Original Research Article

Indian Journal of Anesthesia and Analgesia
2018; 5(11): 1777-1783
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.51118.1

A Comparative Evaluation of Thiopentone Sodium and Propofol as Inducing Agent for Caesarean Section

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Abstract

The success of anaesthesia in obstetrics depends largely upon surgical demand and materno-foetal well being. Hence the aim of anaesthesia is to provide safety and comfort to the mother, minimal neonatal depression and optimal working condition for the obstetrician. Propofol 2.5 mg/kg was compared with thiopentone sodium 5mg/kg as induction agent for elective caesarean section. A total of 90 healthy pregnant patients of ASA I and II, who were scheduled for elective caesarean section were included in this study and were randomly allocated into 3 groups. Group I- Thiopentone sodium 2.5% (5mg/kg), group II- Propofol 0.5% (2 mg/kg) and group III- Propofol 1% (2mg/kg). Induction was smooth and rapid with both Propofol and Thiopentone with minimal incidence of side effects. Induction time was found to be shortest with Propofol 1% (40.1±6.11 seconds) as compared to Thiopentone sodium 2.5% (47.2±7.26 seconds) and Propofol 0.5% (70.5±19.58 seconds). Mean arterial pressure was lower in Propofol 1% group during the induction and intra-operatively. Other hemodynamic changes were similar in all three groups. Apnoea occurred less frequently with Propofol 1% (10%) than with Thiopentone sodium (43.33%). Pain on injection (6.66%) and awareness (10%) was found with Propofol whereas cough (3.33%), hiccup (6.66%) and nausea & vomiting (33.33%) were observed with Thiopentone sodium. Recovery time was shorter with clear headedness with Propofol. There was no significant neonatal depression as assessed by Apgar score. Propofol appears to be a better alternative to Thiopentone sodium as induction agent for caesarean section.

Keyword: General Anaesthesia; Caesarean Section; Propofol; Thiopentone Sodium; Apgar Score.

How to cite this article:

Ajai Vikram Singh. A Comparative Evaluation of Thiopentone Sodium and Propofol as Inducing Agent for Caesarean Section. Indian J Anesth Analg. 2018;5(11):1777-83.

Introduction

A woman in labour posses one of the most critical problem to the anaesthetist. The anaesthetic care of the obstetric patient differs from that of her non-pregnant counterpart because of the physiological changes in the parturient, the presence of a second individual (the foetus) who is also affected by the anaesthetic process and the fact that the majority of request for anaesthesia are unplanned and urgent.

The choice of anaesthetic technique between general and regional anaesthesia, which depends on patients preference to existing medical condition, the reason of surgery, the degree of urgency and the anaesthetist judgement and experience.

Regional anaesthesia is the most commonly employed technique as compared to general anaesthesia, as it is cost effective and has minimal incidence of aspiration in emergency caesarean sections, where parturient is considered as full

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Received on 27.06.2018, **Accepted on** 27.08.2018

stomach. Though regional anaesthesia is a time consuming procedure and does not allay anxiety and fear of this particular group of patients who are tired, anxious and exhausted and want to become unconscious as early as possible to avoid surgical stress. Moreover, there is an increased chance of hypotension which may produce serious foetal hypoxia affecting thereby the neonatal outcome.

General anaesthesia, the alternative technique for caesarean section overcomes the problems of regional anaesthesia. A good general anaesthesia is fundamental to the success and feasibility of obstetric surgery practice. An ideal induction agent for caesarean section should be rapid and smooth acting, shorter in duration, devoid of cardiovascular and respiratory side effects and should be safe for both mother and foetus, should give good operating conditions and also devoid of post operative nausea and vomiting.

After introduction in 1934 by Water and Lundy, thiopentone sodium because of its property of rapidly acting, act in one arm-brain circulation, producing peaceful sleep, gained rapid acceptance worldwide and it remains to this day the commonest used induction agent for obstetric surgery. Although, thiopentone sodium is quite safe but is not devoid of certain adverse effects like cardiovascular and respiratory depression, cough, hiccup, pain and thrombophlebitis at the site of injection, nausea, vomiting, prolonged somnolence, psychic problems, motor disturbances, acute tolerance, true cutaneous allergy, anaphylaxis, laryngospasm, bronchspasm and neonatal depression.

After thiopentone sodium, many intravenous induction agents such as propanidid,althesin, etomidate, diazepam, midazolam and ketamine were introduced but they lost their popularity because of their adverse effects.

Now presently propofol, the most recent nonbarbiturate intravenous anaesthetic agent is introduced into the clinical practice by Kay and Rolly in 1977. They confirmed the potential of propofol as an anaesthetic induction agent. Because of its rapid onset of action, short duration with rapid and clear headed emergence and lack of cumulative effect, it has become very popular. It is also known to exert antiemetic action.

Aim of Study

1. To evaluate the efficacy of propofol as an induction agent as compared to thiopentone sodium.
2. To assess maternal and foetal well being during propofol induction against thiopentone sodium for caesarean sections.

Material and Method

The present study was conducted on 90 young pregnant patients of ASA I and ASA II, scheduled for elective caesarean section under general anaesthesia, admitted in the department of Obstetrics and Gynaecology.

Criteria for including the patients in the study are:

1. Patients with no antipartum haemorrhage.
2. Patients with no cardiac disease like valvular heart disease.
3. Patients with no foetal distress.
4. Patients with no pregnancy induced hypertension or eclampsia.
5. Patients with no full stomach.
6. Patients with no associated medical problems like diabetes, liver disease etc.

Each selected patient was randomly assigned to one of the three following groups, containing 30 patients each and depending on the induction agent used.

Group I- Thiopentone sodium 2.5%, 5mg/kg

Group II- Prpofol 0.5% 2mg/kg

Group III- Propofol 1% 2mg/kg

Thorough pre-anaesthetic check up was done and detailed clinical history was obtained from all selected patients regarding

- Any past or present history of disease of respiratory system, cardiovascular system, hepatobiliary system, renal and central nervous system.
  - Any drug allergy.
  - Previous drug intake.
  - Course of present pregnancy.
  - Course of previous pregnancies and complications if any.
  - Any previous anaesthetic administration.
  - Any drug abuse, addiction or habituation.
  - Social and economic status.

All patients were assured and reassured during pre-anaesthetic check up. Proposed technique of

anaesthesia was explained in detail and a written informed consent was obtained. Patients were kept fasting for 8-12 hrs prior to surgery. Injection metoclopramide 0.2 mg/kg and injection ranitidine 1.0 mg/kg were given intramuscularly 45 minutes before induction of anaesthesia. Injection atropine 15µgm/kg was given intravenously 5 min before induction of anaesthesia in the operation theatre through a secured I.V. line using 5% dextrose solution.

Pre-oxygenation was done with 100% oxygen for 3-5 minutes. Patients were induced either by Thiopentone sodium 5 mg/kg (group I) or Propofol 2 mg/kg 0.5% solution by adding equal amount of 5% dextrose (group II) or Propofol 1% (group III) through slow intravenous injection over a period of 30 seconds. Ventilation was assisted with 100% oxygen as and when apnoea occurred. Laryngoscopy was then performed under the effect of suxamethonium 1.5 mg/kg and proper size endotrachial tube was introduced atraumatically and connected to anaesthesia machine via Bain's rebreathing circuit and IPPV was started. Anaesthesia was maintained with N_2O and O_2 in 60:40 ratio and Vecuronium bromide 0.8 mg/kg. On completion of surgery, residual neuro-muscular block was reversed by Neostigmine 45 µgm/kg and glycopyrroalate 10 µgm/kg with slow intravenous injection.

Following data were observed and recorded during induction of anaesthesia.

- Pain on injection.
- Induction time in seconds from injection to spontaneous closure or loss of eyelash reflex.
- Abnormal limb movements
- Presence or absence of apnoea
- Pulse rate
- Blood pressure- Systolic and diastolic during induction, during laryngoscopy and then at regular interval till the end of surgery.
- Arterial oxygen saturation
- Side effects if any like cough, hiccup, brochospasm and laryngospasm.
- Post operatively patients were enquired about acceptance with particular reference to induction phase and any incidence of awareness during anaesthesia.

Observations

Table 1 shows that longest time for induction of anaesthesia was found in group II (Propofol 0.5%) which was 70.5±19.58 seconds, followed by group I (Thiopentone sodium 2.5%) 47.20±7.26 seconds, whereas it was shortest in group III (Propofol 1%).

Differences between group I and II and group I and III was statistically very highly significant ($p<0.001$).

Table 2 shows that in all three groups there were very highly significant ($p<0.001$) rise in mean pulse rate till the end of surgery from pre-induction level.

Table 3 shows that there was very highly significant ($p<0.001$) fall in mean arterial pressure during induction in group I while insignificant ($p>0.05$) fall in group III.

Table 1: Time for onset of induction (seconds)

Time	Group I	Group II	Group III
Mean ± S.D.	47.20±7.26	70.5±19.58***	40.1±6.11***

*** Denotes very highly significant ($p<0.001$)

Table 2: Changes in mean pulse rate

Time interval	Group I	Group II	Group III
Pre-induction	97.40±13.72	103.8±23.04	92±17.61
During induction	122.4±15.24***	127±19.51***	107.4±17.66***
During intubation	123.0±18.67***	121.4±14.04***	112.3±10.41**
After 5 min	116.0±13.88***	118.4±12.43**	109.6±13.01***
After 15 min	112.6±15.65**	124.0±14.03***	113.0±14.17***
After 30 min	113.0±15.76**	124.0±12.44***	117.3±14.47***
After 45 min	116.2±18.85***	126.6±12.67***	115.2±14.95**
Just after extubation	128.8±15.09***	137.0±17.67***	120.0±22.93***
15 min after extubation	112.2±15.89**	118.2±21.20**	102.0±11.89***

*Denotes significant change ($p<0.05$)
**denotes highly significant change ($p<0.01$)
***denotes very highly significant change ($p<0.001$)

Table 3: Change in mean arterial pressure Mean+S.D. mmHg

Time interval	Group I	Group II	Group III
Pre-induction	93.99±5.71	93.39±5.53	94.53±5.90
During induction	90.53±5.09	93.32±5.76	92.53±4.24
During intubation	105.53±3.97***	105.39±4.99***	103.53±3.82***
After 5 min	104.46±3.55***	105.39±4.99**	96.06±4.78
After 15 min	95.66±4.79	104.26±4.60**	95.19±4.08
After 30 min	96.26±4.57	103.13±2.91**	95.39±4.92
After 45 min	98.99±3.56	103.73±3.42**	95.13±4.12
Just after extubation	103.66±3.50***	106.19±4.39***	102.52±2.88***
15 min after extubation	95.33±4.53	94.73±5.30	96.52±5.39

*denotes significant change ($p<0.05$)
**denotes highly significant change ($p<0.01$)
***denotes very highly significant change ($p<0.001$)

Table 4: Change in Apgar scores

Groups	At 1 min	At 2 min	At 3 min	At 4 min	At 5 min
Group I	6.0±1.36	7.4±1.13	8.0±1.11	9.0±0.45	9.9±0.30
Group II	5.8±0.88	7.0±0.78	7.9±0.71	8.3±1.02	9.7±0.65
Group III	6.5±1.77	7.6±1.65	8.2±0.99	9.3±0.79	9.9±0.30

Table 5: Complications

Complications	Group I	Group II	Group III
Pain on injection	02	01	02
Laryngospasm	-	-	-
Bronchospasm	-	-	-
Apnoea	13	-	03
Cough	01	-	-
Hiccup	02	-	-
Abnormal limb movements	-	01	02
Thrombophlebitis	03	-	01
Nausea and vomiting	10	-	-
Awareness intra-operatively	-	02	01

In all the three groups, very highly significant ($p<0.001$) rise in mean arterial pressure during intubation was found, and early return of mean arterial pressure in group III as compared to group I and II.

Table 4 shows that lowest Apgar score at 1 min was found in group II (Propofol 0.5%) 5.80±0.88, whereas highest was in group III (Propofol 1%) 6.5±1.77.

Difference between group I and II and group I and III was statistically insignificant ($p>0.05$).

Table 5 shows that pain on injection site was experienced by 02 patients in group I, 01 patient in group II and 02 patients in group III.

Prevalence of apnoea was seen in group I where 21 patients had cessation of breathing during induction, while it appeared only in 03 patients in group III.

Hiccup was experienced by 02 patients in group I, while not seen in group II and III.

Abnormal limb movements were experienced by 02 patients in group III and 01 in group II, while it was not seen in group I.

Nausea and vomiting and incidence of post-operative thrombophlebitis were mostly observed in patients of group I.

Awareness during surgery was found in 02 patients in group II while in 01 patient in group III.

Discussion

The introduction of Propofol into clinical practice of intravenous anaesthesia has put yet another feather in the cap of anaesthesiology. Propofol allows smooth, safe and rapid induction in one arm-

brain circulation time. Redistribution quickly clears it from the blood rich organs and unlike Thiopentone it does not accumulate in the body. This allows Propofol infusions to be used to maintain anaesthesia. Less post-operative nausea and vomiting and faster emergence are characterized by the absence of post-operative confusion and sedation. Rapid recovery from anaesthesia would be advantageous in obstetric patients because of the increased risk of aspiration which may occur in post-operative period. Seeing the foresaid advantage of Propofol, it was decided to evaluate its use for induction of anaesthesia in comparison to conventional intravenous anaesthetic Thiopentone sodium for caesarean section.

After analyzing the obtained data from this study, induction time was observed to be fastest with 1% Propofol than Thiopentone sodium and 0.5% Propofol. Mean induction time was maximum (70.5±19.58 seconds) in group II, minimum (40.1±6.11 seconds) in group III and in between (47.2±7.26 seconds) in group I. Finding of rapid induction with Propofol is in conformity with Kotur P.F. et al (2000) [1].

Thiopentone sodium and Propofol exert their action through GABA receptors. Thiopentone sodium and Propofol being highly lipophilic in nature rapidly crosses the blood-brain barrier thus accounting for rapid onset of action.

The doses used for induction was fixed according to body weight which was adequate to reach the induction criteria. Doses used by Gint et al. (1990) [2], Celleno D et al. (1989) [3] were almost similar.

In this study, there was a highly significant ($p<0.01$) increase in mean pulse rate from pre-induction values at induction, during intubation, 5 minutes, 15 minutes, 30 minutes and 45 minutes after intubation. Thus confirming the views of Valtonen M et al. (1989) [4] Tumukunde J et al. (2015) [5], Siafaka et al. (1992) [6] and Kotur P F et al. (2000) who found a similar rise in mean pulse rate in all the groups.

Since Thiopentone produces peripheral vasodilatation causing pooling of blood in the extremities and reduction in the venous return to the heart leading thereby to decrease in cardiac output. There is some degree of tachycardia (10-20%), which with lower doses contribute to maintenance of the blood pressure and cardiac output. Higher doses causes increased myocardial depression and vasodilatation but tolerable with normal cardiovascular system.

Propofol decreases arterial blood pressure during induction of anaesthesia. An induction dose of 2 to 2.5 mg/kg produces a 25-40 % reduction of systolic blood pressure. Similar changes are seen in mean and diastolic blood pressure. The decrease in arterial pressure is associated with a decrease in cardiac output/cardiac index (about 15%), stroke volume index (about 20%) and systemic vascular resistance (15-25%), left ventricular stroke work index is also decreased (30%). Heart rate does not change significantly after an induction dose of propofol because it either resets or inhibit the baroreflex, thus reducing the tachycardic response to hypotension.

It was observed in all the three groups showing rising tendency in blood pressure particularly at intubation varied significant to highly significant. In group III, there was early return of blood pressure to pre-operative level at 5 minute after intubation, in group I return of blood pressure at 15 minute after intubation, while in group II blood pressure was raised throughout the surgery. Moore J et al. (1989) [7] found that hemodynamic response to Propofol and Thiopentone were similar. Gin T et al. (1990) [8] concluded that post induction arterial pressures were similar to pre-induction values with no differences. Following intubation, the rise in systolic blood pressure was greater and was found slower in returning to baseline values in the Thiopentone group. Yau G et al. (1991) [9] found that hypertensive response after intubation was of shorter duration in the Propofol group compared with Thiopentone. Djordjevic B et al. (1998) [10] concluded that following induction of anaesthesia, a significantly greater decrease of blood pressure was found with Propofol, when compared with the patients in Thiopentone group. findings of this study corresponds with their studies.

Apgar scores were found 8 at 5 minutes in all three groups, although lowest Apgar score at 1 minute was found in group II (5.8±0.88), whereas highest was in group I (6.5±1.77), but difference between group I and II, and group I and III was statistically insignificant. Findings of this study is in conformity with Kanto J et al. (1990) [11] and with other studies [12,13,14], who concluded that on the basis of Apgar scores and blood gas analysis of the foeto-placental unit, Propofol appears to be a a safe alternative to other available induction agents. Gin T et al. (1990) [15] concluded that neonatal apgar scores, neurobehavioral testing and umbilical catecholamine, blood gas tension and oxygen content analysis were similar between Propofol and Thiopentone groups.

Pain on injection was experienced by 2 patients each in group I and III, and 1 patient in group II. Thrombophlebitis had occurred in 3 patients in group I and in 1 patient in group III. These

complications in group I was due to alkaline nature of solution and more frequent when small veins are used for induction. Abnormal limb movement was seen in 2 patients in group III and in 1 patient in group II. Apnoea had occurred maximum in group I (13 patients) whereas only in 3 patients in group III. Propofol affects the respiratory system in a manner qualitatively similar to the action of Thiopentone. Findings were found similar to the studies of Taylor M B et al. (1986) [16] and Goodman N W et al. (1987) [17]. Apnoea after an induction dose of Propofol: The incidence and duration of apnoea appear to be dose dependent and speed of injection. An induction dose of Propofol results in 25-30% incidence of apnoea. This was concluded by Taylor M B et al. (1986) [16].

Nausea and vomiting was found in 10 patients in group I, whereas none in group II and III. Absence of nausea and vomiting in Propofol group is confirmatory with the findings of other studies, in which it is concluded that Propofol possess singnificant antiemetic activity.

Awareness intra-operatively was found in 2 patients in group II and in 1 patient in group III, and was not found in group I. In conformity of Celleno D et al. (1993) [18] and Bischoff et al. (2011) [19] , who concluded that awareness during surgery at higher infusion rate has been found in lighter planes of anaesthesia with Propofol and Midazolam as compared to Thiopentone sodium. Compared to patients of group II and III, patients of group I remains sedated for prolonged period after surgery, although they were arousable. Thus it appears that Propofol is a good induction agent for obstetric patients in the sense that it preserves materno-foetal well being. It appears to have an edge over Thiopentone by producing rapid and clear headed recovery and absence of nausea and vomiting, thus minimizing the chances of post-operative aspiration pneumonitis.

Conclusion

In this study, induction time was found to be shortest, smooth, better cardiac and respiratory stability, better Apgar score, minimum side effects and complications with Propofol 1% in group III.

Thus it can be concluded that Propofol 1% is an effective, safe and reasonable alternative to Thiopentone sodium 2.5% as an inducing agent for general anaesthesia in caesarean section.

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