(International Print/Online Journal)

SJIF IMPACT FACTOR: 5.565
PUBMED-National Library of Medicine ID-101739732

ISSN (Print): 2209-2870
ISSN (Online): 2209-2862

International Journal of Medical Science and Current Research (IJMSCR)
Available online at: www.ijmscr.com
Volume4, Issue 2, Page No: 915-919
March-April 2021

A Comparative Study to Evaluate Changes in Intraocular Pressure with Thiopentone Sodium and Etomidate in Patients Undergoing Surgery for Traumatic Brain Injury

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Type of Publication: Original Research Paper
Conflicts of Interest: Nil

ABSTRACT

Introduction: Traumatic brain injury leads to elevated intracranial pressure. Intraocular pressure (IOP) may also be affected by intracranial pressure. All drugs used in anaesthesia induction can change IOP. Irritation of the gag reflex after usage of the endotracheal tube can increase IOP, therefore, the administration of anesthetic drugs, which make the lowest change in IOP, is important while cardiovascular depression must be avoided.

Material and methods: Hundred patients (age 18-55 years) who underwent emergency craniotomy for TBI were selected for the study. Patients were randomly assigned to two groups of 50 patients each according to the drugs used for induction: group T was given thiopentone sodium (5mg kg^{-1}) and group E was given etomidate (0.3mg kg^{-1}). Preanaesthesia intraocular pressure (IOP) was measured using Schiotz tonometer. Induction of anaesthesia was achieved with etomidate or thiopentone along with fentanyl (2 mcg kg^{-1}). Intravenous rocuronium (0.9mg kg^{-1}) was given to facilitate intubation. Intraocular pressure was measured after 1 minute of induction agent administration and 5 minutes after intubation. Patient was shifted toward/ICU after completion of surgery.

Results: Intraocular pressure in thiopentone group in left eye and right eye before induction was 14.97±3.94 mmHg and 14.72±3.75 mmHg respectively and for etomidate group was 15.28±3.69 mmHg and 15.54±4.46 mmHg respectively. After induction IOP decreased significantly in both the eyes ($p<0.001$) in both the groups. After 5 min of intubation IOP was significantly less than the baseline in both the eyes but it was more than the IOP after induction with the drug. It was found that there was no statistically significant difference in IOP between the two groups at any point of time.

Conclusion: Both the drugs caused a significant decrease in IOP after induction and after 5 minutes of endotracheal intubation. We observed that it is appropriate to use etomidate as an induction agent when elevation of intra-ocular pressure is undesirable as etomidate maintains cardiovascular stability too.

Keywords: thiopentone, etomidate, intraocular, hemodynamics

INTRODUCTION

Traumatic brain injury (TBI) is a major public health problem and leading cause of morbidity and mortality worldwide.[1] Inflammatory and neurotoxic processes due to TBI result in vasogenic fluid accumulation within the brain, contributing to raised intracranial pressure (ICP). Intraocular pressure (IOP) may also be affected by raised ICP. Increased venous pressure in the cavernous sinus can increase the pressure in the

superior orbital vein resulting in an increase in IOP.[2,3] Intraocular pressures can be easily measured usually by digital strain gauge technology such as hand held tonometer. It is hypothesized that noninvasive measurement of IOP directly reflects ICP in patients with intracranial pathology.[3]

Anaesthetic agents that produce rapid onset of hypnosis and rapid control of the airway without an increase in ICP and IOP and providing haemodynamic stability are preferred. Propofol and thiopentone are commonly used but may cause hypotension, especially in the presence of uncorrected hypovolemia.[1,4] Etomidate has advantages in terms of cardiovascular stability and a decrease in IOP.[5] By virtue of its cardiovascular stability, etomidate is useful in patients maintained in the sitting position during neuroanaesthesia.[6] Thiopentone decreases IOP by 40% whereas etomidate decreases IOP by 30-60% for up to 5 minutes.[7]

Material and methods

A total of 100 patients (age 18-55 years) who underwent emergency craniotomy for TBI were selected for the study. Patients were excluded if they had history of hypersensitivity to the study drugs, known primary or secondary adrenal insufficiency or on steroid medication and polytrauma patients with massive hemorrhage.

The patients were randomly assigned to two groups of 50 patients each according to the drugs used for induction: group T was given thiopentone sodium (5mg kg^{-1}) and group E was given etomidate (0.3mg kg^{-1}). Baseline parameters heart rate, mean arterial pressure and SpO_2 were recorded. Preoperative GCS was also noted. Preanaesthesia intraocular pressure (IOP) was measured after instillation of 2% xylocaine using Schiotz tonometer. Induction of anaesthesia was achieved with etomidate (0.3mg kg^{-1}) or thiopentone (5mg kg^{-1}) along with fentanyl (2 mcg kg^{-1}) by a fellow anesthesiologist unaware of study protocol as per the groups assigned. Clinical assessment of patient falling asleep was done by loss of eyelash reflex (T_L). Intravenous rocuronium (0.9mg kg^{-1}) was given to facilitate orotracheal intubation. Intraocular pressure was measured after 1 minute of induction agent administration and 5 minutes after orotracheal intubation. Maintainance of anaesthesia was done with isoflurane in 50% nitrous oxide with fresh gas flow of 5 litres. At the end of surgery the residual neuromuscular block was reversed and the patient was shifted toward/ICU.

Statistical analysis Statistical testing was conducted with the statistical package for the social science system version SPSS 17.0. Continuous variables were presented as mean±SD or median if the data is unevenly distributed. Categorical variables are expressed as frequencies and percentages. The comparison of normally distributed continuous variables between the groups was performed using Student's t test. Nominal categorical data between the groups was compared using Chi-square test or Fisher's exact test as appropriate. Non-normal distribution continuous variables were compared using Mann Whitney U test. P value less than 0.05 was taken to indicate a significant difference. Etomidate and Thiopentone drug, at 2-sided type 1 error of 0.05, 90% power and SD of 15, a sample size of 50 per group is required to detect a significant difference.

Observation

The patients in both the groups were comparable in terms of demographic profile as shown in table 1. There was no significant difference between the groups for the hemodynamic and respiratory variables prior to thiopentone or etomidate administration.

Table 1

Table showing demographic profile of the patients (age and weight) in two groups

	Group T (mean±sd)	Group E (mean±sd)	P value
Age (years)	36.23 ± 17.09	35.26 ± 12.50	0.381

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Weight (kg)	70.63 ± 7.78	74.06 ± 10.36	0.061
Male	44 (88%)	45 (90%)	0.345
Female	6 (12%)	5 (10%)	
HR (beats/min)	88.17±12.38	84.34±15.85	0.132
MAP (mmHg)	88.40±9.70	89.09±11.29	0.393
SpO_2	99.37±0.77	99.57±0.74	0.136
GCS	11.92±3.04	11.35±3.47	0.232
T_L (sec)	16.29±3.43	15.51±1.93	0.125

Table 2 (graph 1 and 2) shows changes in IOP before induction, after induction and 5 min after intubation for both thiopentone and etomidate. Intraocular pressure in thiopentone group in left eye and right eye before induction was 14.97±3.94 mmHg and 14.72±3.75 mmHg respectively and for etomidate group was 15.28±3.69 mmHg and 15.54±4.46 mmHg respectively. After induction IOP decreased significantly in both the eyes (p<0.001) in both the groups. After 5 min of intubation IOP was significantly less than the baseline in both the eyes but it was more than the IOP after induction with the drug. It was found that there was no statistically significant difference in IOP between the two groups at any point of time.

Table 2

Showing IOP of both eyes in the two groups at various intervals

IOP			**Before Induction**	**After induction**	**5 min after intubation**
Left Eye	Group T	Mean ±sd	14.97 3.94	12.15 3.11	12.24 4.69
		p-value (vs baseline)	-	<0.001	<0.001
	Group E	Mean ±sd	15.28 3.69	11.11 2.31	11.19 4.74
		p-value (vs baseline)	-	<0.001	<0.001
	p-value (T vs. E)		0.367	0.058	0.179
Right Eye	Group T	Mean ±sd	14.72 3.75	12.01 2.99	11.99 4.69
		p-value (vs baseline)	-	<0.001	<0.001
	Group E	Mean ±sd	15.54 4.46	11.21 2.45	11.06 4.85
		p-value (vs baseline)	-	<0.001	<0.001
	p-value (T vs. E)		0.203	0.113	0.209

Discussion

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The changes in IOP were observed at various intervals in our study for both thiopentone and etomidate. Comparing the IOP in both the eyes at different intervals of time in cases of thiopentone and etomidate, it was found that there was no statistically significant difference between the two groups at any point of time ($p > 0.05$). However, compared to baseline there was a significant drop in IOP after induction and 5 minutes after intubation in both the groups ($p < 0.001$). Although the IOP after 5 minutes was more as compared to the IOP after induction. A decrease in IOP was noted in both the groups. But the drop in IOP was slightly more in etomidate group as compared to thiopentone group, however it was statistically insignificant ($p > 0.05$).

In concordance with our study, Famewo et al in his study found a significant decrease in baseline IOP (15.52 mmHg) at 1 minute (10.62 mmHg) and 3 minutes (10.51 mmHg) after etomidate injection ($p < 0.001$).[8] In our study also similar decrease in IOP was seen from the baseline value at induction and 5 minutes after etomidate injection. Similar results were noted by Alipour et al who observed significant decrease in IOP ($p < 0.05$) after injection of thiopentone and etomidate in comparison to baseline values and this drop remained noticeable even after LMA insertion. The IOP decreased significantly from the baseline value of 17.66±4.58 mmHg to 11.07±4.00 mmHg after induction with etomidate while it decreased to 8.00±2.04 mmHg from the baseline value of 13.41±3.20 mmHg in thiopentone group. In addition, Alipour et al observed that IOP after LMA insertion was more than before LMA insertion, although it was less than the baseline value which was similar to what we observed after securing the airway. The IOP at different intervals was not significant between the groups.[9]

Thus in our study similar to other studies both the drugs caused a significant decrease in IOP after induction and after 5 minutes of endotracheal intubation. However, the decrease was slightly more in etomidate group as compared to thiopentone group.

The mechanism of decrease in IOP by intravenous induction agents is debatable. Systemic hypotension after the induction of anaesthesia has been shown to cause a decrease in intra-ocular pressure. A decrease in the tone of the extra-ocular muscles can also result in a decrease in intra-ocular pressure.[8] We observed that it is appropriate to use etomidate as an induction agent when elevation of intra-ocular pressure is undesirable.

Conclusion

The IOP decreased significantly in both the eyes after induction of anaesthesia in both the groups. After 5 min of intubation IOP was significantly less than the baseline in both the eyes but it was more than the IOP after induction with the drug. The IOP decreased slightly more in Group E than Group T however there was no statistically significant difference in intraocular pressure between the two groups at any point of time.

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