression effects, the relatively longer period of recovery, in addition to a higher incidence of post-operative agitation and vomiting, necessitated a longer period of monitoring and care after the procedure (Abdul Kader, 2005). In group B (K/M), the results were consistent with the results reported in other studies (Abdul Kader, 2005; Sherwin, 2000 and Wathen, 2000), as the prolonged duration of recovery, in addition to a higher incidence of post-operative agitation and vomiting were the most important disadvantage to this group due to limited space to provide post-operative care in the excimer laser operating room. It can be argued that the addition of Midazolam might have prolonged the recovery time with Ketamine, many studies revealed that the use of Midazolam with Ketamine was effective in reducing Ketamine-induced dysphoria experienced especially by older children and teenagers (Sherwin, 2000 and Wathen, 2000). Wathen and coauthors reported that the incidence of emesis was reduced when Midazolam was given with Ketamine (Wathen, 2000). Although in some cases presence of significant nystagmoid eye movements were recorded, yet it was not a problem, as fixation was achieved during the procedure using a suction ring. Satisfaction score of the surgeon was high and comparable between the two groups in the study.

Conclusion:

Using a combination of Propofol/Ketamine may be a useful technique to be used to provide adequate anesthesia outside the OR in pediatric refractive surgery.

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