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Original Research Article

Evaluation of effect of sevoflurane or etomidate as induction agent on optic nerve sheath diameter in children patients undergoing strabismus surgery

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Abstract

Objective: Various drugs have been endorsed but no standardised premedication protocol exists to minimize cerebral blood flow effects during intubation. ONSD (Optic Nerve Sheath Diameter) is a noninvasive method to measure intracranial pressure. Sevoflurane and etomidate are two well known induction agents in pediatric patients. This study was designed to evaluate the effect of both drugs on optic nerve sheath diameter in strabismus surgery patients.
Methodology: Patients were induced with either Sevoflurane 4-6 % (group S, n=20) or Etomidate 0.2mg/kg (group E; n = 20) inside the operation theatre. The ONSD, haemodynamic response and adverse effects were recorded for 10 min.
Results: After intubation HR (Heart rate) increase significantly from baseline values in group S as compared to group E. In group E there was no significant change in HR, MBP (Mean blood pressure) and ONSD. The ONSD in group E was significantly low as compared to group S ($p<0.02$). There was no significant change in value of HR, MBP and ONSD at 5 and 10 min after intubation.
Conclusion: Our findings suggest that etomidate is a preferable agent for induction in strabismus surgeries.
Keywords: Sevoflurane, Etomidate, Optic nerve sheath diameter.

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1. Introduction

Literature revealed various drug to blunt stress response of intubation for general anaesthesia (GA). [1,2] This haemodynamic perturbation associated with intubation can have varied effect on intracranial pressure (ICP) depending upon the drug used during GA. Sevoflurane dilates intracranial vasculature and increases ICP and possible increase size of optic nerve sheath diameter (ONSD). On the other hand, etomidate is cerebroprotective and have no effect on ICP. [3] More recently, advancement in the field of research has enabled the diagnosis of raised ICP much reliably by noninvasive modalities. One such noninvasive modality includes estimation of ONSD using bedside ultrasound. [4]

Children undergoing strabismus surgery are required to be opthalmoplegic and maintain normal ICP. Strabismus surgery itself a risk factor for postoperative nausea and vomiting (PONV). [5] We aimed to compare the effects of both drugs on ONSD during peri induction time.

2. Material and methods

This study was carried out at a tertiary level hospital in India. Written informed consent was obtained from parents of the patients. A total of 40 patients in ASA physical status grade I or II, between 01 and 08 years of age, undergoing strabismus surgery requiring GA were enrolled for this study. Patients with known allergy/Hypersensitivity to the study drug, congenital diseases, and developmental delay or with neurological disease, hydrocephalus, and history of chronic illness or known case of increased intracranial pressure were excluded from the study.

According to a computer-generated randomisation chart, the patients were assigned to one of the two treatment groups. Patients in group S (n=20) received Sevoflurane 4-6% and patients in group E received Etomidate 0.2mg/kg for induction under GA. The patient was allowed to be with the parents during administration of the drug. Standardized opioids and GA was used in both patients. Both group received Inj Ondansetron 0.15mg/kg before extubation. ONSD was measured using a 6- to 12-MHz linear probe of the ultrasound machine. After induction and intubation, patients' eyes were covered with transparent plaster. A water-soluble ultrasound-transmission jelly was applied over the probe. The probe was gently placed over the eyelid paying careful attention not to exert excessive pressure. The optic nerve was focused in the center 3mm behind the globe for measurement.

The ONSD was measured at 1, 5 and 10 min after intubation. Mean of three readings of ONSD was taken as the final value. Other haemodynamic variables were also recorded. All patients were ventilated with a tidal volume of 6 mL/kg and respiratory rate set to keep the partial pressure of carbon dioxide (PaCO2) at 30–35 mmHg.

Comparison between two study groups was done with the help of Levene's test for equality of variances and t test for equality of means. Analysis of their significance was done by using the p values obtained through student t-test. For statistical comparison, the difference was considered significant when the p-value was found to be less than 0.05.

3. Observation and Results

Demographic parameters and clinical characteristics were comparable between the groups. The baseline haemodynamic (HR and MBP) parameters were normal and comparable in both the groups (Table 1). Oxygen saturation was maintained throughout the observation period.

Table 1: Demographic profile and baseline clinical characteristics of patients in both the group

Patient data	Group S (n=20) mean±SD	Group E (n=20) mean±SD	P value
Age (yr)	2.3±1.3	2.7±1.5	0.37
Weight (kg)	10.3±2.2	11.2±2.5	0.24
Gender M/F	13/7	11/9	
ASA (I/II)	19/1	18/2	

Values are expressed as mean ± SD,
ASA- American society of anaesthesia, M-Male-Female

After intubation HR increase significantly from baseline values in sevoflurane group S as compared to group E (Table 2).

Table 2: Systemic haemodynamic parameters at various time points in two groups

Value/Groups	Group S	Group E	p value
HR			
0 min	100±8.5	99.9±7.6	0.96
1 min	108±5.4	104±6.4	0.03
5 min	104.2±5.9	101.5±7.1	0.19
10 min	104±5.4	100.2±6.6	0.05
MBP			
0 min	66.7±4.4	67.6±2.8	0.44
1 min	66.7±5.5	68±3.2	0.36
5 min	67±3.9	67.1±2.9	0.92
10 min	66.7±3.4	67.2±2.1	0.57
ONSD			
0 min	3.1±1.1	3.3±0.6	0.47
1 min	3.5±0.4	3.2±0.4	0.02
5 min	3.2±0.4	3.1±0.2	0.32
10 min	3±0.5	3.2±0.2	0.10

Values are expressed as mean ± SD, HR-Heart Rate, MBP- Mean blood Pressure, and ONSD-Optic nerve sheath diameter

In group E (n = 20) there was no observable change in HR, SBP and ONSD. The HR in group E was significantly low as compared to group S at 1and 10 min of intubation ($p<0.03$, $p<0.05$). ONSD measured significantly less at 1 min of intubation in group E ($p< 0.02$). There was no significant change in value of HR, SBP and ONSD at 5 min after intubation. SpO_2 was 100% throughout the study period. PCO_2 in both the groups was maintained between 30 and 35 mmHg. No patient developed hypotension. Three patients in group E developed PONV postoperatively; however no drug intervention was required in either patient. No PONV observed in Group S patients.

4. Discussion

Our study showed that the Sevoflurane increased the diameter of the optic nerve sheath in patients after 1 min of intubation. The mean values of ONSD for patients in the E group were significantly lower at 1 min of intubation than that in the S group. Literature revealed that the change in ONSD correspond to ICP changes.[6] The cerebrospinal fluid surrounded over optic nerve is directly in communication with subarachnoid space of brain. Hence, ICP is directly proportional to the ONSD. In our study the site of measurement of ONSD was 3 mm behind the globe, the reason being that the most distensible region of optic nerve is 3mm behind the papilla in the globe. [7] We measured optic nerve diameter after 1 min of induction to 10 min, as the distensibility allows the optic nerve sheath to inflate within a few minutes of exposure to elevated ICP.

We noticed observable differences in ONSD between the sevoflurane and etomidate groups. Etomidate constricts cerebral vasculature as a reflex of elevated cerebral blood blow due to stress response of intubation. Literature revealed that Etomidate decreased the cerebral metabolic rate (CMR) by 36 %, and ICP by 15%, in patients with normal ICP.[8] Use of etomidate for induction in patients with cerebral dysregulation believed to confer a neuroprotective effect against mild ischemic insults.

We considered paediatric patients undergoing surgery for strabismus for our study as opthalmoplegia and normal intracranial pressure were the prerequisites of such surgeries. Postoperative nausea and vomiting (PONV) which is most common unwanted complication in eye surgery were also evaluated in this study. Strabismus surgery is one of leading cause of increased risk of PONV. Elevated ICP can be contributing cause of PONV.

The limitation of this study was that patients having pre-existing intracranial pathology were excluded from the study. Therefore, the effects on ICP in patients with intracranial pathology could not be evaluated in this study. Patients with pre-existing elevated ICP or cerebral ischemia may experience different results in terms of ONSD.

In conclusion, Sevoflurane induction increased the diameter of the optic nerve sheath in patients with normal intracranial pressure for strabismus surgery. The mean ONSD in the etomidate group was significantly less than that in the sevoflurane group during the post intubation period. Our findings suggest that etomidate is a preferable agent for induction in strabismus surgeries. We suggest a large sample size study to be conducted to establish the preferable induction agent.

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