COMPARATIVE EVALUATION OF ETOMIDATE, PROPOFOL AND THIOPENTONE IN SHORT SURGICAL PROCEDURES UNDER GENERAL ANAESTHESIA

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ABSTRACT

Background: Research in Anaesthesia aims to find an ideal anesthetic agent having quick induction and pleasant recovery with minimal adverse effects. Till date, no single drug meets the criteria of an ideal anesthetic agent. Also, very few studies are available comparing the induction and recovery characteristics of more than two intravenous agents simultaneously. So, the present study was conducted to compare the induction and recovery characteristics along with adverse effects of etomidate, propofol and thiopentone in surgical procedures of short duration under general Anaesthesia. Methods: It was a randomized, prospective, open-label parallel-group study conducted in 60 patients posted for short duration surgeries. The patients were randomized into three groups of 20 each receiving propofol, thiopentone or etomidate after they fulfilled the inclusion criteria and signed the informed consent. The induction, hemodynamic and recovery characteristics along with adverse effects were noted and analyzed. Results: Etomidate showed rapid induction as compared to propofol and thiopentone with extremely significant p value. On comparing the three groups together, etomidate showed distinct cardiostability in terms of no significant change in heart rate, systolic and diastolic blood pressure whereas propofol showed faster recovery on Standardized Aldrete Score and Sedation Score. Few nonserious adverse effects were shown by etomidate and propofol but were absent in thiopentone group. Conclusion: The results of our study showed that etomidate is cardiostable and has rapid induction while recovery is faster and better with propofol.

KEYWORDS: Propofol, Thiopentone, Etomidate, Cardiostability, Standardized Aldrete Score.

INTRODUCTION

Intravenous anaesthesia has been a major advancement in the field of anaesthesiology, as the problem of slow and unpleasant induction with inhalational agents was largely overcome by rapid, smooth and predictable loss of consciousness with intravenous agents. The commonly used intravenous induction agents are propofol, thiopentone, midazolam, ketamine and etomidate.

Propofol is a short acting, agent which produces quicker recovery and early return of psychomotor function but many studies have reported a reduction in mean arterial pressure, cardiac output and systemic vascular resistance. Thiopentone is a time tested agent, widely used for rapid induction of Anaesthesia but known to cause prolonged recovery and emergence delirium in addition to dose-dependent reduction in cardiac output, stroke volume and systemic vascular resistance associated with a compensatory tachycardia. Etomidate, an imidazole-derivative, first introduced in the seventies, was withdrawn, because of anaphylactic reactions to cremaphore EL. There were also concerns about reductions in the serum cortisol levels. However, it has a very stable cardiovascular profile and has been reintroduced in India. It is remarkable for its minimal cardiovascular effects and rapid onset of action. It is recommended for induction in patients with poor left ventricular (LV) function.

There is a paucity of literature regarding the choice of suitable agent to avoid any deleterious effects in patients undergoing general Anaesthesia. So, the present study was planned to evaluate the induction and recovery characteristics of etomidate as compared to propofol and thiopentone along with their adverse effects in surgical procedures of short duration under general Anaesthesia.
METHODOLOGY

The approval for the protocol of this study was sought from the Institutional Thesis Committee and the Institutional Ethics Committee (IEC). After obtaining approval from the concerned authorities, the study was initiated and patients were recruited after taking their informed consent in accordance with the established protocol. The study was conducted in accordance with the Principles of Good Clinical Practice and Declaration of Helsinki.

It was a randomized, prospective, open-label parallel-group study conducted in 60 patients posted for short duration surgeries at Department of Anaesthesiology & Critical care at the Padmashree Dr. D.Y Patil Medical College and Hospital, Pune. The patients were randomised into three groups according to statistical table of random numbers after they fulfilled the inclusion criteria and signed the informed consent. The sample size was calculated as 20 in each group, with a total of 60; using stat calculator assuming the a power of study to be 80%, and α of 95%. These patients were subjected to thorough preanaesthetic evaluation. All other relevant laboratory investigations were performed before administering the anaesthetic drug as per the allocated group according to the protocol.

Inclusion Criteria

Patients who were found fit in baseline examination and willing to sign the informed consent were included in the present study as per the criteria given below.

1) ASA I - II patients according to American Society of Anaesthesiologists (ASA) Physical Status Classification System
2) Patients between 16 - 60 yrs age of either sex
3) Normal laboratory investigations and haemodynamically stable
4) No known allergies to sulphur, egg proteins or similar products.

Exclusion Criteria

1) Patients not willing to get enrolled in the study or sign the informed consent form
2) Patients who were below 16 or above 60 yrs
3) Patients with bleeding disorder or on anticoagulant therapy.
4) Uncooperative patients or those who could not tolerate any degree of respiratory compromise due to underlying diseases
5) Patients with a history of drug allergy or abnormal psychological profile.

Time of end of induction

Table 1: Time of end of induction.

<table>
<thead>
<tr>
<th>Time of Induction (seconds)</th>
<th>Group A (Propofol)</th>
<th>Group B (Thiopentone)</th>
<th>Group C (Etomidate)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD (n=20)</td>
<td>Mean ± SD (n=20)</td>
<td>Mean ± SD (n=20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>20.15 ± 2.01</td>
<td>23.9 ± 1.41</td>
<td>13.4 ± 1.63</td>
<td>&lt;0.0001**</td>
</tr>
</tbody>
</table>

**Extremely significant P value

Drugs investigated were

1. Injection Propofol 2.5 mg/kg in Group A
2. Injection Thiopentone 6mg/kg in Group B
3. Injection Etomidate 0.3 mg/kg in Group C

The following parameters were noted in all the three groups

1. Baseline characteristics such as age, weight, gender distribution, ASA grade and duration of surgery.
2. Time of end of induction
3. Time of eye opening
4. Heart rate, Systolic Blood Pressure, Diastolic blood pressure, spO₂, Respiratory rate at preoperative, 0 min(time of introduction of anaesthetic agent), 5 min, 10 min, 15 min, 20 min and 25 min.
5. Standardized Aldrete Score, Visual Analog Scale, Sedation Score, at 0 min(after withdrawal of anaesthetic agent), 30 min, 60 min and 120 min during the recovery period.
6. Incidence of postoperative nausea vomiting and other adverse effects during the recovery period.

The results were tabulated and expressed as mean ± S.D and analyzed by suitable statistical methods using SPSS software. P value of < 0.05 was considered significant.

RESULTS

In our study, Group A patients were administered with injection Propofol 2.5 mg / kg, Group B with injection Thiopentone 6mg / kg and Group C with injection Etomidate 0.3 mg / kg. Anaesthesia was maintained with the help of N₂O, O₂ and isoflurane on Magill circuit with continuous monitoring of heart rate, blood pressure and oxygen saturation throughout the surgery at regular intervals. After surgery, recovery characteristics of patients in all the three groups were compared.

The baseline characteristics such as age, weight, gender distribution, duration of surgery and ASA I and II distribution was similar in all the three groups with no significant difference (p value > 0.05). On intergroup comparison, the parameters evaluated were time of end of induction, recovery time in terms of time of eye opening, heart rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), oxygen saturation (spO₂), respiratory rate, Visual Analog Score (VAS), Standardized Aldrete Score (SAS) and post operative nausea and vomiting and sedation.
Table 1 shows time of end of induction among the three groups.

Table 1 shows the time of end of induction (seconds) of the three study groups. Mean time of induction of anaesthesia was 20.15 ± 2.01, 23.9 ± 1.41 and 13.4 ± 1.63 in propofol, thiopentone and etomidate group respectively. On intergroup comparison, the results were extremely significant (p< 0.0001).

Heart Rate
Table 2: Heart Rate.

Table 2 shows Heart Rate among the three groups at preoperative stage and subsequently at 0 min, 5 min, 10 min, 15 min, 20 min and 25 min.

Table 2 and Figure 1 show the heart rate among the three groups after induction. As compared to preoperative stage, mean heart rate at the time of induction (0 minutes) showed marked rise in propofol group (from 71.20 ± 8.81 to 110.80 ± 10.17) and thiopentone group (from 72.35 ± 10.63 to 100.60 ± 9.69) but only slight rise in etomidate group (from 71.40 ± 11.46 to 72.30 ± 9.11). At 25 min after induction, the mean heart rate was 72.00 ± 13.75 in etomidate group, 77.00 ± 6.10 in thiopentone group and 75.00 ± 6.63 in propofol group.

Systolic Blood Pressure
Table 3: Systolic Blood Pressure.

Table 3 and Figure 2 show the systolic blood pressure among the three groups after induction. As compared to preoperative stage, systolic blood pressure at the time of induction (0 minutes) showed marked rise in propofol group (from 127.5 ± 15.52 to 190.4 ± 14.99) and thiopentone group (from 124.8 ± 17.14 to 126.9 ± 14.31) but only slight rise in etomidate group (from 125.4 ± 16.03 to 125.4 ± 16.13). At 25 min after induction, the mean systolic blood pressure was 172.50 ± 16.32 in etomidate group, 177.00 ± 6.10 in thiopentone group and 178.50 ± 6.63 in propofol group.
Table 3 shows Systolic Blood Pressure among the three groups at preoperative stage and subsequently at 0 min, 5 min, 10 min, 15 min, 20 min and 25 min.

Figure 2 shows Systolic Blood pressure among the three groups at preoperative stage and subsequently at 0 min, 5 min, 10 min, 15 min, 20 min and 25 min.

Table 3 and Figure 2 show the mean systolic blood pressure (mean SBP) among the three groups after induction. As compared to pre-operative stage, mean systolic blood pressure (SBP) on injecting the anesthetic agent decreased in propofol group (from 127.5 ± 15.52 to 90 ± 10.11) and thiopentone group (from 124.8 ± 17.14 to 100.4 ± 8.82) but increased slightly in etomidate group (from 125.4 ± 16.03 to 126.6 ± 14.31). At 25 min after induction, decline in mean systolic blood pressure (SBP) from the preoperative value was more in propofol group (from 127.5 ± 15.52 to 90 ± 10.11) and thiopentone group (from 124.8 ± 17.14 to 110 ± 0.10) but increased slightly in etomidate group (from 125.4 ± 16.03 to 128.5 ± 16.92). On intergroup comparison, the results were extremely significant with p value of <0.0001.

Diastolic Blood Pressure

Table 4: Diastolic Blood Pressure.

<table>
<thead>
<tr>
<th>DBP (mm Hg)</th>
<th>Group A (Propofol)</th>
<th>Group B (Thiopentone)</th>
<th>Group C (Etomidate)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD (n=20)</td>
<td>Mean ± SD (n=20)</td>
<td>Mean ± SD (n=20)</td>
<td></td>
</tr>
<tr>
<td>Pre operative</td>
<td>81.1± 12.87</td>
<td>79.01 ± 9.23</td>
<td>81.0 ± 15.29</td>
<td>&gt;0.05ns</td>
</tr>
<tr>
<td>0 min</td>
<td>60.90± 13.22</td>
<td>70.80± 5.54</td>
<td>78.17 ± 16.19</td>
<td>&gt;0.05ns</td>
</tr>
<tr>
<td>5 min</td>
<td>65.88± 14.07</td>
<td>72.20± 5.24</td>
<td>79.70 ± 16.79</td>
<td>&lt;0.05*</td>
</tr>
<tr>
<td>10 min</td>
<td>74.85 ± 14.05</td>
<td>74.0± 5.59</td>
<td>79.60 ± 16.85</td>
<td>&lt;0.05*</td>
</tr>
<tr>
<td>15 min</td>
<td>72.33 ± 12.83</td>
<td>76.10 ± 3.91</td>
<td>79.40 ± 16.93</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>20 min</td>
<td>76.10 ± 5.77</td>
<td>76.77 ± 7.62</td>
<td>79.30 ± 16.61</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>25 min</td>
<td>76.67 ± 5.89</td>
<td>77.0 ± 0.01</td>
<td>80.1 ± 17.23</td>
<td>&lt;0.0001**</td>
</tr>
</tbody>
</table>

ns=not significant p value, *Significant P value, **Extremely significant P value

Table 4 shows Diastolic Blood Pressure among the three groups at preoperative stage and subsequently at 0 min, 5 min, 10 min, 15 min, 20 min and 25 min.

Figure 3 shows Diastolic Blood pressure among the three groups at preoperative stage and subsequently at 0 min, 5 min, 10 min, 15 min, 20 min and 25 min.

Table 4 and Figure 3 show the mean diastolic blood pressure (mean DBP) among the three groups after induction. As compared to pre-operative stage, mean diastolic blood pressure (mean DBP) on injecting the anesthetic agent decreased in propofol group (from 81.1± 12.87 to 60.90± 13.22) and thiopentone group (from 79.01 ± 9.23 to 70.80± 5.54) in etomidate group (from 81.0 ± 15.29 to 78.17 ± 16.19). At 25 min after induction, decline in mean diastolic blood pressure (DBP) from the preoperative value was more in propofol group (from 81.1± 12.87 to 76.67 ± 5.89) than in thiopentone group (from 79.01 ± 9.23 to 77 ± 0.01) but well maintained in etomidate group (from 81.0 ± 15.29 to 80.1 ± 17.23). On intergroup comparison, the results were extremely significant with p value of <0.0001.
Time of eye opening
Table 5: Time of eye opening.

<table>
<thead>
<tr>
<th>Time of eye opening(min)</th>
<th>Group A (Propofol) Mean ± SD (n=20)</th>
<th>Group B (Thiopentone) Mean ± SD (n=20)</th>
<th>Group C (Etomidate) Mean ± SD (n=20)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>17.31 ± 4.52</td>
<td>24.05 ± 4.23</td>
<td>22.88 ± 3.97</td>
<td>&lt;0.0001**</td>
</tr>
</tbody>
</table>

**Extremely significant P value

**Table 5** shows mean time of eye opening among the three groups during recovery period.

**Table 5** shows the time of recovery in terms of mean time of eye opening (minutes) among the three groups.

Standardized Aldrete score
Table 6: Standardized Aldrete Score.

<table>
<thead>
<tr>
<th>SA score</th>
<th>Group A (Propofol) Mean ± SD (n=20)</th>
<th>Group B (Thiopentone) Mean ± SD (n=20)</th>
<th>Group C (Etomidate) Mean ± SD (n=20)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 min</td>
<td>8.3 ± 0.47</td>
<td>7.3 ± 0.47</td>
<td>7.6 ± 0.5</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>30 min</td>
<td>8.45 ± 0.51</td>
<td>7.65 ± 0.49</td>
<td>8.2 ± 0.52</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>60 min</td>
<td>8.9 ± 0.31</td>
<td>7.77 ± 0.57</td>
<td>8.3 ± 0.57</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>90 min</td>
<td>9.1 ± 0.31</td>
<td>7.9 ± 0.45</td>
<td>8.45 ± 0.60</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>120 min</td>
<td>9.3 ± 0.47</td>
<td>8.05 ± 0.60</td>
<td>8.5 ± 0.61</td>
<td>&lt;0.0001**</td>
</tr>
</tbody>
</table>

*Significant P value, **Extremely significant P value

**Table 6** shows Standardized Aldrete Score among the three groups during the postoperative recovery period at 0 min (withdrawal of anaesthetic agent), 30 min, 60 min, 90 min and 120 min.

**Figure 4**

![Standardized Aldrete (SA) Score](image)

Figure 4 shows Standardized Aldrete Score among the three groups during the postoperative recovery period at 0 min (withdrawal of anaesthetic agent), 30 min, 60 min, 90 min and 120 min.

**Table 6** and **Figure 4** show the Standardized Aldrete Score among the three groups from the time of withdrawal of anaesthetic agent (0 min) to 120 min thereafter. It was 8.3 ± 0.47 in propofol group at 0 min and 9.3 ± 0.47 at 120 minutes. In thiopentone group, it was 7.3 ± 0.47 at 0 min and 8.05 ± 0.60 at 120 minutes. In etomidate group, it was 7.6 ± 0.50 at 0 min and 8.5 ± 0.61 at 120 minutes. On intergroup comparison, the results were extremely significant (p value < 0.0001) at all time intervals.
Visual analogue scale (VAS)

Table 7: Visual analogue scale (VAS).

<table>
<thead>
<tr>
<th></th>
<th>Group A (Propofol)</th>
<th>Group B (Thiopentone)</th>
<th>Group C (Etomidate)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD (n=20)</td>
<td>Mean ± SD (n=20)</td>
<td>Mean ± SD (n=20)</td>
<td></td>
</tr>
<tr>
<td>At 0 min</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>At 30 min</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>At 60 min</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>At 90 min</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>&gt;0.05 ns</td>
</tr>
<tr>
<td>At 120 min</td>
<td>0.1 ± 0.45</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>&lt;0.01*</td>
</tr>
</tbody>
</table>

ns=not significant p value, *Significant P value

Table 7 shows the score of Visual analogue scale (VAS) among the three groups during the postoperative recovery period at 0 min (withdrawal of anaesthetic agent), 30 min, 60 min, 90 min and 120 min.

Table 7 shows scores from 0 min to 120 min on visual analogue scale (VAS) after induction in the three groups. The score in all the three groups from 0 min to 120 min was zero except in propofol group at 120 min (0.1 ± 0.45) which was significant.

Respiratory rate and Oxygen saturation

The respiratory rate and oxygen saturation were well maintained and showed no significant difference among the three groups.

Sedation score

Table 8: Sedation score.

<table>
<thead>
<tr>
<th>Sedation score</th>
<th>Group A (Propofol)</th>
<th>Group B (Thiopentone)</th>
<th>Group C (Etomidate)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
<td></td>
</tr>
<tr>
<td>0 min</td>
<td>2 ± 0</td>
<td>1.5 ± 0.51</td>
<td>1.37 ± 0.49</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>30 min</td>
<td>2.6 ± 0.41</td>
<td>1.95 ± 0.51</td>
<td>2.1 ± 0.31</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>60 min</td>
<td>2.85 ± 0.22</td>
<td>2.1 ± 0.45</td>
<td>2.5 ± 0.51</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>90 min</td>
<td>2.90 ± 0.44</td>
<td>2.3 ± 0.47</td>
<td>2.80 ± 0.01</td>
<td>&lt;0.0001**</td>
</tr>
<tr>
<td>120 min</td>
<td>2.99 ± 0.67</td>
<td>2.75 ± 0.44</td>
<td>2.90 ± 0.01</td>
<td>&lt;0.05*</td>
</tr>
</tbody>
</table>

*Significant P value, **Extremely significant P value

Table 8 and Figure 5 show the score of Sedation Score among the three groups during the postoperative recovery period at 0 min (withdrawal of anaesthetic agent), 30 min, 60 min, 90 min and 120 min.

Table 8 shows the sedation score among the three groups from withdrawal of anaesthetic agent (0 min) to 120 min in the recovery period. From the time of withdrawal of anaesthetic agent, the sedation score at 90 min improved in propofol group from 2 ± 0 to 2.90 ± 0.44, in thiopentone group from 1.5 ± 0.51 to 2.3 ± 0.47 and in etomidate group from 1.37 ± 0.49 to 2.80 ± 0.01. On intergroup comparison, these results were extremely significant (p value <0.0001). However, at 120 min, the results were significant (p value <0.05) with the sedation score of 2.99 ± 0.67, 2.75 ± 0.44 and 2.90 ± 0.01 in propofol, thiopentone and etomidate group respectively.

Nausea Vomiting

There was no post operative nausea and vomiting in propofol and thiopentone group whilst it was minimal in etomidate group which was clinically not significant.
Other Adverse effects
Table 9: Other Adverse effects.

<table>
<thead>
<tr>
<th>Other Adverse effects</th>
<th>Group A (Propofol)</th>
<th>Group B (Thiopentone)</th>
<th>Group C (Etomidate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apnoea</td>
<td>9 (45)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Pain on injection site</td>
<td>7 (35)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Myoclonic activity</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>6 (30)</td>
</tr>
</tbody>
</table>

Table 9 shows the other adverse effects in patients among the three groups.

Table 9 shows other adverse effects occurred in the three groups after induction of anaesthesia. In propofol group, 9 (45%) patients had apnoea and 7 (35%) had pain on injection site whereas myoclonic activity was seen only in etomidate group in 6 (30%) patients.

DISCUSSION

General anaesthesia is a state of unconsciousness with loss of protective reflexes resulting from the administration of one or more general anaesthetic agent. A variety of medications are administered by the anesthesiologists, to obtain a combination of hypnosis, amnesia, analgesia, relaxation of skeletal muscles and control of reflexes of autonomic nervous system. The optimal combination of these agents is desirable for a particular procedure and advantageous for the patient. Anaesthetic agents are administered by various routes, including inhalation, intravenous, intramuscular or subcutaneous, oral and rectal. Onset of anaesthesia is faster with intravenous injection than inhalation. This offers the advantage of avoiding the excitatory phase of anaesthesia and reducing complications related to induction. Commonly used intravenous induction agents include propofol, sodium thiopental, etomidate and ketamine.

In our study total 60 patients were screened and found eligible to be included in the study after meeting the inclusion criteria and obtaining the informed consent. These patients were then randomized into three groups of 20 patients each in either of group A, B or C receiving propofol, thiopentone and etomidate respectively. The induction, recovery characteristics and adverse effects were studied and compared among the three groups.

During the induction period, the mean time of end of induction noted was least in etomidate as compared to propofol and thiopentone. (Table 1) The results of our study were in consonance to a previous study in which the induction time was less in etomidate group as compared to propofol and thiopentone group. Similar results were also obtained in another study which compared the time of induction of etomidate, thiopentone and midazolam with alfentanil in each group showing minimum time of induction in etomidate group followed by thiopentone and longest with midazolam group.[16,17]

At the time of induction (0 minutes), the mean heart rate showed marked rise from the preoperative values in propofol and thiopentone group as compared to etomidate group. (Table 2, Figure 1) After taking appropriate measures, the mean heart rate improved in propofol and thiopentone group. The final readings of mean heart rate at 25 minutes after induction, showed that it was controlled in all three groups but was still higher than the baseline preoperative values in propofol and thiopentone group with significant intragroup p value (p < 0.05). In etomidate group, the heart rate was well maintained throughout, with the final readings at 25 minutes being comparable to the baseline preoperative value, with non significant intragroup p value (p > 0.05). This shows that etomidate is more cardiostable than thiopentone and propofol. The cardiostability with etomidate was also reported in a previous study where the heart rate remained unchanged with etomidate as compared to increase with midazolam and thiopentone groups.[17]

The mean systolic blood pressure (SBP) was well maintained throughout the induction period in etomidate group whereas there was decline in both propofol and thiopentone group with extremely significant intergroup p value (<0.0001). (Table 3, Figure 2) This also shows that etomidate is more cardiostable as compared to propofol and thiopentone. This cardiostability of etomidate was also seen in a study conducted by Ebert TJ, Muzi M, Berens R which reported that etomidate induction maintained blood pressure whereas propofol produced significant hypotension in 25 unpremedicated patients.[9] Similar results were also obtained in another study showing decrease in systolic BP and increase in heart rate with midazolam and thiopentone but no change in etomidate group in 80 patients undergoing elective surgery.[17]

The mean diastolic blood pressure (DBP) was well maintained throughout the induction period in etomidate group whereas there was decline in both propofol and thiopentone group with extremely significant intergroup p value (<0.0001) after 15 min of introduction of anesthetic agent. (Table 4, Figure 3) This shows that blood pressure is better maintained with etomidate than propofol and thiopentone. These findings are similar to a previous study which reported that etomidate maintained blood pressure whereas propofol produced significant hypotension.[3] The respiratory rate and oxygen saturation were well maintained and showed no significant difference among the three groups.
In our study, the parameters noted during the recovery period were time of eye opening, Standardized Aldrete Score, Visual Analog Score and Sedation Score. The mean time of eye opening (minutes) was less for propofol as compared to etomidate and thiopentone. (Table 5) The results of our study were in consonance to a previous study in which propofol showed fastest recovery including psychomotor recovery as compared to thiopentone but were in contrast with another study which reported no difference in recovery time in propofol, thiopental and etomidate groups in women undergoing termination of pregnancy.[38,39]

The Standardized Aldrete Score at 120 min after withdrawal of anaesthetic agent which evaluates motor activity, colour, circulation, respiration, consciousness and neurological status was better with propofol than etomidate followed by thiopentone. (Table 6, Figure 4) Similar results were reported in a study which showed better recovery with propofol than thiopentone-isoflurane anaesthesia in elderly patients.[40]

In our study, Visual Analog Score showed that none of the patients experienced postoperative pain from the time of induction to 120 min after induction except in propofol group where the patients experienced slight pain at 120 min. (Table 7) These results show that postoperative analgesia was better with both etomidate and thiopentone than propofol. The Sedation Score from 0 min to 90 min improved in all the three groups with extremely significant p value (<0.0001). (Table 8, Figure 5) The score was better in propofol group followed by etomidate group and then thiopentone group. At 120 min, the score improved considerably in thiopentone and etomidate as compared to propofol group, although the final score was still better in propofol group. Similar results were reported in another study conducted by McDonald NJ, Mannion D, Lee P.[21]

The adverse effects noted in our study along with post operative nausea and vomiting were apnoea, pain on injection site and myoclonic activity. (Table 9) There was no post operative nausea and vomiting in propofol and thiopentone group whilst it was minimal in etomidate group which was clinically not significant. However, these results were in contrast to the previous two studies reporting no difference in post operative nausea vomiting in propofol group as compared to etomidate group.[22,23] Other adverse effects reported were apnoea and pain on injection site in propofol group and myoclonic activity in etomidate group. These findings were in consonance with another study reporting pain on injection with propofol and myoclonic activity with etomidate.[23] Also Morton NS, Wee M, Christie G, reported pain on injection site with propofol as compared to halothane in children.[24]

In our study, the induction and recovery after anaesthesia was smooth in all the three groups. The post operative recovery was earliest with propofol followed by etomidate and thiopentone. Propofol produces complete awakening without any residual CNS effects with a low incidence of post operative nausea and vomiting but it has a negative inotropic effect.

Comparison of blood pressure and mean heart rate showed that there was a declining trend observed in propofol and thiopentone groups, while all these parameters were unchanged in patients receiving etomidate. This shows that etomidate is a “cardiostable” intravenous inducing agent which is a desirable quality especially in patients with poor left ventricular function as it produces minimal changes in heart rate, stroke volume and cardiac output. Also in contrast to other IV anaesthetics, etomidate does not greatly decrease the renal blood flow which helps in maintaining the heart rate, systolic and diastolic blood pressure. The adverse effects seen in our study were nausea vomiting and myoclonic activity in etomidate group while apnoea and pain on injection in propofol group. Thiopentone group was devoid of any of these adverse effects. However, none of the patients in any group had very serious adverse effects requiring any therapeutic intervention.

**CONCLUSION**

Presently, the main focus of research in anaesthesia is to find an ideal anaesthetic agent which provides adequate analgesia and muscle relaxation having faster induction and recovery along with minimal adverse effects on vital organ and hemodynamic parameters.

The results of our study showed that in patients undergoing short surgical procedures propofol has better and faster recovery while cardio stability is a distinct feature of etomidate. Though all the three drugs are well established intravenous inducing agents, etomidate is desirable in patients with poor cardiac reserve and propofol can be preferred in patients for faster recovery. The limitation of our study was the small sample size hence the results need to be confirmed in larger multicentric trials.

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**REFERENCES**