HAEMODYNAMIC EFFECTS OF PROPOFOL DURING CORONARY ARTERY BYPASS SURGERY

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SUMMARY

We have studied the haemodynamic effects of a bolus injection of propofol 2 mg kg\(^{-1}\) in 20 patients with good ventricular function undergoing aorto-coronary bypass surgery. Heart rate and systolic and diastolic systemic (SAP, DAP) and pulmonary arterial pressures, central venous pressure, pulmonary artery wedge pressure, cardiac output (CO), right ventricular ejection fraction, systemic (SVR) and pulmonary vascular resistances and left ventricular stroke work index (LVSWI) were measured before and at 1, 3, 5, 10, 20 and 30 min after the administration of propofol. At 1 min, maximum decreases were detected in SAP (—26%, \(P < 0.007\)), DAP (—17%, \(P < 0.001\)), SVR (—22%, \(P < 0.001\)) and LVSWI (—23%, \(P < 0.001\)). The other variables studied showed no significant variations at any time during the study. We conclude that propofol reduces systemic arterial pressure by a decrease in SVR, but not in CO or ventricular filling pressures.

KEY WORDS


The decrease in arterial pressure produced during anaesthetic induction with propofol has been attributed to decreases in systemic vascular resistance (SVR) [1] and in cardiac output (CO) [2], the latter as a result of a direct negative inotropic effect of the drug [3] or a reduction in preload because of venodilatation [4]. We have studied the haemodynamic effects of a bolus dose of propofol in patients with coronary artery disease but good ventricular function during myocardial revascularization surgery, and its effect on right ventricular ejection fraction (RVEF) and on pressure-rate quotient (PRQ).

METHODS AND RESULTS

With Ethics Committee Approval, we studied 20 patients (one female), mean age 54.5 yr (range 41–77 yr), weight 76.2 (SD 10.6) kg and body surface area 1.85 (0.17) m\(^2\), undergoing myocardial revascularization surgery. All patients had an ejection fraction > 0.5 and a left-ventricular end-diastolic pressure < 12 mm Hg. Internal mammary artery bypass was performed in all patients and haemodynamic measurements were obtained during dissection of the artery. Eleven patients had suffered previous myocardial infarction, one of them on two occasions. None of the patients had clinical evidence of unstable angina. Preoperative treatment consisted of calcium channel blocking drugs (13 patients), beta adrenoceptor blocking drugs (11 patients) and nitrates (six patients), and was continued until the morning of surgery.

The patients were premedicated with i.m. morphine 0.1 mg kg\(^{-1}\) and hyoscine 0.3 mg and oral diazepam 10 mg 1 h before surgery.

In the operating room, ECG (leads II and V\(_5\)) and arterial oxygen saturation (pulse oximetry) were displayed continuously. A radial artery and two peripheral venous cannulae were inserted. Anaesthesia was induced with etomidate 0.2 mg kg\(^{-1}\), midazolam 0.1 mg kg\(^{-1}\), fentanyl 10 μg kg\(^{-1}\) and pancuronium 0.1 mg kg\(^{-1}\). After orotracheal intubation, the patient's lungs were ventilated mechanically with an oxygen–air mixture (\(F_{\text{O}_2} 0.5\) ) to achieve an end-tidal \(P_{\text{CO}_2}\) of 4-4.7 kPa. A pulmonary artery catheter was inserted via the right internal jugular vein (REF-1, Baxter Healthcare Corporation, American Edwards Laboratories). ECG and systemic and pulmonary arterial pressures were displayed continuously and central venous pressure (CVP) and pulmonary artery wedge pressure (PAWP) intermittently, using calibrated transducers with the right atrium as the reference point.

Anaesthesia was maintained with fentanyl i.v. to a total of 40 μg kg\(^{-1}\) at the moment of propofol administration, and isoflurane supplementation of up to 1% of the inhaled gas, according to clinical criteria. The last dose of fentanyl (10 μg kg\(^{-1}\)) was given to all patients and isoflurane discontinued 10 min before the haemodynamic study. No other drug, with the exception of propofol, was administered until the end of the study. At the start of the dissection of the internal mammary artery, it was verified in each patient that the end-tidal concentration of isoflurane was 0%. Until that time, fluid balance was maintained using Ringer's lactate.
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The following variables were recorded as baseline: heart rate (HR), systolic, mean and diastolic arterial pressure (SAP, MAP and DAP), systolic and diastolic pulmonary arterial pressure (SPAP and DPAP), CVP, PAWP, CO and RVEF by thermodilution (REF-1, Ejection Fraction/Cardiac Output Computer). Propofol 2 mg kg\(^{-1}\) was then injected over 1 min, and the same variables were assessed at 1, 3, 5, 10, 20 and 30 min. SVR, pulmonary vascular resistance (PVR) and left ventricular stroke work index (LVSWI) were derived using standard formulae.

During the study, the presence of myocardial ischaemia was assumed if there was ST-depression of 0.1 mV in V\(_5\) or 0.2 mV in lead II, or both, and increased PAWP or the appearance of prominent v-waves. In addition, PRQ (MAP x HR\(^{-1}\)) [5] was calculated.

For statistical analysis, each measurement was compared with baseline using the Wilcoxon test for paired data, applying Bonferroni’s correction for multiple comparisons. \(P < 0.05\) was considered statistically significant.

The administration of propofol 2 mg kg\(^{-1}\) produced a maximum decrease in SAP, MAP and DAP after the first 1 min (\(-26\%\), \(-19\%\) and \(-17\%\), respectively) \((P < 0.001)\), which remained statistically significant throughout the entire study. The maximum decreases in SVR and LVSWI were recorded at 1 min (\(-21\%\) and \(-23\%\)) \((P < 0.001)\) and remained significant until 10 min and 3 min, respectively. The rest of the variables studied underwent no significant changes in our study, with the exception of the DPAP at 20 min \((P < 0.05)\) (table I).

There was no evidence of myocardial ischaemia in any of the patients during the study. PRQ was reduced from the first 1 min (\(-22\%\)) \((P < 0.001)\) and remained significantly decreased until 10 min (table I).

**COMMENT**

I.v. administration of propofol 2 mg kg\(^{-1}\) to patients with good ventricular function during the dissection of the internal mammary artery in aortocoronary bypass surgery produced a significant decrease in systemic arterial pressure that persisted throughout the 30-min duration of the study. This decrease was the result of a reduction in SVR rather than changes in CO or ventricular filling pressures.

This study was performed in patients subjected to minimal surgical stimulus, who were already under the effects of other anaesthetic drugs. Although we cannot exclude the possibility that these agents may have modified the haemodynamic changes associated with propofol, the basal values and all those recorded until the end of the study were obtained under the same conditions, and the changes observed must be attributed to the new drug and may apply to other clinical situations. In contrast, administration of the drug to anaesthetized patients with moderate hypocapnia eliminates the influence of the surgical stimulus, tracheal intubation, loss of consciousness
or hypercapnia and respiratory acidosis observed in other studies [1]. Haemodynamic stability in our patients was assured, as sternotomy had been performed at least 15 min before the study, and the only response to isoflurane withdrawal and fentanyl administration was a slight decrease in HR which returned to baseline within a few minutes.

Our study confirms the lack of significant changes in HR after administration of propofol [1, 2]. It has been shown that propofol produces a resetting of the baroreflex mechanisms that enables a reduced HR to be sustained despite decreased arterial pressure [6]. It has also been shown that the addition of fentanyl significantly potentiates the effects of propofol on arterial pressure and HR [2]. Despite the fact that we used large doses of this opioid (40 |g kg\(^{-1}\)), we did not observe these effects.

We have shown that there was a significant decrease in SVR lasting 10 min after propofol injection. Others have reported reductions in SVR of nearly 50 % with respect to basal values 5 min after administration of the drug in patients with artificial hearts and constant CO [4], suggesting a direct action of propofol on resistance vessels. The same work also demonstrated that propofol significantly reduces the preload of the right ventricle, suggesting a venodilator effect [4]. However, in our study, previous administration of crystalloids and colloids explains the stability of CVP and PAWP.

A decrease in SVR while PAWP remains constant, with no increase in CO, is commonly accepted as a sign of myocardial depression. The decrease in LVSWI observed partially counteracts the negative inotropic effect of propofol which is suggested in our report. Others had shown that the cardiodepressant effect of propofol may be prolonged and recovery may not parallel the anticipated decrease in plasma concentrations of propofol [3]. This could explain the fact that in our patients, who were subjected to a minimal stimulus, the haemodynamic effects of a single dose of propofol persisted for some time beyond the mean distribution life of the drug (1.8-4.7 min). It is interesting that the SAP, MAP and DAP remained significantly reduced after 30 min and it would be valuable to know the time required for it to return to baseline, but the design of our study did not permit us to assess this aspect.

We found no signs of myocardial ischaemia at any time during the study in spite of the fact that PRQ decreased significantly from 1 min to 10 min and approached the critical value of 1, which represents the cut-off point for an increased risk of ischaemia. In this respect, the absence of tachycardia to compensate for arterial hypotension produced by propofol prevents an increase in the demand for myocardial oxygen at a time in which the oxygen supply may be reduced.

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REFERENCES


