原 著

Significant Increase in Blood Pressure after Discontinuation of Propofol Following Cardiac Surgery

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Abstract

The hemodynamic changes after discontinuation of propofol infusion were investigated following the cardiac surgery. Ten patients who had undergone cardiac surgery using propofol were studied. Changes in blood pressure and heart rate were observed in the hemodynamic records in the ICU retrospectively. An increase in systolic and diastolic blood pressure after discontinuation of propofol was observed in all patients. Percent increase in systolic blood pressure was 56.0±25.6% (mean±SD). Changes in heart rate were not uniform, increased or decreased. Anesthetists have to be aware of an increase in blood pressure when they stop infusion of propofol after cardiac surgery.

Key Words: Propofol, Hypertension, Cardiac surgery

Recently, propofol has been used for the induction and maintenance of anesthesia for cardiac surgeries[1]. It produces intraoperative hemodynamic stability[2], postoperative early extubation[3], and low cost[4]. Furthermore, propofol may avoid episodes of awareness and does not affect myocardial contractility[5]. Owing to those advantages, the indication of propofol for heart surgery increases in our hospital. Previous study indicated that induction and maintenance of anesthesia with propofol was associated with significant decrease in systemic arterial blood pressure[6]. However, increases in blood pressure have been noted in many cases after discontinuation of propofol. To our knowledge, there has been no report about such hemodynamic changes.

Therefore, we reported the hemodynamic changes after discontinuation of propofol infusion following the cardiac surgery.

Methods

The study was approved by the Hospital Ethics Committee. Ten patients (7 male and 3 female), aged between 47 and 79 years, who had undergone cardiac surgery using propofol were studied retrospectively. Nine of ten patients had a history of hypertension. Performed operations were 5 aorto-coronary bypass graft surgeries, 3 aortic valve replacements, 1 mitral valve replacement, and 1 closure of ventricular septal defect.

All patients were premedicated with atropine and midazolam or morphine. Anesthesia was induced and maintained using midazolam (0.2-1.0 $mg \cdot kg^{-1}$), fentanyl (20-60 $\mu g \cdot kg^{-1}$), and propofol. A continuous infusion of propofol at 2-5 $mg \cdot kg^{-1} \cdot hr^{-1}$ was initiated after induction and maintained during anesthesia (Table 1). Dopamine at 2-5 $\mu g \cdot kg^{-1} \cdot min^{-1}$ was given after cardiopulmonary bypass in all cases. The propofol infusion was discontinued in the ICU immediately after the transference. Patients did not receive any other form of sedation in the ICU. Radial arterial blood pressure was measured. Changes in blood pressure and heart rate were observed in the he-

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Table 1 Patient Characteristics and Details of Surgery and Anesthesia.

patients	age	sex	height	weight	past hystory	operation	Midazolam ($mg \cdot kg^{-1}$)	Fentanyl ($\mu g \cdot kg^{-1}$)	Propofol ($mg \cdot kg^{-1} \cdot hr^{-1}$)
1	79	M	167	60	HT	AVR	0.2	35	4
2	78	M	157	50	HT	AVR	1.0	46	2
3	70	F	135	44	HT	CABG	0.4	50	4
4	68	M	160	48	HT,DM	CABG	0.4	50	4
5	68	M	164	59	HT	CABG	0.4	60	2
6	62	M	158	55	HT	CABG	0.2	44	2
7	61	M	150	56	HT	MVR	0.2	36	2
8	56	F	159	64	HT	AVR	0.4	47	3
9	48	F	143	47		VSD closure	0.6	40	2
10	47	M	165	78	HT, CI	CABG	0.4	40	2

HT=hypertension ; DM=diabetes mellitus ; CI=cerebral infarction ; AVR=aortic vulve replacement ; CABG=coronary artery bypass grafting ; MVR=mitral vulve replacement ; VSD=ventricular septal defect

modynamic records in the ICU in a retrospective manner. Baseline blood pressure and heart rate were measured on admission to the ICU. Second measurements of blood pressure and heart rate were made 20-40 min after stopping propofol. Blood pressure and heart rate were measured every 30 min thereafter.

Change in blood pressure and heart rate were analyzed using Wilcoxon's rank sum test. A p value less than 0.05 was considered significant.

Results

Systolic ($P<0.005$) and diastolic ($P<0.01$) blood pressure increased after stopping propofol (Fig. 1). Percent increase in systolic blood pressure after discontinuation of propofol was 56.0±25.6% (mean ±SD, range; 32-122%). Dopamine was stopped and nicardipine, diltiazem, nitroglycerin, and droperidol were given to treat hypertension.

Heart rate was increased in six, unchanged in one, and decreased in three adult cases (Fig. 2).

Discussion

Propofol used for sedation after cardiac surgery was associated with a statistically greater incidence of hypotension[7]. Several studies have suggested that the decrease in blood pressure can be attributed to direct negative inotropic action[7], direct effects on venous smooth muscle tone[8], and an inhibition of sympathetic

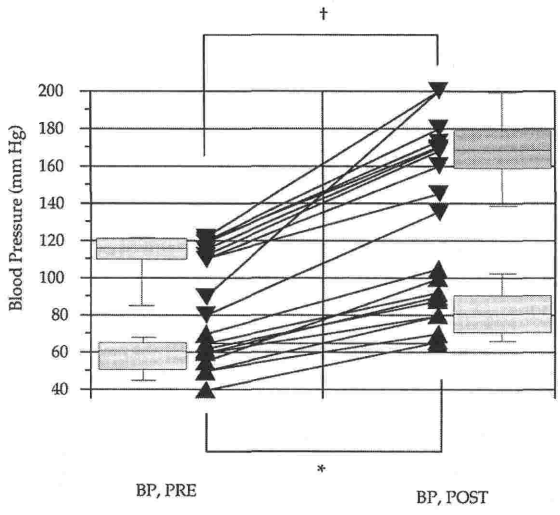

Fig. 1 Change of systolic and diastolic blood pressure measured before and after stopping propofol.

Results are presented as each individual patient as well as the box and whisker plots. The box represents the 25th and 75th percentiles, and median is represented by the solid line. The extended bars represent the 10th and 90th percentiles. Discontinuation of propofol increased both the systolic and diastolic blood pressures. BP, PRE=blood pressure on admission to the intensive care unit ; BP, POST=blood pressure at 20-40 minutes after stopping propofol. ▼=systolic blood pressure ;▲=diastolic blood pressure.
*$P<0.01$, †$P<0.005$

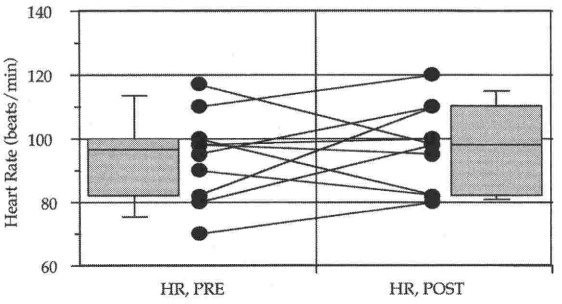

Fig. 2 Change of heart rate measured before and after stopping propofol.

Results are presented as each individual patient as well as the box and whisker plots. The box represents the 25th and 75th percentiles, and the median is represented by the solid line. The extended bars represent the 10th and 90th percentiles. Heart rate was not changed significantly after stopping propofol. HR, PRE=heart rate on admission to the intensive care unit ; HR, POST=heart rate at 20-40 minutes after stopping propofol. ●=heart rate.

vasoconstrictor nerve activity[6]. However, there were no reports for increase in blood pressure following propofol infusion. After stopping the propofol infusion, plasma concentration was reduced rapidly. Sudden elimination of negative inotropic effects and/or rapid vasoconstriction following the discontinuation of propofol might be responsible for the increase in blood pressure. However, after stopping propofol infusion, myocardial contractility did not recover in parallel with the decrease in plasma propofol concentration[9]. In addition, propofol did not affect myocardial contractility adversely[5]. More detailed study should be required to elucidate the interaction between discontinuation of propofol infusion and cardiovascular effects.

In the present study, cardiopulmonary bypass was used intraoperatively. Pharmacokinetic variables may change in the period after cardiopulmonary bypass. The elimination half-life of propofol may be reduced and the patients could recover from anesthesia rapidly. However, previous studies have shown that the elimination half-life of propofol was equivalent[10] or prolonged[11] compared with subjects who had not undergone cardiopulmonary bypass. Additionally, patients were fully sedated with midazolam and fentanyl during the increase in blood pressure because they were no response to loud auditory stimulus. Thus, rapid recovery from anesthesia due to reduction of the elimination half-life of propofol would be negligible in our study.

Propofol reduced sympathetic nerve activity, resulting in peripheral vasodilation and bradycardia[12]. Propofol has been reported to possess the presynaptic effect of inhibiting norepinephrine release from perivascular nerves[13]. Therefore, after discontinuation of propofol infusion, sympathetic nerves might be activated and norepinephrine might be released from perivascular nerves. Stimulation of the alpha and beta adrenoceptor by norepinephrine may lead to the increase in blood pressure and heart rate. However, increase in blood pressure may induce the baroreflex that results in decrease in heart rate. Accordingly, heart rate does not always increase. In our cases, increase in blood pressure and variable changes in heart rate were noted. Sympathetic nerve activation and consequent release of norepinephrine could be attributed to an increase in blood pressure. Measurement of plasma norepinephrine and epinephrine may be necessary to elucidate the mechanisms of increase in blood pressure after stopping propofol infusion.

Propofol has been reported to induce intraoperative hemodynamic stability and early extubation in cardiac surgery[2,3]. In carotid endarterectomy, patients anesthetized with propofol were more hemodynamically stable and had a decreased requirement for treatment of hypertension than patients anesthetized with isoflurane[14]. However, our study demonstrated that blood pressure increased after discontinuation of propofol following the cardiac surgery. We have to be aware of this phenomenon when we use propofol for cardiac surgery in adults.

Our study was performed in a retrospective manner. Although prospective study would be preferable to obtain the necessary data under controlled conditions, retrospective study should be necessary for medical research in which the consequences would be disadvantageous or critical for patients. Since increase in blood pressure that we experienced after cardiac

surgery can be detrimental to our patients, we decided to do the study retrospectively.

In summary, blood pressure increased after discontinuation of propofol infusion following the cardiac surgery, though the mechanism is unclear. Further studies are necessary to elucidate the mechanism of the hemodynamic changes.

References

1) Jain U : Perioperative use of propofol for cardiac surgery. J Clin Anesth 8 : 61S-66S, 1996
2) Roekaerts PM, Gerrits HJ, Timmerman BE, et al : Continuous infusions of alfentanil and propofol for coronary artery surgery. J Cardiothorac Vasc Anesth 9 : 362-367, 1995
3) Searle NR, Cote S, Taillefer J, et al : Propofol or midazolam for sedation and early extubation following cardiac surgery. Can J Anaesth 44 : 629-635, 1997
4) Sherry KM, McNamara J, Brown JS, et al : An economic evaluation of propofol/fentanyl compared with midazolam/fentanyl on recovery in the ICU following cardiac surgery. Anaesthesia 51 : 312-317, 1996
5) Bell J, Sartain J, Wilkinson GA, et al : Propofol and fentanyl anaesthesia for patients with low cardiac output state undergoing cardiac surgery: comparison with high-dose fentanyl anaesthesia. Br J Anaesth 73 : 162-166, 1994
6) Robinson BJ, Ebert TJ, O'Brien TJ, et al : Mechanisms whereby propofol mediates peripheral vasodilation in humans. Sympathoinhibition or direct vascular relaxation? Anesthesiology 86 : 64-72, 1997
7) Pagel PS, Warltier DC : Negative inotropic effects of propofol as evaluated by the regional preload recruitable stroke work relationship in instrumented dogs. Anesthesiology 78 : 100-108, 1993
8) Muzi M, Berens RA, Kampine JP, et al : Venodilation contributes to propofol-mediated hypertension in humans. Anesth Analg 74 : 877-883, 1992
9) Coetzee A, Fourie P, Coetzee J, et al : Effects of various propofol plasma concentrations on regional myocardial contractility and left ventricular afterload. Anesth Analg 69 : 473-483, 1989
10) Massey NJ, Sherry KM, Oldroyd S, et al : Pharmacokinetics of an infusion of propofol during cardiac surgery. Br J Anaesth 65 : 475-479, 1990
11) McMurray TJ, Collier PS, Carson IW, et al : Propofol sedation after open heart surgery. A clinical and pharmacokinetic study. Anaesthesia 45 : 322-326, 1990
12) Deutschman CS, Harris AP, Fleisher LA : Changes in heart rate variability under propofol anesthesia: A possible explanation for propofol-induced bradycardia. Anesth Analg 79 : 373-377, 1994
13) Biddle NL, Gelb AW, Hamilton JT : Propofol differentially attenuates the responses to exogenous and endogenous norepinephrine in the isolated rat femoral artery in vitro. Anesth Analg 80 : 793-799, 1995
14) Mutch WAC, White IWC, Donen N, et al : Haemodynamic instability and myocardial ischaemia during carotid endarterectomy: a comparison of propofol and isoflurane. Can J Anaesth 42 : 577-587, 1995

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