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RESEARCH

Effect of peribulbar block on emergence agitation in children undergoing strabismus surgery under desflurane anaesthesia

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Background: Strabismus surgery in children may be associated with a high incidence of emergence agitation that may be related to pain and visual disturbances. The objective was to evaluate the effect of peribulbar block on the incidence of emergence agitation in children undergoing strabismus surgery under desflurane anaesthesia.
Methods: Fifty-six healthy children aged 2–10 years, undergoing strabismus surgery under general anaesthesia, were recruited. Children were randomly allocated to receive fentanyl 2 µg/kg (Group F) or peribulbar block (Group PB) with 0.3 ml/kg of 0.25% bupivacaine + 2% lignocaine. The primary outcome of the study was incidence of emergence agitation; secondary outcome measures were time to first rescue analgesia, the incidence of oculocardiac reflex and vomiting.
Results: Of 52 children, 14/25 (56%) children in Group F developed emergence agitation compared with 3/27 (11.11%) in group PB ($p = 0.001$). Postoperatively, the paediatric anaesthesia emergence delirium scores showed significantly lower emergence agitation in the PB group with a median (IQR) of 0.00 (0.00–2.00) compared with group F (5.5 (0.75–8.75) at all time intervals ($p = 0.003$ Mann–Whitney test). Pain scores were comparable between groups (group F 48% vs. group PB 25.9%). The time to first rescue analgesia was increased in group PB (126.875 ± 38.22 min vs. 88.08 ± 28.48 min in group F). The oculocardiac reflex occurred in 7/25 in Group F compared with 1/27 in Group PB ($p = 0.015$). There was no difference in the incidence of postoperative vomiting (24% in Group F vs. 22% in Group PB).
Conclusion: Use of peribulbar block in children undergoing strabismus surgery under desflurane anaesthesia was associated with reduced incidence of emergence agitation and oculocardiac reflex but did not significantly increase the time to first analgesic or the incidence of pain and vomiting. A sub-tenon block may be safer and provide better operating conditions and equal analgesia.

Keywords: agitation, children, anaesthesia, strabismus surgery, peribulbar block

Introduction

Emergence agitation (EA) occurs during the early stage of emergence from anaesthesia in children and has several presentations such as crying, excitation, agitation and delirium.[1] The incidence of EA has increased with the use of short-acting anaesthetic agents like sevoflurane and desflurane and varies between 20% and 60% depending on the scoring system and anaesthetic technique.[2,3]

The aetiology of EA remains unknown and anaesthetic agents, surgical procedure and use of short-acting inhalational agents creates a dissociative state and is considered as one of the major aetiological factors for EA.[4] Postoperative pain is another important factor that may further contribute to or exacerbate the problem.[5–7]

Most children undergoing strabismus surgery have pain and vomiting after surgery leading to significant postoperative distress.[8] Further, use of opioids for pain management may increase pain and vomiting, an important cause of morbidity after strabismus surgery.[9] An analgesic technique that decreases pain and vomiting might decrease the incidence of emergence agitation associated with use of desflurane anaesthesia in children undergoing strabismus surgery. By blocking the ciliary nerves, ciliary ganglion and cranial nerves II, III, IV and VI, a peribulbar block inhibits the oculo-emetic pathway, and should decrease pain, reduce the incidence of the oculocardiac reflex (OCR) and provide a smooth, pain-free emergence from anaesthesia in this population.[10]

We hypothesised that a peribulbar block might decrease EA with desflurane anaesthesia while preserving rapid awakening and recovery. Additional possible benefits might be a reduced incidence of pain and vomiting and improved analgesia.

Methodology

Ethics approval for the study was provided by the institutional ethics committee of the Post Graduate Institute of Medical Education & Research, Chandigarh, India (MS/1269/Dept/2102). After written informed consent from parents, 56 healthy ASA I–II children aged 2–10 years, undergoing strabismus surgery on one eye under general anaesthesia, were enrolled in this prospective randomised double-blind study. Children with a history of allergy to local anaesthetics or opioids, recent upper respiratory tract infection and compromised sclera were excluded.

No premedication was given. Anaesthesia was induced with inhaled sevoflurane in 100% oxygen; an intravenous line was established after induction. The sevoflurane concentration was maintained at 2–3% until adequate jaw relaxation was attained and a laryngeal mask airway (LMA) was inserted. Anaesthesia was thereafter maintained with desflurane 4–6% targeted at a

MAC of 1–1.2, N_2O 2 l min^{-1} and O_2 1 l min^{-1} using controlled ventilation resulting in an end-tidal CO_2 of 4.5 ± 0.5 kPa (35 ± 4 mmHg). Children were randomised to one of the two groups, i.e. Group F (fentanyl analgesia) or Group PB (peribulbar block analgesia). Randomisation was done by computer-generated random number and kept in opaque sealed envelopes. Each envelope was opened and the drug prepared by an independent anaesthesiologist not involved in the study. Children in Group F received 2 µgm/kg of intravenous fentanyl. Patients in group PB received peribulbar block with 0.3 ml/kg of mixture of 0.25% bupivacaine + 2% lignocaine (with maximum volume of 10 ml so as to avoid potential toxicity) injected through a 26-G hypodermic needle. Digital ocular compression was applied for 5 minutes after placement of the block. For the purpose of blinding, this anaesthesiologist then left the room and was not involved in subsequent patient management. Surgery was allowed to start after 10 minutes. All children received 1 mg/kg intravenous dexamethasone (maximum 16 mg) for the control of postoperative pain, nausea and vomiting.[11]

Heart rate, blood pressure, oxygen saturation (SpO_2), end-tidal carbon dioxide ($EtCO_2$), end-tidal desflurane concentration and respiratory rate were recorded after induction at the surgical incision and then at five-minute intervals until the end of surgery. Signs of inadequate depth of anaesthesia (i.e. limb movements, rise in heart rate and/or blood pressure of 20% above the baseline) were initially treated with increase in desflurane concentration by 1–2%. If there were still signs of inadequate depth of anaesthesia, 1 µgm/kg of intravenous fentanyl was administered as rescue analgesia.

The oculocardiac reflex (OCR) was defined as a sudden abrupt decrease in heart rate to less than 60 beats/min after traction on the extraocular muscle. OCR was treated first by increasing the depth of anaesthesia and second by asking the surgeon to stop traction on the extraocular muscle. Injection of atropine 0.02 mg/kg was administered if there was no response to the above measures. At the end of surgery, eye ointment and an eye patch were placed on the operated eye. The LMA was removed at an end-tidal desflurane concentration of 5% after the child resumed spontaneous breathing and the desflurane was then turned off.

The incidence of untoward airway events after removal of the LMA such as breath holding (holding breath for 20 seconds or more after the removal of LMA) severe coughing or strain (severe coughs defined as four or more coughs and SpO2 < 95%) were recorded. Children were then transferred to the PACU after demonstrating a regular respiratory pattern, facial grimacing and purposeful movement. Upon arrival in the PACU, all children were received by one of their parents. Emergence time was defined as the time to first response to a simple verbal command after removal of the LMA. Emergence agitation was assessed continuously from removal of LMA to one hour after surgery and was recorded at 5, 10, 15, 20, 25, 30, 45 and 60 minutes using the Paediatric Anaesthesia Emergence Delirium (PAED) scale.[12] The PAED scale contains five items (eye contact, purposefulness of actions, awareness of surroundings, restlessness and consolability), each scored on a 0–4 scale, to a maximum of 20 points. A perfectly calm child scores 0 and extreme agitation corresponds to 20 points. The peak EA score was recorded. Agitation scores < 10 were interpreted as an absence of agitation, scores ≥ 10 were regarded as presence of agitation, and scores ≥ 15 were regarded as severe agitation. PAED scoring was done in all cases by a single blinded anaesthesiologist. Pain was evaluated using the Face, Legs, Activity, Cry, Consolability (FLACC) scale score. For patients with a total PAED score of > 10 or a FLACC scale > 3 in the PACU, the first measure was to facilitate parental contact. Intravenous fentanyl 1 µgm/kg was administered to children with a FLACC score ≥ 3 and these patients were then removed from analysis for agitation. Time to rescue analgesia (time from receival of a child in PACU to administration of rescue dose of fentanyl) was recorded. Propofol 1 mg/kg was given intravenously to treat agitation in a pain-free child when parental contact failed to console a child with an agitation score of more than 10 and was repeated after 10 minutes if needed. Postoperative vomiting was assessed using numerical rank score for emesis. A pain-free, calm child with a modified Aldrete score ≥ 9 was considered fit for discharge.

The primary outcome of the study was the effect of peribulbar block on the incidence of emergence agitation; secondary outcome measures were the time to first rescue analgesia, incidence of OCR and incidence of vomiting in the post-anaesthesia care unit.

Statistical analysis

The statistical analysis was performed using SPSS® version 21 (IBM Corp, Armonk, NY, USA) for Macintosh. A previous study revealed a 50% incidence of EA with the use of opioids.[13] A sample size of 25 in each group was needed to detect a decrease in the incidence of EA by 33%, i.e. to 15% with α of 0.05 and β of 0.2 (power being 80%). 56 patients were enrolled to include possible dropouts. Demographic data were analysed using Student's t-test and expressed as mean ± SD. Categorical data were reported as percentages and were analysed using the chi-square test or Fisher's exact test as appropriate. Non-parametric data including agitation scores from PAED, the incidence of OCR and adverse events were expressed as median and range and were compared by using Wilcoxon's ranked sum test. A p-value of < 0.05 was considered to be statistically significant

Results

A flow diagram of the participants is depicted in Figure 1. Of the 70 patients assessed for eligibility, 56 were enrolled. Study methodology was not followed in two patients, one in each group. One patient in Group F developed intraoperative laryngospasm and was given a muscle relaxant. The desflurane vaporiser became disconnected from the power supply intraoperatively in another patient in Group F, thus leaving 52 patients for analysis. The surgical technique used was resection of the medial or lateral rectus muscle in 14 children, recession in 20 children and recession-resection in 18 children, with equal distribution between groups

Demographic data were comparable between the two groups (Table 1). A total of 14/25 (56%) children developed agitation in Group F as compared with 3/27 (11.11%) in Group PB (p = 0.001). Data of patients with PAED score > 10 at various time intervals are presented in Table 2. PAED scores in the PACU showed significantly lower EA for the PB group with median (IQR) of 0.00 (0.00–2.00) compared with group F (5.5 (0.75–8.75) at all time intervals (p = 0.003 Mann–Whitney test). One child (3%) in Group PB and six children (24%) in Group F received propofol for EA postoperatively. There was no significant difference between treatments in the need for propofol rescue for EA.

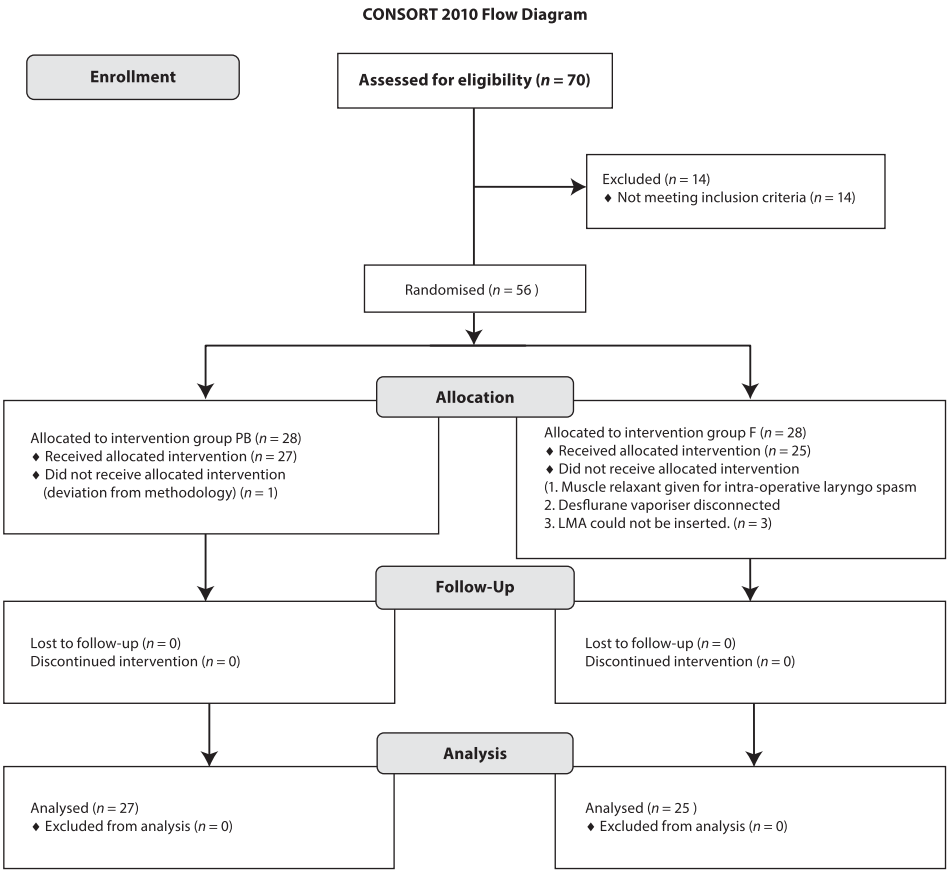

Figure 1: Diagram showing flow of patients.

Table 1: Demographic data

Factor	Group F (*n* = 25)	Group PB (*n* = 27)
Age	5.46 ± 2.88	6.65 ± 2.62
Sex (M:F)	12:13	14:13
Duration of anaesthesia	57.93 ± 16.6	56.50 ± 12.7
Emergence time	5.34 ± 3.54	3.85 ± 3.25

Table 2: PAED score > 10 at different time intervals between the groups

Time (minutes)	Group F (*n* = 25)	Group PB (*n* = 27)
< 5	8 (32%)	2 (7.40%)
10	11 (44%)	2 (7.40%)
15	7 (28%)	2 (7.40%)
20	3 (12%)	2 (7.40%)
30	2 (8%)	1 (3.70%)
45	0 (0%)	1 (3.70%)
60	0	0

OCR was seen in seven patients in Group F compared with one in Group PB ($p = 0.015$). All incidences of OCR responded to cessation of operative manipulation. No patient received atropine. There was no significant difference in the incidence of vomiting between the two groups. Six out of 25 children developed vomiting in Group F and 6/27 in Group PB. ($p = 0.88$) No child received fentanyl intraoperatively as rescue analgesic. Although a higher number of children had FLACC scores > 3 in Group F (12/25 [48%]) than in group PB (7/27 [25.92%]), this was not statistically significant ($p = 0.11$). Similarly, the time to first rescue analgesia was increased in Group PB (126.875 ± 38.22 min vs. 88.08 ± 28.48 min in Group F) but the difference did not reach statistical significance.

Haemodynamic parameters were statistically comparable between groups throughout the intraoperative period. One child developed laryngospasm at the time of LMA removal in Group F.

Discussion

The purpose of the present study was to determine the effect of a PB on the incidence of EA in children undergoing strabismus surgery under desflurane anaesthesia. Secondary outcomes were the need for and timing of rescue analgesia, pain and vomiting, and the incidence of OCR. Our study suggests that pre-surgical placement of a PB reduces the incidence of EA and OCR. Although the time to first analgesic was longer on average in the PB group, this difference was not statistically significant. Likewise, there was no statistical difference in the incidence of pain and vomiting between groups.

Although the precise aetiology of EA is unknown, suggested risk factors include anaesthetic agents, rapid emergence from anaesthesia, type of surgery, pain, preoperative anxiety and non-familiar environment. However, a strong connection between postoperative pain and EA has been supported by many studies.[4–7,14] The use of perioperative analgesia in the form of a regional nerve block to decrease EA has been reported in only two studies; one involved a subtenon block on the eye and another a caudal block for inguinal hernia repair.[15,16] EA usually occurs within the first 30 minutes after termination of anaesthesia, with the highest incidence in the first 5–

15 minutes.[14,15] Seo *et al.* injected lignocaine at the end of strabismus surgery in the subtenon space and found a decrease in the incidence of EA to ~10% compared with ~27% in children who received a saline sham block.[15] We also found a statistically significant decrease in the incidence of EA with use of PB block during the first 10 minutes of recovery. Thus, a PB block was effective in decreasing the incidence of EA in children undergoing strabismus surgery.

Other common postoperative problems in children undergoing strabismus surgery are pain and vomiting and postoperative pain. Acute correction of visual axes alignment leads to distortion of visual image and a high incidence of emesis. Although the use of a PB block in children provides effective analgesia in the intraoperative and postoperative period,[6–9,17] our study did not reveal a significant reduction in pain scores or time to rescue analgesic. Additionally, our study did not find a difference in the incidence of pain and vomiting. It is possible that our study did not find any difference in incidence of pain and vomiting between groups because all children received prophylactic dexamethasone, thus masking any possible effects of PB block on pain and vomiting.

A possible safety issue is that the use of a PB block is associated with a transient increase in intraocular pressure (IOP), secondary to the increase in the orbital pressure due to the injection of local anaesthetic, which may be further exacerbated by the need to maintain gentle but brief orbital pressure to ensure adequate drug distribution. This increase in IOP returns rapidly to baseline values due to the relaxation of extraocular muscles and a decrease in external pressure over the ocular globe.[18] A disadvantage is that this block results in a soft, hypotonic eye secondary to akinesia of muscles that may affect suture placement in strabismus surgery. Therefore some surgeons may be reluctant to use the technique and, in spite of the ease with which it can be performed, the block is an underutilised option, especially in strabismus surgery.[17] In our study, all surgeries were performed by a single surgeon who agreed to proceed with the study, since he had not faced a problem in placing the sutures in his clinical practice. Deb *et al.*[17] did not find any complications related to the block while using it as an adjunct to general anaesthesia in children undergoing ophthalmic surgical procedures. Similar to other studies,[10,19] we did not encounter any complication with the PB technique; however, the number of patients was small and true safety cannot be assessed.

Strabismus surgery is associated with an increased incidence of OCR. Some 30% of the children in the control group in our study developed OCR compared with 3% in the PB block group. We found a significantly lower incidence of OCR with the use of peribulbar block. Decreased incidence has been attributed to the anti-dysrhythmic effect exerted secondary to blocking the afferent limb of the reflex arc.[20] One patient in the PB block group who developed OCR had dense adhesions requiring excessive traction. Heart rate returned to baseline on releasing the traction on muscle in most cases. All incidences of OCR responded to cessation of operative manipulation. None of the patients received atropine.

Opioids have been shown to decrease the incidence of EA. Cohen *et al.* determined 2.5 µgm/kg of fentanyl given at the time of induction in children undergoing adenoidectomy with desflurane anaesthesia as the median effective dose to prevent emergence agitation.[4] Our patients received 2 µgm/kg of fentanyl at the induction of anaesthesia. However, the drug has a short onset time and duration of analgesia of 30–60 minutes. No patient received intraoperative fentanyl and the mean duration of desflurane anaesthesia was 57.9 ± 16.6 minutes

Limitations of our study are that we did not correlate EA with preoperative anxiety scores. Another limitation is that we recorded the PAED scale at 10-minute intervals after 20 minutes. However, all the children were continuously monitored and any PAED score of more than 10 was recorded as agitation. Recording of this time interval was chosen according to the results of Cole *et al.*,[14] who scored children every 10 minutes on arrival in the PACU up to 1 hour and found that the peak of agitation occurs in the first 30 minutes after admission.

In conclusion, our study indicates that the presurgical use of PB block in children undergoing strabismus surgery under desflurane anaesthesia is associated with significant reduction in the incidence of emergence agitation and OCR. We found no improvement in postoperative pain scores, time to first analgesic or pain and vomiting. All children received dexamethasone prophylaxis and this may have exceeded any benefit from the PB block. In many patients a subtenon block would seem to be safer than a PB block with similar effectiveness in terms of anaesthesia, akinesia,[21] lesser volume of local anaesthetic agent (0.06–0.08 ml/kg in subtenon block[22] compared to 0.3 ml/kg in peribulbar block), and may provide superior operating conditions for some surgeons.

Disclosure statement – No potential conflict of interest was reported by the authors.

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