A COMPARATIVE STUDY OF HAEMODYNAMIC EFFECTS OF INDUCTION DOSES OF PROPOFOL THIOPENTONE AND PROPOFOL KETAMINE COMBINATIONS

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ABSTRACT

BACKGROUND

The commonly used intravenous (I.V.) Induction agents in anaesthetic practice are propofol, Thiopentone, Ketamine. But haemodynamic instability is common like use of ketamine results in tachycardia and hypertension while propofol and thiopentone results in hypotension. But ideally an induction agent should provide hypnosis, amnesia, analgesia without undesirable cardiac and respiratory depression. So here a combination of induction agents was used. This study was conducted to compare the hemodynamic effects of propofol-ketamine combination as induction agents to propofol-thiopentone Combination.

MATERIALS AND METHODS

This study was carried out at Sri Venkateswara Medical College Tirupathi. Sixty ASA 1 and 2 patients in the age group of 18-50 years, undergoing elective surgery under general anaesthesia were enrolled for this study and were randomly allotted into two groups (A and B) of 30 each. Group A was induced with propofol-thiopentone and Group B was given propofol-ketamine combination. The hemodynamic parameters- heart rate, systolic, diastolic and mean arterial pressures were monitored starting from baseline up to 10 minutes.

RESULTS

There is statistically significant difference of mean systolic blood pressure at pre intubation, fourth and seventh minute ($p<0.05$) between two groups. But there was no statistically significant difference between two groups in mean diastolic pressure. Whereas in mean arterial pressure there was statistically significant difference in two groups at pre intubation, first minute ($p<0.01$) and at seventh minute ($p<0.05$). The heart rate was high in group A when compared to group B at first, four, seven, ten minutes after intubation.

CONCLUSION

Administration of ketamine with propofol was comparatively better in maintaining the hemodynamic stability after induction as compared to Thiopentone-propofol combination.

KEYWORDS

Propofol-thiopentone, Propofol-ketamine, Haemodynamics.

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BACKGROUND

Propofol, thiopentone and ketamine are the commonly used intravenous (IV) agents in anaesthesia practice. Haemodynamic disturbances are common with these agents; while thiopentone and propofol are associated with hypotension, ketamine causes hypertension and tachycardia. Several studies have been conducted in order to find out the anaesthetic agent with least haemodynamic changes.

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Propofol has a rapid onset and recovery with fewer unwanted side effects and is ideal for short and ambulatory surgical procedures.[1] Propofol produces dose dependent sedation, hypnosis, anxiolysis and amnesia. When used as a sole induction agent, it causes significant reduction in arterial blood pressure and cardiac output.[2] Decrease in blood pressure is due to both decreased systemic vascular resistance and reduced myocardial contractility.[1] Despite a decrease in arterial pressure, heart rate remains unchanged due to depression of baroreceptor response. It produces decrease in systemic arterial blood pressure greater than with comparable doses of thiopentone.[3]

Thiopentone has been in use for a long time as an induction agent, it causes rapid and smooth induction. But unlike propofol it does not suppress the airway reflexes. It causes decrease in myocardial contractility as well as peripheral vasodilation.[4] Cardiac output is often maintained.[5] Admixture of thiopentone and propofol is compatible and stable. It has a synergistic interaction. It has been shown

that a mixture of thiopentone and propofol produces less hypotension as compared to propofol alone.[6]

Ketamine is a potent analgesic which release catecholamines, with subsequent tachycardia and hypertension and a preferred agent in patients with hypotension and shock.[5] Intravenous ketamine causes a rise in systemic and pulmonary arterial blood pressure, HR, cardiac output and myocardial oxygen requirement.[7] Administration of ketamine before induction with propofol has been shown to produce more haemodynamic stability as compared to propofol alone.[8]

The ideal IV anaesthetic drug would provide hypnosis, amnesia and analgesia without undesirable cardiac and respiratory depression. Because no single drug is ideal, many newer IV anaesthetics often used together, have been introduced that offer some or all of the desired effects.

The aim of the study was to compare the hemodynamic effects of propofol-ketamine combination as induction agent to propofol-thiopentone combination.

Aims and Objectives

1. To compare the hemodynamic effects of propofol-thiopentone combination to propofol -ketamine as an induction agent.

MATERIALS AND METHODS

Source of Data- Place of Study- S.V Medical College, Tirupati.

The study was done till the completion of 60 patients after getting approval from Institutional Ethical Committee. After getting approval for the study, written informed consent was obtained from all the patients before being included in the study.

Method- Prospective Randomized trial.

Inclusion Criteria

1. Patients aged between 18 to 50 years.
2. American society of anesthesiologists (ASA) physical status I and II.
3. Scheduled for elective surgery under general anaesthesia.

Exclusion Criteria

1. Patients refusal to give consent
2. Pregnant, lactating patients
3. Patients with Suspected difficult airway
4. Hypertensive patients
5. Patients with history of allergy to given drug.
6. Patients with neurological disease.

Method of Collection of Data

It was calculated that 60 patients would be required for study to be able to reject the null hypothesis with a power of 60% with 0.01 and 0.05 level of significance. 60 patients were divided into two equal groups- group A (propofol-thiopentone) and group B (propofol-ketamine).

Randomization was done among the enrolled patients for allocation in to groups by using computer generated random number table. Data was collected and study parameters was noted.

Patients were fasted overnight and premedicated with Tablet Ranitidine 150 mg and Alprazolam 0.5 mg tablet night before surgery. In the operating room baseline blood pressure and heart rate were recorded. Patients were premedicated with intravenous glycopyrrolate 0.2 mg, ondansetron 4 mg, Fentanyl 1 mcg/kg and midazolam 0.02 mg/kg body weight followed by preoxygenation for 3 minutes with 100 % oxygen. Induction with propofol and thiopentone in equal volumes (thiopentone 1.25% and propofol 0.5%) was done in group A. In group B, ketamine 0.5 mg/kg was given 1 min prior to induction with propofol 2 mg/kg.

Loss of response to verbal commands and absence of eye lash reflex were taken as end point for induction. Immediately after induction, Vecuronium 0.1 mg/kg was administered. Patients were ventilated with face mask with oxygen 40%, nitrous oxide 60% and sevoflurane 1% for 3 minutes, followed by endotracheal intubation. Anaesthesia was maintained with 0.5%-1% Sevoflurane and 60% nitrous oxide in oxygen. The systolic, diastolic, mean arterial pressure and HR were recorded as baseline, preinduction, prior to tracheal intubation, 1 min after intubation and every 3 minutes thereafter for up to 10 min.

The data was collected and analysed using appropriate statistical methods.

Statistical Analysis

The statistical software namely SPSS 21.0 was used for analysis of data and Microsoft Excel have been used to generate graphs and tables.

Percentage distribution of age group, gender was compared in between groups using non parametric (Pearson Chi-Square) test. Mean difference of Age, SBP, DBP, MAP, HR were compared in between groups using paired sample t-test. The significance level of 0.01 and 0.05 was set for the entire statistical test at 99% and 95% confidence interval.

RESULTS AND OBSERVATIONS

Age in Years	Group A		Group B		Chi-square
	Frequency	Percentage	Frequency	Percentage	
Below 30 years	8	26.7	6	20.0	
31 - 35 years	6	20.0	10	33.3	x^2 : 3.449 (p=0.693) df= 3
36 - 40 years	11	36.7	6	20.0	
Above 40 years	5	16.7	8	26.7	Not significant
Total	**30**	**100.0**	**30**	**100.0**	
Mean	35.1 ± 6.13		35.7 ± 7.07		

Table 1. Age Distribution of Patients in Study Group

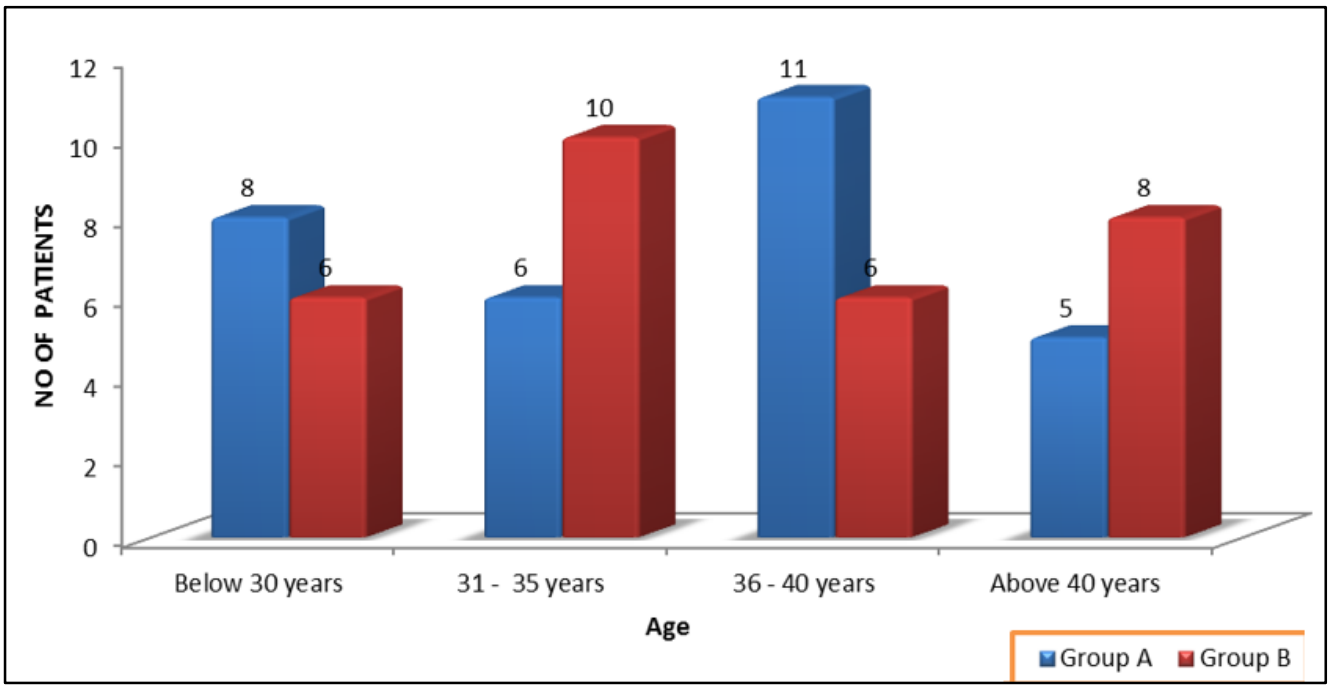

Figure 1. Age Distribution of Patients Studied

The dominant age group of the patients was 36 to 40 years (36.7%) in Group-A followed by below 30 years (26.7%) in terms of other group the dominant age group of the patients was 31-35 years (33.3%) followed by above 40 years (26.7%) whereas above 40 years (16.7%) was the smallest in group A. The mean value of ages with standard deviation is 35.61 ± 6.13 and 35.7 ± 7.07 for Group A and Group B respectively.

In chi square test we see that significance level has not achieved. This means that chi square table is showing no systematic association between the above two groups.

Sex	Group A		Group B		Total	Chi-square
	Frequency	Percentage	Frequency	Percentage		
Male	19	63.3	18	60.0	37	x^2 : 3.449 (p=0.327)
Female	11	36.7	12	40.0	23	df= 3
Total	**30**	**100.0**	**30**	**100.0**	**60**	Not Significant

Table 2. Sex Distribution of Patients Studied

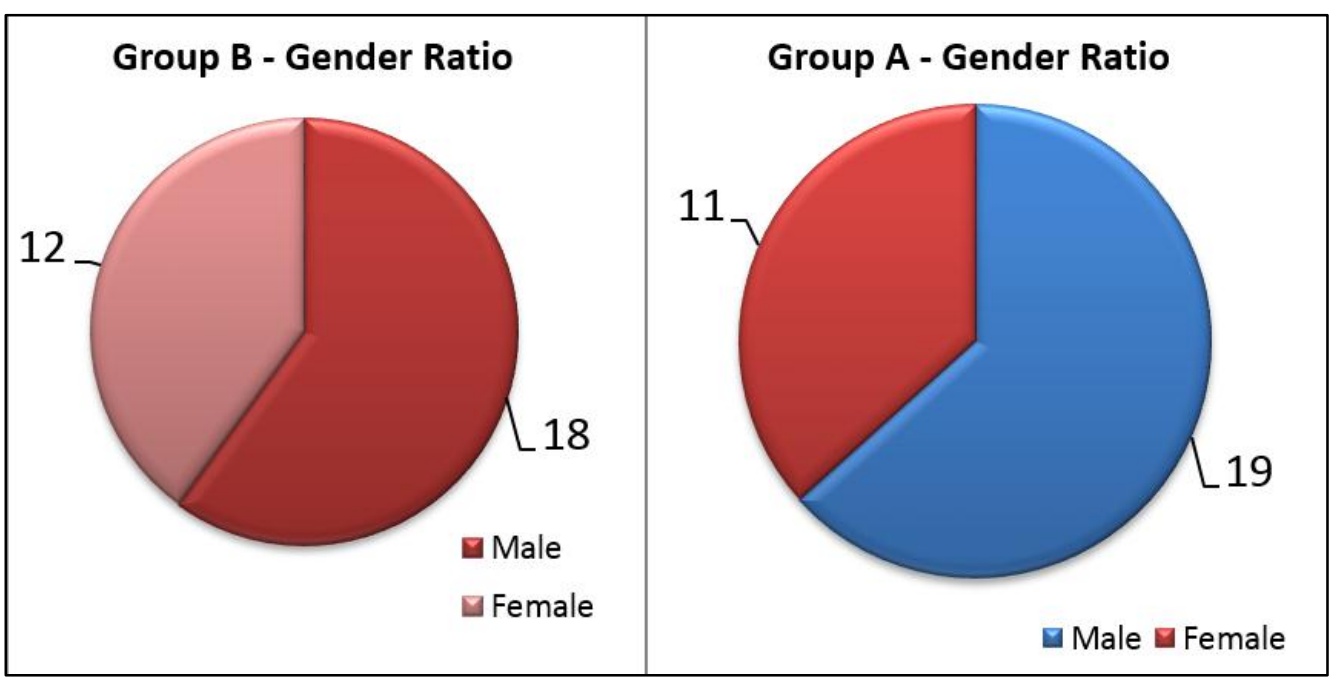

Figure 2. Sex Distribution of Patients Studied

In Group A, 63.3% of the patients were males and 36.7% were females.
In Group B, 60% of the patients were males and 40% were females.
No significant differences were observed gender wise between the two groups. (p>0.05).

	Group	Mean ± S.D.	P-Value	Significance
Age (in Years)	Group A Group B	35.13 ± 6.135 35.70 ± 7.072	t-value = 0.398 p=0.693	Not significant
Body weight (in kg)	Group A Group B	60.63 ± 9.114 60.70 ± 11.375	t-value = 0.024 p=0.981	Not significant

Table 3. Age and Weight Distribution of Patients Studied

Mean weight in group A is 60.6 with a standard deviation of ±9.114.
In group B Mean weight is 60.7 with a standard deviation of ±11.37.
No significant differences were observed in weight between the two groups (p>0.05).

Group	Systolic Blood Pressure						
	Base Line	Pre Induction	Pre Intubation	1 Min	4 Min.	7 Min.	10 Min.
A	124.07 ± 9.432	122.73 ± 7.956	100.50 ± 7.829	120.03 ± 10.387	126.20 ± 9.445	117.53 ± 8.561	115.00 ± 9.259
B	123.97 ± 9.095	123.30 ± 9.436	108.23 ± 11.802	124.50 ± 14.355	120.03 ± 10.387	121.17 ± 7.235	118.33 ± 6.682
t-value p-value	0.040 0.969@	0.244 0.809@	2.936 0.006**	1.288 0.208@	2.397 0.023*	2.101 0.044*	1.682 0.103@

Table 4. Comparison of Systolic Blood Pressure (SBP) in Two Groups of Patients Studied

Note- @- not significant;* significant at 0.05 level; ** significant at 0.01 level.

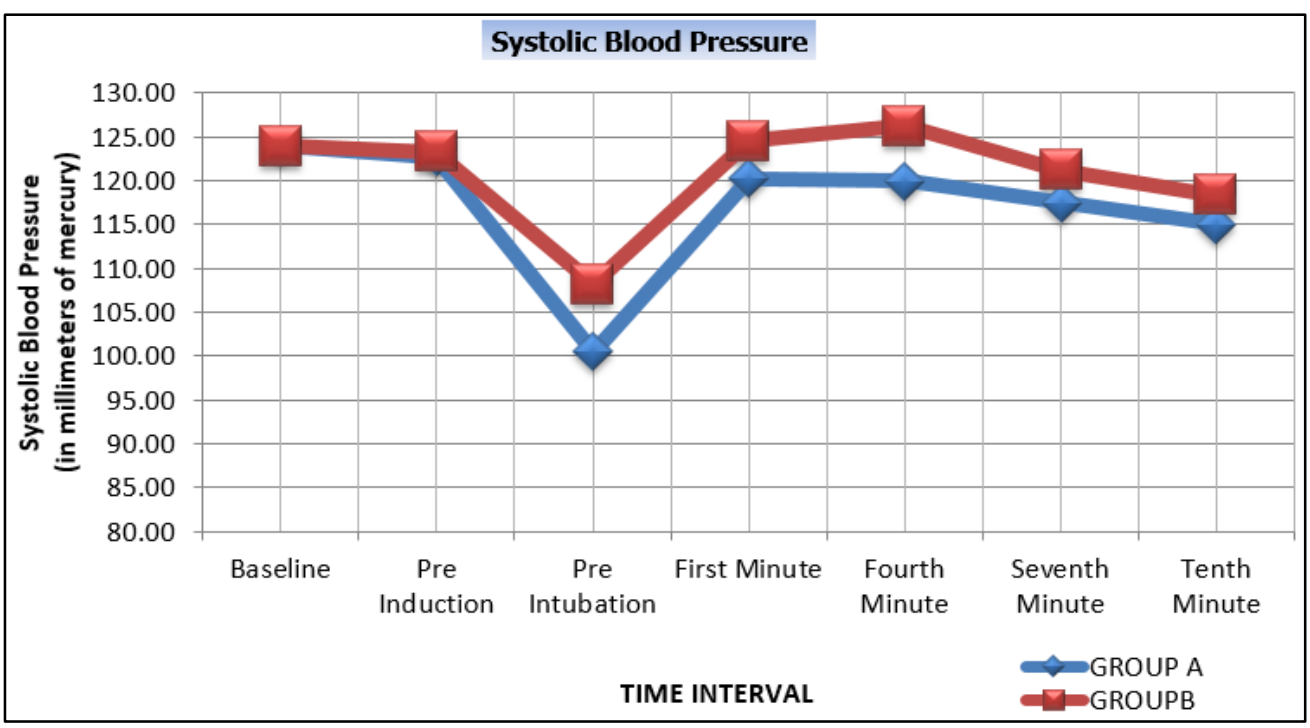

Figure 3. Comparison of Systolic Blood Pressure between Two Groups

In group A Systolic blood pressure at baseline was 124.07 ± 9.432 and had fallen pre intubation to 100.50 ± 7.829. At 1 min it increased to 120.03 ± 10.387, at 4 min and 7 min it decreased to 126.20 ± 9.445 and 117.53 ± 8.561 respectively and finally at 10 min to 115.0 ± 9.259.

In group B systolic blood pressure at baseline was 123.97 ± 9.095 and then fallen pre intubation to 108.23 ± 11.802. At 1 min it increased to 124.00 ± 14.358, at 4 min and 7 min to 120.03 ± 10.387 and 121.17 ± 7.235 respectively and finally at 10 min 118.35 ± 6.682.

There is statistically significant difference of mean systolic blood pressure at pre intubation (p<0.01), 4 min and 7 min (p<0.05) between two groups.

Group	Diastolic Blood Pressure						
	Base Line	Pre Induction	Pre Intubation	1 min	4 min	7 min	10 min
A	78.13 ± 5.438	77.90 ± 4.596	68.50 ± 10.608	80.47 ± 10.582	76.37 ± 7.690	76.60 ± 6.328	74.87 ± 7.722
B	81.6 ± 9.676	81.80 ± 8.612	72.43 ± 9.493	81.17 ± 10.498	79.10 ± 8.988	77.03 ± 8.389	76.43 ± 7.560
t-value	1.510	2.155	1.463	0.231	1.269	0.208	0.832
p-value	0.142@	0.043*	0.154@	0.819@	0.214@	0.836@	0.412@

Table 5. Comparison of Diastolic Blood Pressure between Two Groups

Note: @- not significant;* significant at 0.05 level;

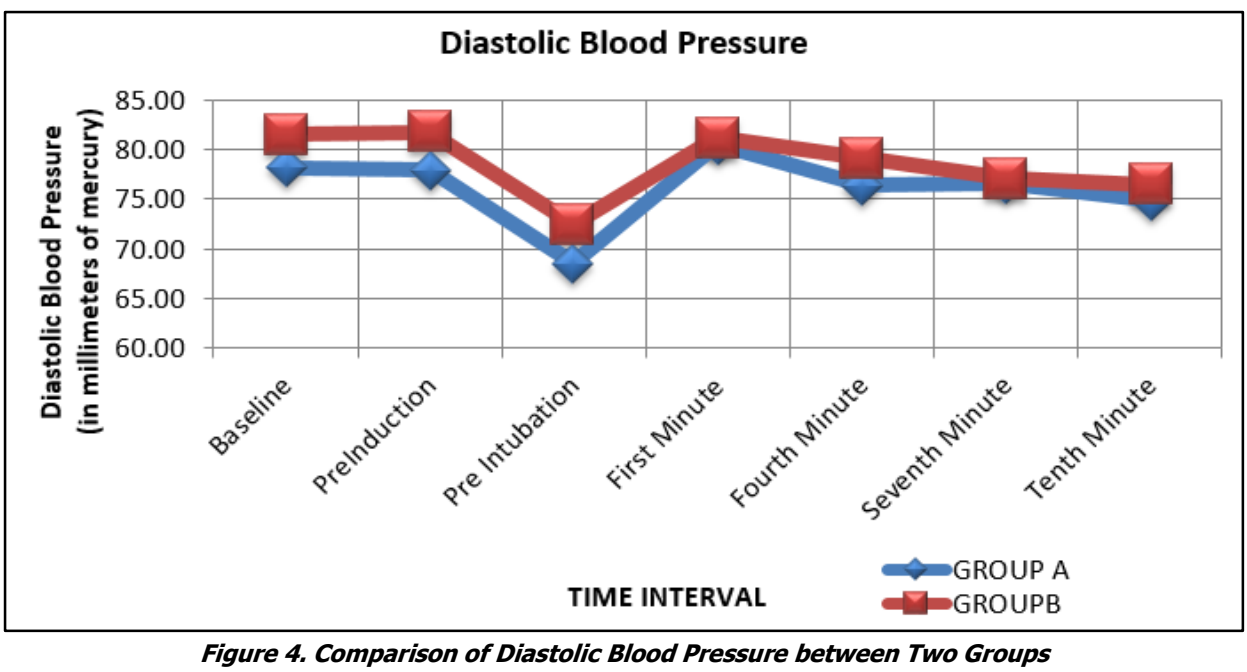

Figure 4. Comparison of Diastolic Blood Pressure between Two Groups

In group A mean diastolic blood pressure at baseline was 78.13 ± 5.438 and had fallen pre intubation to 68.50 ± 10.608. At 1 min it increased to 80.47 ± 10.582, at 4 min and 7 min it decreased to 76.37 ± 7.690 and 76.60 ± 6.328 respectively and finally at 10 min to 74.87 ± 7.722.

In group B diastolic blood pressure at baseline was 81.6 ± 9.676 and then fallen pre intubation to 72.43 ± 9.493. At 1 min it increased to 81.17 ± 10.498, at 4 min and 7 min it decreased to 79.10±8.988 and 77.03±8.389 respectively and finally at 10 min to 76.43 ± 7.560.

There was no statistically significant difference between the two groups.

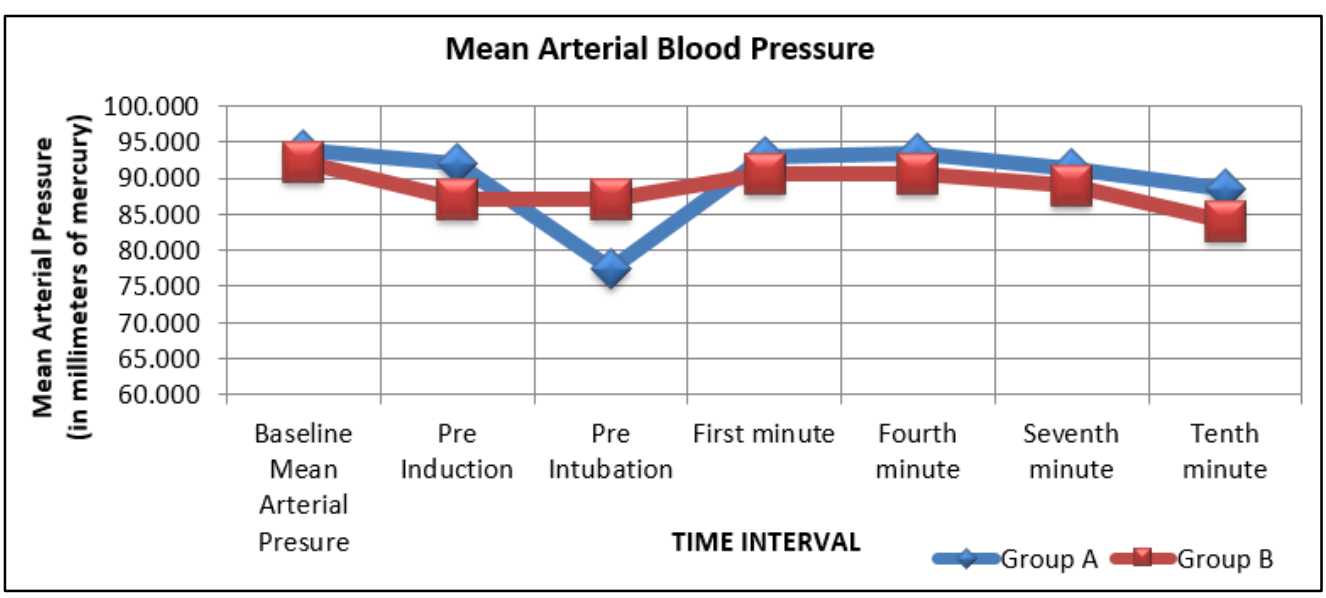

Figure 5. Comparison of Mean Arterial Pressure between Two Groups

In group A mean arterial blood pressure at baseline was 92.17 ± 8.20 and had fallen pre intubation to 77.47 ± 9.779. At 1 min it increased to 90.57 ± 10.549, at 4 min and 7 min it decreased to 90.70 ± 8.770 and 89.03 ± 7.823 respectively and finally at 10 min to 88.37 ± 6.764.

In group B mean arterial blood pressure at baseline was 93.90 ± 6.121 and then fallen pre intubation to 87.13 ± 10.728. At 1 min it increased to 103.17 ± 9.935, at 4 min and 7 min to 93.50 ± 8.597 and 94.67 ± 12.750 respectively and finally at 10 min it was 84.13 ± 9.515.

There was statistically significant difference of mean arterial pressure between the two group at pre intubation, 1 min ($p<0.01$) and at 7 min ($p<0.05$).

Group	Heart Rate						
	Base Line	Pre-Induction	Pre-Intubation	1 Min	4 Min	7 Min	10 Min
A	79.33 ± 7.836	82.27 ± 9.392	87.93 ± 10.065	91.90 ± 8.930	89.87 ± 8.930	87.33 ± 12.750	85.80 ± 8.040
B	83.10 ± 9.611	85.20 ± 12.226	93.07 ± 9.965	103.17 ± 13.239	95.90 ± 10.105	94.67 ± 9.245	91.83 ± 12.382
t-value	1.817	1.104	2.102	3.922	2.995	2.979	2.935
p-value	0.080@	0.279@	0.044*	0.000**	0.006**	0.006**	0.006**

Table 6. Comparison of Mean Heart Rate between Two Study Groups

Note: @- not significant;* significant at 0.05 level; ** significant at 0.01 level.

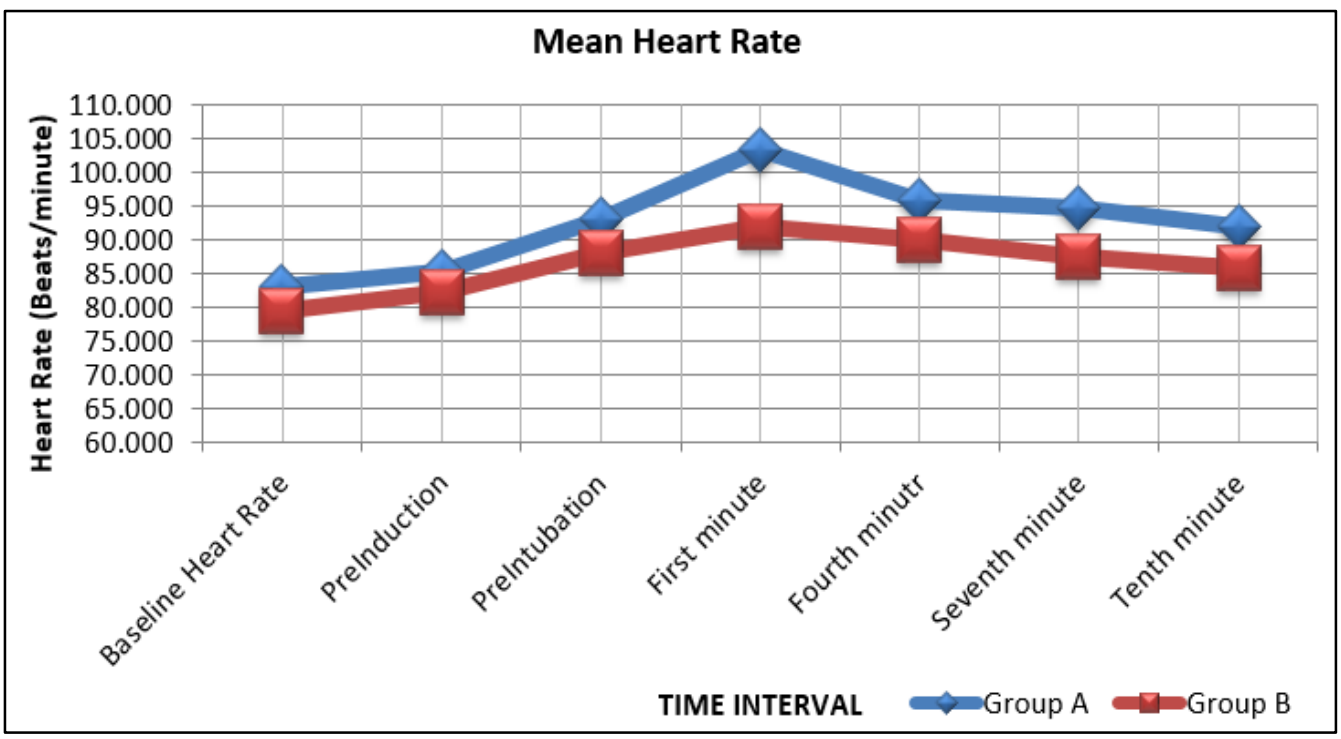

Figure 6. Comparison of Mean Heart Rate between Two Study Groups

In group A, mean baseline heart rate was 79.33 ± 7.836 and had increased pre intubation to 87.93 ± 10.065. At 1 min it further increased to 91.90 ± 8.930, at 4 min and 7 min to 89.87 ± 8.930 and 87.33 ± 12.750 respectively and finally at 10 min it was 85.80 ± 8.040

In group B mean baseline heart rate was 83.10 ± 9.611 and had increased pre intubation to 93.07 ± 9.965. At 1 min it increased to 103.17 ± 13.239, at 4 min and 7 min it decreased to 95.90 ± 10.105 and 94.67 ± 9.245 respectively and finally at 10 min it was 91.83 ± 12.382.

There was statistically significant difference between the two groups in heart rate at pre intubation ($p<0.05$) and 1, 4, 7 and 10 minutes after intubation ($p<0.01$).

DISCUSSION

The maintenance of peri intubation haemodynamics is an important consideration during induction of general anaesthesia.

The widely used induction agent during general anaesthesia is propofol. It results in a larger decrease in blood pressure after induction, by decreasing systemic vascular resistance and myocardial contractility. Vagotonic effects of propofol reduce the heart rate that may cause severe bradycardia, complex atrioventricular block and can even cause cardiac arrest.[1]

The fall in blood pressure with propofol is much greater than those seen after thiopentone administration. But the advantage of propofol is that it is more effective in preventing the increase in arterial pressure after intubation than thiopentone.

Thiopentone sodium decreases myocardial contractility and causes peripheral vasodilation.[4] But the cardiac output is maintained due to reflex tachycardia and increase in myocardial contractility from compensatory baroreceptor reflex mechanism.

Ketamine, a phencyclidine derivative as an anaesthetic agent produces sympathetic stimulation leading to increase in myocardial contractility and vascular resistance, which in turn leads to increased arterial pressure and heart rate. Increase in plasma concentrations of epinephrine and norepinephrine occur as early as 2 minutes after intravenous administration of ketamine and return to control levels 15 minutes later.[7]

Propofol has a better recovery profile and its postoperative side effects are rare but it has tendency to cause apnoea on induction, cardiovascular instability, pain on injection. During induction of general anaesthesia maintenance of hemodynamic stability is an important consideration.

Thiopentone and ketamine are time tested agents but with disadvantages like prolonged recovery, emergence delirium, postoperative nausea and vomiting etc. were there. So the combination of propofol with either thiopentone or ketamine might be a better alternative.

Propofol and Ketamine has a significantly opposing hemodynamic effects which can be detrimental in patients with high risk, if they are used as sole induction agents. So investigators have used various combinations of propofol and ketamine with an aim to offset the hemodynamic effects and minimize other adverse effects of both agents.

In the present study 60 patients were enrolled and randomized into two groups of 30 each. Group A received Propofol-thiopentone combination for induction while patients in group B were induced with ketamine and propofol. Demographic variables were comparable in both the groups. The mean age in group A was 35.13 ± 6.135 and group B was 35.7 ± 7.072 with a p value of 0.693 ($p>0.05$). There was no statistically significant difference (p value>0.05). The average weight in group A was 60.63 ± 9.114 and in group B 60.7 ± 11.375 with a p value of 0.981. There was no statistically significant difference (p value>0.05).

In the present study the hemodynamic variables (SBP, DBP, MAP and HR) in both the groups at various intervals. In group A, SBP at baseline was 124.07 ± 9.432, it decreased at preintubation to 100.50 ± 7.829. At one minute SBP increased due to hemodynamic response to laryngoscopy and tracheal intubation to 120.03 ± 10.387. There was gradual decrease in blood pressure at 4, 7 and 10 minutes. In group B, SBP at baseline was 123.97 ± 9.905 and it decreased at preintubation to 108.23 ± 11.802, which was less compared to the drop in blood pressure in group A.

At one minute SBP was 124.5 ± 14.355 and at 4 min and 7 min it was 120.03 ± 10.387 and 121.17 ± 7.235 respectively. Statistically significant difference in SBP was seen at preintubation, fourth and seventh minute. In a study done by Shabnam et al[9] they found significant difference in systolic blood pressure at one minute between group A (propofol-thiopentone) and group B (propofol-ketamine). Similarly in a study done by Vora et al[10] they found that fall in systolic blood pressure from pre induction baseline values was significantly more in the propofol group when compared to admixture group. Among admixture groups hemodynamic stability was better in propofol- ketamine group.

Diastolic blood pressure in group A at baseline was 78.13 ± 5.438, decreased at preintubation to 68.50 ± 10.608. At one minute DBP increased to 80.47 ± 10.582 followed by gradual decrease in DBP at 4, 7 and 10 minutes. In group B, DBP at baseline was 81.6 ± 9.676 and it decreased at preintubation to 72.43 ± 9.493. At one minute DBP increased to 81.17 ± 10.498. There was no statistical difference in DBP in two groups but fall in diastolic blood pressure was more in group A**.** Even in the study done by Shabnam et al[9] they found no significant change in diastolic blood pressure between two groups.

In the present study in group A MAP at baseline was 92.17 ± 8.200, decreased at preintubation to 77.47 ± 9.779. At one minute MAP increased due to hemodynamic response to laryngoscopy and intubation to 90.57 ± 10.549. There was decrease in MAP at 4,7 and 10 minutes. In group B, MAP at baseline was 93.90 ± 6.121, it decreased at preintubation to 87.13 ± 10.728. At one minute MAP was 103.17 ± 9.935. There was statistically significant difference of mean arterial pressure between the two groups at pre intubation, first minute and seventh minute.

In the present study in group A mean HR at baseline was 79.33 ± 7.836, it increased at preintubation to 87.93 ± 10.065. At one minute HR increased in response to laryngoscopy and intubation to 91.90 ± 8.930. There was gradual decrease in heart rate at 4, 7 and 10 minutes. In group B baseline HR was 83.10 ± 9.611, increased at preintubation to 93.07 ± 9.965. At one min HR increased to 103.17 ± 13.239. Increase in HR was seen in both groups but was more in group A with statistically highly significant difference at first minute ($p<0.01$) and fourth, seventh, tenth minute ($p <0.05$). This findings correlated with study done by Mayer M et al[11] studied the effect of propofol-ketamine anaesthesia on haemodynamics and they found that heart rate did not change in propofol- ketamine group.

In the present study we compared haemodynamics of two combinations of drugs, propofol-thiopentone and propofol-ketamine. According to the results latter combination preserved greater hemodynamic stability than former. This results correlate with that of Furuya et al.[8]

Admixture of thiopentone and propofol is compatible and stable due to its bactericidal properties, as it does not support the growth of micro-organisms despite the presence of nutrients in the admixture.[12] This admixture has a synergistic interaction and does not prolong recovery when used for induction of anaesthesia and may reduce the incidence of convulsion. Cherin and Smiler [13] took this admixture as an example of cost containment, while taking advantage of both the drugs, as it can be used for 24 hours if kept at operating room temperature (21- 23'IC), further decreasing wastage of drugs and thereby being more cost

effective. This admixture was used successfully for the induction of anaesthesia in adults.

In the present study low dose ketamine was used prior to induction, the discovery of N-methyl-D-aspartate receptor and its links to processing and spinal neural plasticity has renewed an interest in ketamine as a potential anti-hyperalgesic agent. High-dose ketamine is traditionally used as an intravenous (IV) anaesthetic, but in low-dose ketamine acts as an analgesic but a major barrier in use of ketamine has been the fear of hemodynamic instability and side effects resulting from its induction dosing. Use of low-dose ketamine has not been associated with significant changes in hemodynamic status.[14]

So propofol alone as an inducing agent has many disadvantages, so it was mixed with other induction agents to counter act its side effects. There are studies comparing propofol and thiopentone admixture with propofol alone and it was found that propofol-thiopentone combination is more haemodynamically stable.[15] Also there are studies comparing propofol alone with propofol-ketamine combination and it was found that propofol-ketamine combination is more haemodynamically stable. So in our study a comparison of propofol-thiopentone and propofol-ketamine combinations was done.

CONCLUSION

Administration of ketamine with propofol was comparatively better in maintaining the haemodynamic stability after induction as compared to thiopentone-propofol combination.

REFERENCES

[1] Bano F, Zafar S, Sabbar S, et al. Intravenous ketamine alternates injection pain and arterial pressure changes during the induction of anaesthesia with propofol. A comparison with lidocaine. J Coll Physician Surg Pak 2007;17:390-393.

[2] Djaini G, Ribes-Pastor MP. Propofol auto co-induction as an alternative to midazolam co induction for ambulatory surgery. Anaesthesia 1999;54(1):51-58.

[3] Stoelting RK, Hillier SC. Pharmacology and physiology in anaesthetic practice. 4th edn. Lippincott Williams and Wilkins 2006:126-139,163-167.

[4] Aitkenhead AR. Thiopentone sodium as induction agent. In: Aitkenhead AR, Rowbohian DJ, Smith G, eds. Intravenous anaesthetic agents. Edinburgh: Churchil Livingstone 2001:171-172.

[5] Katz RL, Levy A, Slepian B, et al. Haemodynamic stability and ketamine–alfentanil anaesthetic induction. Br J Anaesth 1998;81(5):702-706.

[6] Yeo KS, Kua SW, Teoh GS, et al. The use of thiopentone/propofol admixture for laryngeal mask airway insertion. Anaesth Intens Care 2001;29(1):38-42.

[7] Tweed WA, Minuck MS, Mymin D. Circulatory response to ketamine anaesthesia. Anaesthesiology 1972;37(6):613-619.

[8] Furuya A, Matsukawa T, Ozaki M, et al. Intravenous ketamine attenuates arterial pressure changes during the induction of anaesthesia with propofol. Eur J Anaesthesiol 2001;18(2):88-92.

[9] Saleem S, Ismat W, Naaman K. An interventional comparative study of hemodynamic effects of induction doses of propofol-thiopentone and propofol-ketamine combinations. Anaesth Pain & Intensive Care 2010;14(2):82-87.

[10] Vora KS, Prabodhachandran MS, Bhosale GP, et al. Comparison of admixtures of propofol-thiopentone, propofol-ketamine and propofol in ambulatory surgery. J Anaesth Clin Pharmacol 2005;21(4):413-418.

[11] Mayer M, Ochman O, Doenicke A, et al. Effect of propofol-ketamine anaesthesia in comparison with propofol fentanyl. Anaesthetist 1990;39(12):609-616.

[12] Stokes DN, Hutton P. Rate-dependent induction phenomena with propofol: implications for the relative potency of intravenous anesthetics. Anesth Analg 1991;72(5):578-583.

[13] Cherin EL, Smiler B. Propofol-thiopentone admixture: implication for cost savings and clinical use. Am J Anesthesiol 1997;24:251-253.

[14] Siddiqui KM, Khan FA. Effect of preinduction low-dose ketamine bolus on intra operative and immediate postoperative analgesia requirement in day care surgery: a randomized controlled trial. Saudi Journal of Anaesthesia 2015;9(4):422-427.

[15] Sinha R, Shende D, Garg R. Comparison of propofol (1%) with admixture (1:1) of thiopentone (1.25%) and propofol (0.5%) for laryngeal mask airway insertion in children undergoing elective eye surgery: double-masked randomized clinical trial. Indian J Anaesth 2010;54(2):104-108.