

Can the infusion of isotonic fluids or vasopressors prevent hemodynamic changes in cardiac surgery patients?

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Abstract

BACKGROUND: A common problem in cardiac surgery patients is decreased central venous pressure (CVP) and systemic blood pressure during transfer from operation room to intensive care unit (ICU). Since these reductions may lead to dangerous complications, this study aimed to evaluate the effects of vasopressors and isotonic fluids on hemodynamic status of cardiac surgery patients during their transfer to ICU.

METHODS: This randomized single-blind clinical trial was conducted in Chamran Hospital (Isfahan, Iran). A total number of 75 consecutive patients undergoing planned first-time coronary artery bypass grafting entered our study. Systolic blood pressure (SBP), diastolic blood pressure (DBP), CVP, and pulse rate (PR) were recorded at 5 to 10 minutes before leaving operating room and immediately after hospitalization in the ICU. Subjects in the first group received 7 cc/kg intravenous normal saline (as an isotonic fluid) within 5-10 minutes. The second group received 10 mg ephedrine before being transferred to the ICU.

RESULTS: The mean age of participants was 61.0 ± 3.6 years. No significant change in PR was detected in normal saline group ($P > 0.05$). No significant differences were found in two groups in SBP before and after hospitalization in the ICU ($P > 0.05$). DBP and CVP had statistically significant reductions in both groups after hospitalization in the ICU ($P < 0.001$). The mean CVP was also reduced significantly (10.7 ± 2.9 vs. 8.2 ± 3.4 ; $P < 0.001$).

CONCLUSION: Significant reductions in mean values of DBP and CVP occur during cardiac surgery and after arrival to the ICU. These reductions cannot be prevented by administration of vasopressors, such as ephedrine, or infusion of isotonic fluids, such as normal saline. Further studies are required to assess whether more fluids, other types of fluids, or other drugs can stop this phenomenon.

Keywords: Ephedrine, Cardiac Surgery, Isotonic Fluids, Intensive Care Unit

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Introduction

Patient transfer is always accompanied by stress, risk, and malpositions. It is also associated with instability, physiological changes, and reduced access of the treatment team. Nowadays, cardiac surgery is one of the most common operations worldwide. One of the frequent complications cardiac surgeons and anesthesiologists encounter is significant reductions of systemic blood pressure (BP) and central venous pressure (CVP) of patients immediately at their arrival to the intensive care unit (ICU).¹ This reduction can be very risky especially in critical patients. It may result in hypoperfusion, dangerous arrhythmia, and even heart arrest. The problem would be worse if the distance between the operating room and the ICU is

too long. Therefore, this prospective study was designed to investigate changes in systolic blood pressure (SBP), diastolic blood pressure (DBP), CVP, and pulse rate (PR) of patients during the last minutes in operating room and the first minutes at the ICU.

Materials and Methods

This randomized single-blind clinical trial was conducted in Chamran Hospital (the biggest referral cardiac centre in Isfahan Province, Iran) during August 2006 to January 2007. Totally, 75 consecutive patients undergoing planned first-time coronary artery bypass grafting entered our study. The subjects were randomly divided into two test groups. One group

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was treated by normal saline ($n = 42$) while the other was treated by ephedrine ($n = 33$). The institutional ethics committee approved this trial and a thorough, informed consent was obtained from each patient.

All patients undergoing planned first-time coronary artery bypass grafting entered our study. Patients were excluded if they had known unstable hemodynamic conditions (due to any reason), had active bleeding through chest tube, were receiving any kind of inotropic drugs, or had diabetes mellitus or cerebrovascular diseases. Moreover, individuals who were urgently operated (i.e. on the same day as angiography was performed) were excluded since it was impossible to uniformly obtain informed consents.

CVP, SBP, DBP, and PR were recorded 5-10 minutes before leaving the operating room and immediately after entering the ICU. Subjects in the first and second groups received 7 cc/kg intravenous normal saline or 10 mg ephedrine before being transferred to the ICU, respectively.

All data was collected prospectively, stored on a computer database, and analyzed using SPSS for Windows 13.0 (SPSS Inc., Chicago, IL, USA). Clinical data is shown as mean \pm standard deviation (SD). Differences between mean values of continuous variables were evaluated using paired t-test. P values less than or equal to 0.05 were considered statistically significant.

Results

The mean age of participants was 61.0 ± 3.6 years. Females and males constituted 58% and 42% of the population, respectively. Both groups were demographically homogenous. No significant change in PR was detected in normal saline group (93.9 ± 18.3 vs. 93.8 ± 17.2 beats/min; $P = 0.938$) or the Ephedrine group (100.1 ± 20.9 vs. 97.6 ± 12.9 ; $P = 0.341$).

No significant differences were found in the two

groups in SBP before and after hospitalization in the ICU ($P > 0.05$). DBP and CVP had statistically significant reductions in both groups after hospitalization in the ICU ($P < 0.001$). In addition, a significant reduction in mean DBP was observed in the normal saline group (68.5 ± 11.8 vs. 61.5 ± 12.1 mmHg; $P < 0.001$). DBP also showed a significant reduction in the ephedrine group (65.6 ± 12.7 vs. 61.4 ± 11.8 ; $P < 0.001$). The mean CVP was also reduced significantly (10.7 ± 2.9 vs. 8.2 ± 3.4 ; $P < 0.001$) (Table 1).

Discussion

Changes in hemodynamic status start immediately after a patient leaves the operating room. Controlling these changes is one of the most important issues in open heart surgery. It requires monitoring BP, PR, heart rhythm, and CVP. At the end of the surgery and while closing the patient's chest, blood pressure is reduced due to systemic inflammatory reaction of mediastinum to surgery and cardiopulmonary bypass (CPB) complications.¹

Several reasons cause blood pressure reduction after CPB. For example, having vasoplegic syndrome causes hard vasodilatation after CPB. Vasoconstriction, which is the opposite of vasodilatation, is particularly important in stopping hemorrhage and acute blood loss. Vasoconstrictors or vasopressors are substances used in vasoconstriction.² When blood vessels constrict, the flow of blood is limited or reduced. Therefore, body heat is maintained and vascular resistance is increased. The second reason might be inordinate temperature of the patient during rewarming under CPB. This process may reduce vasodilatation which in turn decreases blood circulation and BP. Earlier studies have indicated that the inflammatory response to CPB was induced by vasodilatation.³

Table 1. Pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and central venous pressure (CVP) of patients receiving normal saline ($n = 41$) and ephedrine ($n = 33$) in the operating room (OR) and intensive care unit (ICU)

Variable	Normal saline				Ephedrine			
	OR	ICU	Change	P	OR	ICU	Change	P
PR (bpm)	93.9 ± 18.3	93.8 ± 17.2	-1.1 ± 9.8	0.938	100.1 ± 20.9	97.6 ± 12.9	-2.4 ± 14.6	0.341
SBP (mmHg)	121.4 ± 19.1	116.6 ± 25.0	-4.8 ± 18.4	0.102	112.6 ± 13.4	108.4 ± 19.3	-4.2 ± 14.5	0.102
DBP (mmHg)	68.5 ± 11.8	61.5 ± 12.1	-6.9 ± 10.1	<0.001	65.6 ± 12.7	61.4 ± 11.8	-4.2 ± 14.3	0.018
CVP (mmHg)	10.7 ± 2.9	8.2 ± 3.4	-2.5 ± 2.6	<0.001	8.1 ± 3.7	6.2 ± 2.6	-1.9 ± 2.7	<0.001

ICU patients frequently experience pain due to stimulation of the autonomic nervous system and decreased homodynamic indices.⁴ Decreased oncotic pressure due to low albumin levels allows fluid and blood circulation content to leak out and thus decreases blood pressure.⁴ Reductions in heart contractions and coronary spasm are also considered as other reasons for blood pressure reduction.⁵

Although there are no definite methods to prevent reduced blood pressure, two methods, i.e. injection of 7 cc/kg normal saline or 10 mg ephedrine, are commonly used. Our comparisons showed no significant differences between the two groups, i.e. both treatments had the same effect and none was superior except in case of DBP and CVP. Critchley et al. demonstrated that fluid loading with colloid has a vital part to play when ephedrine is used to avoid hypotension throughout subarachnoid block. They suggested that ephedrine in the doses used in their study had only limited action as a peripheral vasoconstrictor.⁶ This ability was enhanced by fluid loading.⁷

Since the reason of hypotension in vessels in our study was not clear, all above-mentioned causes might have been responsible. It is noteworthy that we were not searching for CVP and BP reduction, but were comparing two methods of hypotension treatment.

Conclusion

Significant reductions in mean values of DBP and CVP occur after cardiac surgery at arrival in ICU. These reductions cannot be prevented by administration of vasopressors such as ephedrine or infusion of isotonic fluids like normal saline. Further studies are needed to assess whether more fluids, other types of fluids, or other drugs can stop this phenomenon.

Conflict of Interests

Authors have no conflict of interests.

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