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Original Research Article

A comparative study of various types of intravenous fluids on the changes during induction of general anaesthesia

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ABSTRACT

Background: The induction and endotracheal intubation is the most risky and initial process of general anaesthesia. Without induction and endotracheal tube placement one cannot imagine the general anaesthesia. Propofol and fentanyl are the commonly used drugs for induction of general anaesthesia. These drugs produce hypotension and other cardiorespiratory disturbances. These hazardous and sometimes fatal effects can be reduced and eliminated by preloading the patients with colloid or crystalloid solutions.
Methods: We selected 90 patients who visited our hospital in the last 2 years from June 2017 to May 2019. All the investigations and pre-anaesthetic check-up was done routinely. These patients had to undergo different surgical procedures under general anaesthesia. The induction of anaesthesia was done with propofol and fentanyl. These patients were divided in three groups A, B and C. Group A patients did not receive any preloading. Group B was given colloids (3.5% gelatins) and group C received crystalloids (Ringer's lactate solution). The haemodynamic changes were noted and analysed statistically.
Results: The study showed that IV fluids given before induction of general anaesthesia blunts the adverse cardiovascular response.
Conclusions: We concluded that preload with fluids whether colloids or crystalloids are beneficial to counter the detrimental effects of propofol and fentanyl for induction of general anaesthesia. The preload fluids stabilise the patient haemodynamically. When compared the two, colloids were better to blunt the cardiovascular changes.

Keywords: Propofol, Fentanyl, Haemodynamic, General anaesthesia

INTRODUCTION

General anaesthetics are the drugs that produce reversible loss of sensation and consciousness. A wide variety of chemical agents produce general anaesthesia. In the modern practice of balanced anaesthesia these modalities are achieved by using combination of drugs each for a specific purpose. These drugs may be in the form of inhalational or intravenous agents. Propofol is the recent intravenous anaesthetic agent used in clinical practice. It is used for induction and maintaining loss of consciousness and sensation but it does not have any analgesic property. It is short acting and has no residual effects. So it is used very commonly with short acting opioids like fentanyl or alfentanil which possesses good analgesic effects. This combination is commonly used in day care surgeries where early ambulation is required. When both propofol and fentanyl are used during induction of anaesthesia they have an effect on blood pressure and heart rate. Propofol inhibit sympathetic vasoconstriction causing vasodilation so causing fall in blood pressure.[1,2] It is reported that it decreases 25-40%

systolic and diastolic pressure.[3,4] Propofol is a vasodilator and myocardial depressant but it does not change heart rate. Fentanil is a synthetic opioid. Most evidences indicate that it does not change arterial blood pressure, heart rate, cardiac output or pulmonary vascular resistance. Pulmonary wedge pressure remains unchanged with fentanyl.[5,6] But the combination of propofol with fentanyl may produce significant changes in haemodynamic parameters. Fentanil produces conduction delay due to vagal stimulation while propofol reduces blood pressure. These changes are well tolerated in healthy patients American Society of Anaesthesiologists (ASA) grade I, but not in patients with systemic diseases. It is better to control these changes before their occurrence when we use propofol and fentanyl in combination.

As we all know that subarachnoid block produce fall in blood pressure and this can be checked by preloading the patient with intravenous fluids. So haemodynamic changes induced by propofol and fentanyl can also be prevented by preloading with intravenous fluids. In the present study the patients were preloaded with either colloids or crystalloids over a period of 30 minutes before induction of anaesthesia with propofol and fentanyl. Haemodynamic changes were measured before and after induction and intubation of anaesthesia in all the groups.

METHODS

The study was conducted in the Department of Anaesthesiology, Peri-operative Medicine and Critical Care, Rama Medical College Hospital and Research Centre, Hapur, Uttar Pradesh (India) from June 2017 to May 2019. Due approval of ethics committee was obtained. Ninety patients between 20-40 years of age of both sexes belonging ASA grade-1 were included in the study. These patients were scheduled for different elective surgeries under general anaesthesia. Pre-anaesthetic check-up of all the patients was done. All the relevant investigations like hemoglobin, bleeding time, clotting time, total leukocyte count, differential leukocyte count, platelets count, blood sugar, blood group, renal function tests, liver function tests, human immunodeficiency viruses, hepatitis C virus, HbsAg, chest X-ray and electrocardiogram were performed in each case. Patient with difficult intubation, any drug or food allergy, renal, hepatic and neuromuscular disease were not included in the study.

Premedication

All patients were kept nil orally in the night before surgery. All the patients received tab alprazolam 0.25 mg and tab ranitidine 150 mg per orally in the night before and at 6.00 AM on the day of surgery with a little water.

A total number of 90 patients were selected for the study. Patients were randomly divided in three groups of 30 each. No preloading was given to group A. Group B received colloid (3.5% degraded gelatins) 8 ml/kg over 30 minutes before induction of anaesthesia at a rate of 16 ml/kg/hour and group C received 15 ml/kg crystalloid over 30 min just before induction at the rate of 30 ml/kg/hour.

Induction of anaesthesia

Base line heart rate, systolic and diastolic blood pressure were recorded at the time of fluid infusion. Patients were given 100% oxygen for three minutes. Induction was done with fentanyl 1.5 µg/kg and propofol 2.5 mg/kg over a period of 30 seconds. Endotracheal intubation was performed with vecuronium 0.1 mg/kg and maintained on oxygen, nitrous oxide and isoflurane with controlled ventilation. $EtCO_2$ monitoring was done in laparoscopic surgery and maintained within normal range (30-40 mmHg).

Any decrease in systolic blood pressure >20% of base line was defined as hypotension and heart rate <60 beats per minute was considered bradycardia.

Observed parameters

Heart rate was monitored at the beginning of fluid preload (baseline) and at the end of fluid load (at induction) and every 2 minutes up to 20 minutes after induction of anaesthesia.

Systolic, diastolic and mean arterial blood pressure was measured at base line, after preload and every 2 minutes up to 20 minutes after induction of anaesthesia.

SpO_2 and ECG monitored throughout the surgery. $EtCO_2$ monitored in laparoscopy surgery.

On completion of study observations were tabulated. Demographic and clinical data were analysed to see the effect of fluid preloading.

RESULTS

Table 1 shows demographic data of the study. The mean age of group A without preload was 32.70±6.91 yrs. The mean age of group B preload with colloids was 32.70±6.91 yrs. The mean age of group C preload with crystalloids was 32.70±6.91 yrs. Total number surgeries were 90 and these were all different operations (Table 2).

Table 3 shows mean of heart rate with standard deviation of the group before preloading, at the time of induction and then every 2 minutes for 20 minutes. In all groups, pattern shows decrease in heart rate from base line but slight increase at 8-10 min. which shows slight stress response due to laryngoscopy. Decrease in heart rate was statically significant in all groups $p<0.001$.

Table 1: Demographic data.

	Group A without preload	Group B preload with colloids	Group C preload with crystalloids
Age	32.70±6.91	32.97±6.83	31.13±6.67
Sex (M: F)	8: 22	9:21	13: 17
Body wt. (Kgs)	51.53±10.32	48.50±7.32	53.37±11.96

Table 2: Surgical procedures in the study.

Surgeries	Group A without preload	Group B with colloids	Group C with crystalloids
Laparoscopic cholecystectomy	17	18	19
Pyelolithotomy	7	7	6
Colostomy	1	-	-
Fibroadenoma breast	2	5	4
Ileostomy	1	-	-
Hysterectomy	1	-	-
Hernia	-	-	1
Exp. laparotomy	1	-	-

Table 3: Comparison of heart rate in different groups.

Time	Group A Mean±S.D.	Group B Mean±S.D.	Group C Mean±S.D.
Baseline	83.53±6.12	81.66±6.63	81.73±6.34
At induction	79.20±5.33	76.43±5.51	76.30±5.94
2 min	78.90±6.99	74.07±4.94	73.07±5.24
4 min	78.23±7.89	75.43±6.85	72.00±3.83
6 min	77.93±7.79	76.47±5.03	75.07±4.92
8 min	79.00±7.19	77.17±5.99	76.63±5.45
10 min	79.10±6.63	78.50±5.31	76.67±5.47
12 min	77.40±5.66	78.50±4.71	77.37±3.78
14 min	77.20±5.16	79.20±4.73	77.60±4.85
16 min	77.20±5.19	79.43±4.31	77.17±4.67
18 min	78.40±6.17	79.57±4.50	77.63±4.19
20 min	79.17±5.65	80.10±4.72	78.47±4.39

Table 4: Comparison of systolic blood pressure in different group.

Time	Group A Mean±S.D.	Group B Mean±S.D.	Group C Mean±S.D.
Base line	121.40±7.45	119.00±4.5	119.67±6.35
At induction	115.83±5.84	120.60±2.53	121.27±4.18
2 min	103.80±10.79	115.10±4.12	114.00±5.61
4 min	105.83±11.28	113.27±3.77	112.57±5.75
6 min	110.73±11.93	118.00±3.64	114.80±7.48
8 min	112.70±11.86	120.57±4.01	116.57±8.34
10Min	113.97±10.96	121.23±3.52	116.67±8.26
12 min	112.70±10.61	121.80±2.70	117.60±7.03
14 min	113.87±10.01	120.53±3.96	119.50±5.46
16 min	115.57±9.99	119.63±3.72	119.13±3.72
18 min	117.40±9.49	119.13±4.15	121.17±6.09
20 min	117.50±9.28	119.37±3.87	122.20±6.03

Table 4 shows mean systolic pressure with standard deviation in all three groups. In all groups systolic blood pressure decreased from base line value but slightly increased at the time of intubation which occurred at 10 min and in group B and C at the time of induction.

Table 5 shows the mean diastolic pressure and standard deviation in all three groups. In all groups the diastolic pressure decreases from the corresponding base line value except at the time of intubation which is 10 minutes and at the end it touches the base line ($p<0.001$).

Table 6 shows mean of oxygen saturation with standard deviation of all the three groups. The trend shows that there is no significant change in base line value after induction.

Table 5: Comparison of diastolic pressure in different groups.

Time	Group A (mean±S.D.)	Group B (mean±S.D.)	Group C (mean±S.D.)
Base line	77.67±6.08	77.63±3.97	77.13±5.35
At induction	76.10±4.95	78.87±2.56	79.57±3.38
2 min	68.27±7.18	74.90±2.95	74.00±4.39
4 min	70.97±8.33	73.90±2.52	72.60±3.97
6 min	73.03±8.21	76.60±3.08	75.17±3.97
8 min	73.93±8.23	79.37±3.49	77.60±4.05
10 min	75.20±7.45	80.27±3.26	77.87±3.77
12 min	74.37±6.75	80.23±3.10	78.70±4.53
14 min	74.50±7.94	80.23±2.57	79.47±4.17
16 min	75.77±7.91	79.67±2.68	79.70±3.52
18 min	76.30±6.52	79.20±2.94	79.80±3.43
20 min	76.13±6.09	79.07±2.86	80.77±3.13

DISCUSSION

The balanced general anaesthesia is the back bone of surgery in the present era. Laryngoscopy and endotracheal intubation is the integral part of balanced anaesthesia. Propofol is supposed to be a good drug for intravenous sedation. It has short duration of action. On intravenous administration it produces various haemodynamic effects generally dose dependant. It causes peripheral vasodilation and to some extent myocardial depression. It is administered with fentanyl which is a short acting synthetic narcotic. It provides good analgesia. Fentanyl in therapeutic doses not possesses any significant effect on blood pressure, heart rate or other parameters of cardiovascular system. But when used in combination with propofol the adverse effects of it are synergised. These effects are hypotension, asystole or respiratory depression. Hypotension produced in any case is dangerous particularly in compromised patients. So it is better to prevent the hypotension and other harmful cardiovascular effects. As we know hypotension induced by the subarachnoid block is prevented by preloading the vascular compartment with colloid and crystalloid fluids.[14,15] On this basis the present study was designed.

In this study 90 patients were randomly chosen and divided in three groups (A, B, C) of 30 each. Group A did not receive any fluid preload and it was considered as control group. In group B, patients received fluid preloading with 8 ml/ kg body weight of 3.5% degraded gelatins (colloids) while Group C patients received fluid preload with 16 ml/kg body weight of Ringer lactate (crystalloids). Patients were given 100% oxygen for three minutes. Induction was done with fentanyl 1.5 µg/kg and propofol 2.5 mg/kg over a period of 30 seconds. Endotracheal intubation was performed with vecuronium 0.1 mg/kg and maintained on oxygen, nitrous oxide and isoflurane with controlled ventilation. $EtCO_2$ monitoring was done in laparoscopic surgeries and maintained within normal range (30-40 mmHg).

Heart rate, SPO_2 and blood pressure were recorded just before preloading and at the time of induction of anaesthesia then every 2 minutes up to 20 minutes. The recorded data were compared to detect the efficacy of fluid preloading. The results of present study showed statistically significant reduction in heat rate, systolic and diastolic blood pressure in comparison to their base line value.

In control group A, base line heart rate was 83.53±6.12 which decreased further and it was associated with decrease in systolic pressure, diastolic and mean arterial pressure. In group B and C there was a decrease in heart rate in the same pattern as in group A. These changes were statistically significant ($p<0.001$) when compared with their base line value.

The findings of this study are comparable with other studies. Aun et al studied the effect of propofol for induction.[7] They observed a significant decrease in systolic, diastolic and mean arterial pressure. In some studies it has been quoted that propofol if given alone does not change heart rate but when given in combination with fentanyl significant change in heart rate occurred.[8,9,16] Vohra et al and Woodey et al had observed no significant changes in heart rate with propofol administration.[10, 11] Williams et al in observed no change with propofol alone but there was significant fall in heart rate when used with fentanyl.[12]

In the present study systolic, diastolic and mean arterial pressure was decreased significantly in all three groups

following administration of propfol and fentanyl. The maximum changes were at initial time of induction of anaesthesia. On group to group comparison the maximum fall in parameters was in group A (control group) less fall in group B and least fall in group C. The effect of hypotension can be reduced by preloading the patient with colloids or crystalloids.[13-15] It is better and good practice to infuse colloids like 6% hexa starch solutions (HES) prior to of laryngoscopy and endotracheal intubation under general anaesthesia to avoid the detrimental hemodynamic changes.[16]

CONCLUSION

In this study we found that propofol and fentanyl when given in combination cause fall in blood pressure. The fall was significant. The probable causes were peripheral vasodilation, myocardial depression and conduction delays in heart muscles. There was not much change in oxygen saturation. We conclude that intravascular preloading either with crystalloids or colloids just before the induction of anaesthesia with propofol and fentanyl is beneficial to control haemodynamic changes. Colloids are better than crystalloids to blunt the haemodynamic changes during endotracheal intubation under general anaesthesia.

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