

A Comparison between Diltiazem and Nitroglycerine for Hypotensive Anaesthesia in Total Hip Arthroplasty.

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ABSTRACT

Background: To compare controlled induced hypotension for facilitating surgical exposure and reducing intraoperative blood loss, using diltiazem and nitroglycerin in total hip arthroplasty under general anesthesia. **Methods:** 60 adults of American Society of Anesthesiologists (ASA) grade I and II posted for total hip arthroplasty in the department of orthopaedics were selected for prospective, randomized study and allocated randomly into three groups: Group A (control group), group B (diltiazem-controlled hypotension), and group C (nitroglycerin-controlled hypotension). Statistical analysis done using SPSS 20 software. Analysis of variance (ANOVA) test was used to compare the demographic data. Intergroup comparison between A and B, B and C, A and C of the heart rate (HR) and mean arterial pressure (MAP) were done using student t test. A P value <0.05 was considered significant. **Results:** The mean HR of group B showed a statistically significant decrement which continued 30 min after stoppage of infusion compared to group A (p=0.001) and C (p=0.001). The mean HR of group C showed a statistically significant increase upto the stoppage of infusion compared to group A (P=0.001) and group B (P=0.001). MAP of group C (59.9±4.28) is decreased to the target MAP between 15 and 45min after starting infusion whereas group B (71.2±4.65) remained above target MAP even after 45min. Group B showed a significant decrease in mean MAP (64.43±4.34) continuing upto 30 min after stoppage of infusion (p=0.001) compared to group A (105.8±3.86) and group C (106.4±4.9). **Conclusion:** Diltiazem is a poor agent for the management of controlled hypotension.

Keywords: Diltiazem, hypotension, nitroglycerine, total hip arthroplasty.

INTRODUCTION

Intraoperative bleeding has been a problem to both surgeon and anaesthetist. The anticipated benefits of moderate controlled hypotension during total hip arthroplasties are well known.^[1,2] The literature provides little information about the use of calcium channel blockers to produce hypotension despite their well known vasodilator effects.^[3,4] Cottrel et al. investigated the effect of nifedipine as an IV bolus on systemic haemodynamics and intracranial pressure in cats.^[5] It is generally agreed that a reduction in blood pressure (BP) is useful, though often essential, in these types of surgery.

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The aim of our study was to compare controlled induced hypotension for facilitating surgical exposure and reducing intraoperative blood loss, using diltiazem and nitroglycerin in total hip

arthroplasty under general anesthesia.

MATERIALS AND METHODS

The present study was a prospective, randomized study carried out in 60 adults of American Society of Anesthesiologists (ASA) grade I and II posted for total hip arthroplasty, in the department of orthopaedics, after obtaining the requisite Hospital Ethics Committee approval. ASA grade III and IV patients, patients with a significant coronary artery disease or ischemic myocardial disease, patients with chronic pulmonary disease, renal failure, hepatic dysfunction, patients with history of hypertension, and patients sensitive to diltiazem and nitroglycerin were excluded. Patients were allocated randomly into three groups: Group A (control group), group B (diltiazem-controlled hypotension), and group C (nitroglycerin-controlled hypotension). Mandatory monitoring included direct intra-arterial BP monitoring, heart rate (HR), oxygen saturation (SpO₂), electrocardiogram, and urine output, if required. Direct intra-arterial monitoring was done by cannulating the radial artery.

After shifting the patients into the operation theatre, they were connected to all non-invasive monitors for baseline parameters including HR, arterial non-invasive blood pressure and SpO₂. Invasive blood pressure monitoring was done by cannulating the radial artery, and connecting it to the transducer. Before the induction of anesthesia, all patients were pre-medicated on table with a standardized protocol using glycopyrrolate 6 µg/kg and fentanyl 1.2 µg/kg intravenously. All patients were preoxygenated with 100% oxygen for 3 min, thereafter induced with propofol 2 mg/kg body weight. Intubation was carried out with succinylcholine 2 mg/kg. All patients were mechanically ventilated with a fresh flow of oxygen and nitrous oxide. Hypotensive agents were started just after intubation. In group A, patients underwent surgery without being given any hypotensive agent, and it served as a control group. In group B, hypotension was maintained with diltiazem 0.15mg/kg bolus and infusion of 1-15 µg/kg/min, while in group C, nitroglycerin was

administered in the range of 1-10 µg/kg/min, through infusion pumps. The aim was to maintain mean arterial pressure (MAP) in the range of 50-60 mmHg, without any complications. First bolus dose of vecuronium 0.1mg/kg was given on the return of respiration followed by 0.02 mg/kg as clinically indicated (on return of respiration). The effect of hypotension was recorded comparing the change in the HR and BP at 5-min intervals. Hypotensive agent infusion was discontinued 15 min before surgeries were over. Patients were reversed with neostigmine 50 µg/kg and glycopyrrolate 10 µg/kg intravenously. Patients were then extubated and transferred to the postoperative ward for further monitoring.

RESULTS

The patients were comparable to each other in terms of the demographic profile [Table 1].

Table 1: Demographic data.

Parameters	Group A(control)		Group B(diltiazem)		Group C(NTG)		Significance P value
	Mean	SD	Mean	SD	Mean	SD	
Weight	53.45	7.2	51.55	5.8	53.65	9.380	0.574
Height	154.25	7.65	156.65	10.84	157.25	8.54	0.827
Body mass index	21.96	3.43	22.20	4.12	21.92	3.92	0.65
Age	64.5	8.8	66.8	8.2	65.4	9.1	0.419

The mean HR of group B showed a statistically significant decrement which continued 30min after stoppage of infusion compared to group A (p=0.001) and C(p=0.001) [Figure 1]. The mean HR of group C showed a statistically significant increase upto the stoppage of infusion compared to group A (P=0.001) and group B (P=0.001) [Table 2 and 3] [Figure 1]. The mean HR of group C showed no significant change 30 min after the stoppage of infusion compared to group A (P=0.34) [Table 2 and 3].

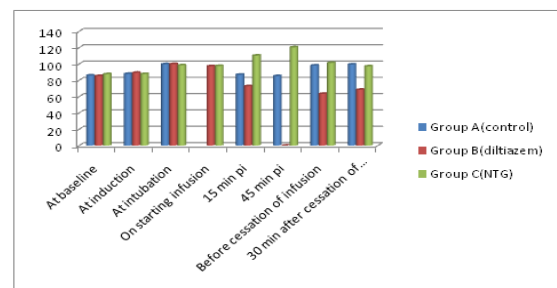


Figure 1: Mean Heart Rate.

Table 2: Mean Heart Rate.

Parameters	Group A(control)		Group B(diltiazem)		Group C(NTG)	
	Mean	SD	Mean	SD	Mean	SD
At baseline	85.9	5.45	85.25	4.4	87.6	3.5
At induction	87.9	3.2	89.3	4.1	87.80	4.6
At intubation	99.8	3.4	99.98	2.89	98.45	6.22
On starting infusion			97.34	4.27	97.65	3.89
15 min pi.	86.9	4.6	72.76	4.2	110.3	3.2
45 min pi	85.2	2.3	64.8	5.3	120.45	3.3
Before cessation of infusion	98.2	4.37	63.42	2.89	101.34	7.9
30 min after cessation of infusion	99.4	3.45	68.48	4.1	97.2	2.78

The mean arterial pressure(MAP) of group B and group C showed a statistically significant decrease during 15 min and 45 min after starting the infusion (p=0.001) and before stoppage of infusion (p=0.001) [Figure 2; Table 4 & 5]. Target MAP (50-60 mm Hg) is not achieved 15 min after starting the infusion in both group B (73.24±3.9)and group C(74.2±4.9).

MAP of group C (59.9±4.28) is decreased to the target MAP between 15 and 45min after starting infusion whereas group B (71.2±4.65) remained above target MAP even after 45min. Group B showed a significant decrease in mean MAP (64.43±4.34) continuing upto 30 min after stoppage of infusion (p=0.001) compared to group A

(105.8±3.86) and group C (106.4±4.9) [Table 4 & 5]. The mean MAP of Group C showed no statistically significant difference (p=0.543)

compared to group A 30 min after stoppage of infusion [Table 5].

Table 3: Comparison of Heart Rate between Groups.

Time interval	Group A Vs Group B P value	Group B Vs Group C P value	Group A Vs Group C P value
At baseline	0.94	0.26	0.34
At induction	0.265	0.13	0.45
At intubation	0.64	0.412	0.28
On starting infusion		0.73	
15 min pi	0.001	0.001	0.001
45 min pi	0.001	0.001	0.001
Before cessation of infusion	0.001	0.001	0.001
30 min after cessation of infusion	0.001	0.001	0.34

Table 4: Mean Arterial Pressure of all groups.

Parameters	Group A (control)		Group B (diltiazem)		Group C (NTG)	
	Mean	SD	Mean	SD	Mean	SD
At baseline	93.89	4.32	95.92	3.45	93.95	3.9
at induction	95.7	3.76	95.78	3.87	96.8	3.67
At intubation	105.6	4.78	103.78	4.24	105.2	4.14
On starting infusion			101.6	5.4	102.4	4.93
15min pi	84.8	3.6	73.24	3.9	74.2	4.9
45min pi	80.86	4.79	71.2	4.65	59.9	4.28
Before cessation of infusion	79.8	4.13	59.6	4.35	59.5	4.62
30 min after cessation of infusion	105.8	3.86	64.43	4.34	106.4	4.9

Table 5: Comparison of Mean Arterial Pressure between Groups.

Time interval	Group A Vs Group B P value	Group B Vs Group C P value	Group A Vs Group C P value
At baseline	0.132	0.139	0.972
At induction	0.798	0.621	0.487
At intubation	0.87	0.166	0.602
On starting infusion		0.54	
15 min pi	0.001	0.001	0.001
45 min pi	0.001	0.001	0.001
Before cessation of infusion	0.001	0.001	0.001
30 min after cessation of infusion	0.001	0.001	0.543

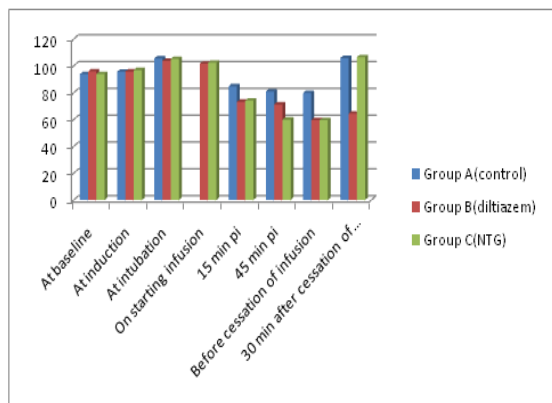


Figure 2: Comparison of Mean Arterial Pressure between Groups.

DISCUSSION

Total hip arthroplasty involves various agents administered to minimize bleeding in the surgical field. If inhaled anesthetics are used to decrease BP, larger inspired concentrations are used than required

to provide surgical anesthesia, and this can result in more bleeding because of the peripheral vasodilator effects of these anesthetics.^[6] Therefore, it is appropriate to choose additional medications for hypotensive effect. There is enough evidence through various studies that induced hypotension significantly reduces blood loss.^[7]

Nitroglycerine had been compared to various other hypotensive agents in various studies. The mean HR on using nitroglycerine as hypotensive agent is known to be much higher than other hypotensive agents.^[8] In the present study, mean HR showed a significant increase in group C (nitroglycerine) compared to group A (control) and group B (diltiazem).

In the present study, there are no reports of reflex tachycardia. Khan and Carleton have cautioned the use of nitroglycerin for induction of hypotension owing to its role in the causation of reflex tachycardia.^[9]

The negative inotropic effect of diltiazem is visible throughout the study. Diltiazem is poorly adapted to the technique of controlled hypotension, contrary to

the statement of Griffin et al who studied the dogs anaesthetized with fentanyl.^[10] The dose of Diltiazem (30 to 90 mcg/kg/min) necessary to obtain a significant drop in systemic vascular resistance (From 3249 +257 to 1138 +148 dyne. Sec. cm⁻⁵. m⁻²) were accompanied by severe arrhythmias and there is a dose related decrease in HR.^[10]

Handling and efficacy of diltiazem is not comparable to that of nitroglycerine. As in our study, target MAP is not achieved by diltiazem even after 45 min of starting the infusion. The prolonged hypotensive effect of diltiazem can be marked 30min after the stoppage of infusion. This finding is in accordance with Bourassa et al.^[11] The time to achieve target levels of hypotensive effect in nitroglycerine group is between 15 and 45 min in our study. This is in accordance with the study conducted by Mishra et al.^[12] Mishra et al showed that the time to achieve the target level of hypotension in the nitroglycerine group to be 30.00 ± 5.13 min. In our study, time to achieve target MAP cannot be determined accurately from the parameters chosen for the study, but it can be narrowed down roughly to less than 45min and more than 45min. In our study, there is no reports of rebound hypertension with nitroglycerine which is in accordance with Rodrigo^[13].

One of the shortcomings of our study is that exact time to achieve the target MAP cannot be determined. Emphases on parameters for the assessment of good surgical conditions were not included. In our study, the diltiazem was used as a bolus dose followed by infusion in contrast to nitroglycerine, which was used as an infusion. The choice of the initial dosage IV bolus of 0.15 mg.kg⁻¹ followed by a continuous infusion was as a result of the work of Valette et al.^[13] One of the shortcomings of the controlled hypotension is the time taken to achieve the desired MAP level. However, this could be offset with the fact that it reduces blood loss to a significant degree, and thus provides a better surgical field, which not only reduces the overall surgical time but also provides scope for a better surgical outcome.

CONCLUSION

Diltiazem is a poor agent for the management of controlled hypotension. Unlike nitroglycerine, its effects are prolonged even 30 min after stoppage of the agent and have a negative inotropic effect.

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