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Hemodynamic Responses to Preoperative Vascular Cannulation in Patients with Coronary Artery Disease

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Controversy surrounds the practice of placing intravascular cannulae in patients with coronary artery disease (CAD) prior to induction of anesthesia. Recently, Lunn *et al.* observed significant cardiovascular stimulation from percutaneous insertion of radial and pulmonary arterial catheters, leading to the recommendation that these cannulae be inserted after the induction of anesthesia.[1] The inconvenience involved in inserting pulmonary artery catheters and the resultant delay of induction of anesthesia is another argument advanced in opposition to their use.[2] Substantial cardiovascular stimulation or excessive delays rarely have resulted from placement of intravascular catheters in unanesthetized patients in our institution. Therefore, we undertook a further prospective evaluation of this practice.

METHODS

The investigational protocol was approved by the Human Investigations Committee of Emory University. Twenty patients scheduled for elective coronary revascularization were evaluated in this study. Their mean age and weight was 55 ± 2 years and 79 ± 4 kg (mean ± SD), respectively. Ten patients had good left ventricular (LV) function, defined as a left ventricular ejection fraction ≥ 0.5 and a left ventricular end-diastolic pressure < 15 mmHg. The other ten patients had poor left ventricular function, defined as a left ventricular ejection fraction < 0.5 and/or a left ventricular end-diastolic pressure ≥ 18 mmHg. All patients received propranolol (118 ± 10 mg/day) until 12 hours before operation, and all were receiving nitrate preparations until the time of operation. The five patients receiving α-methyldopa continued this medication throughout the day before operation. The five patients with congestive heart failure (CHF) received their last dose of digoxin 24 hours prior to operation.

Patients were premedicated with 5–10 mg diazepam, po, 0.1 mg/kg morphine and 0.3 or 0.4 mg scopolamine, im, and topical nitroglycerin ointment 1-2" one hour before vascular cannulation began. Each patient was monitored initially by a blood pressure cuff and a lead V_5 electrocardiogram with a digital heart rate recorder. Control observations of heart rate, systolic arterial pressure, electrocardiogram, and the adequacy of premedication were recorded by an observer not participating in the cannulation process.

After appropriate skin preparation and infiltration with 1 per cent lidocaine, two large-bore intravenous catheters and a 20-gauge radial arterial catheter were inserted in sequence. The digital heart rate display was under continuous observation, and the maximum values observed were recorded for each catheter insertion sequence. Systolic blood pressure was measured before and one and two minutes after insertion of each intravenous catheter and the radial artery catheter. Thereafter, a continuous digital systolic blood pressure display was observed, and maximum values recorded.

Percutaneous pulmonary artery catheterization followed. The right side of the neck was scrubbed, locally anesthetized, and draped with sterile towels in routine fashion. The bed was tilted 15° head-down, and the internal jugular vein identified with a 22-gauge needle. A 2-inch 18-gauge catheter was threaded into the vein, a spring-tipped guide wire passed through the catheter, and a dilator/introducer sheath unit (Universal Medical Instruments) passed over the guide wire. A 7-F thermodilution Swan-Ganz catheter (American Edwards Laboratories) was threaded through the introducer sheath and advanced through the right heart in standard fashion until a wedge tracing was obtained. Elapsed time and the other study variables were observed during and for two minutes after each of the following events during PA catheter insertion: Skin preparation, draping, vein identification, 18-gauge catheter insertion, introducer placement, catheter tip positioned in the wedge position, and two minutes after the wedge position was reached.

Verbal contact with patients was maintained throughout the cannulation sequence. Patients were questioned about their comfort, and were forewarned of skin infil-

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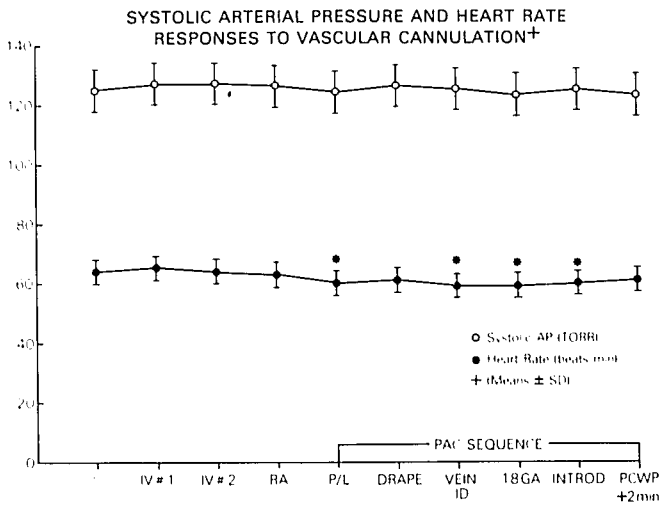

FIG. 1. The mean maximum systolic arterial pressure and heart rate values observed during the insertion of intravenous (IV #1 and IV #2), radial arterial (RA), and pulmonary arterial (PAC) catheters are shown. The six intervals during the PAC insertion sequence are: skin preparation and local anesthetic infiltration (P/L), sterile drape placement (DRAPE), internal jugular vein identification with 22-gauge needle (VEIN ID), 18-gauge needle–catheter unit placement (18-gauge), dilator/introducer sheath unit insertion (INTROD.), and two minutes after the PAC reached the wedge position (PCWP + 2 min). Asterisks (*) denote statistically significant differences ($P < 0.05$, 2-way analysis of variance) from baseline mean values.

tration and needle puncture. Those who appeared anxious or complained of anxiety or discomfort received intravenous supplements of morphine and diazepam after the first intravenous catheter was inserted. Vascular cannulation was carried out by experienced members of the anesthesia care team, including the authors, three anesthesiologist's assistants and two cardiac anesthesia fellows.

A two-way analysis of variance was used for statistical analysis, with multiple comparisons of each baseline mean to each subsequent mean. A P value of <0.05 was considered significant.

RESULTS

Seventeen patients were judged adequately premedicated when they arrived in the operating room. Three patients appeared awake and anxious, and were judged to be premedicated inadequately. These three, plus two other patients who complained of anxiety (one patient) or discomfort (one patient) during venous catheter insertion, received iv supplements of morphine (4.4 ± 0.5 mg) and diazepam (4.5 ± 0.8 mg).

No statistically significant change from the average systolic arterial pressure of 126 mmHg during the control period occurred at any time during the study (fig. 1). A slight but statistically significant decline in heart rate from the mean control value of 64 beats/min was seen at four of the nine recording intervals.

The maximum systolic arterial pressure observed during the study occurred during pulmonary artery catheter placement in nine patients, during the control period in four patients, and during other cannulations in the remaining patients. Maximum heart rate occurred in five patients during the control period, in five during pulmonary artery catheter insertion, and in the other ten during peripheral venous or arterial catheterizations.

No patient experienced chest pain or electrocardiographic changes of myocardial ischemia at any time during the study. The highest heart rate and systolic arterial pressure recorded in any individual patient was no more than 25 per cent greater than that patient's corresponding control value. Seven patients (35 per cent) had transient atrial or ventricular dysrhythmias when the catheter tip passed through the heart. No patient required antiarrhythmic drug treatment. The complete process of pulmonary artery catheter insertion, from beginning of skin preparation until the catheter tip reached the wedge position, took 7.7 ± 2.1 min, with a range of 4.5 to 12.8 min.

DISCUSSION

The insertion of vascular cannulae prior to anesthesia induction in patients with CAD has been controversial. The importance of preventing large increases in myocardial oxygen demand in patients with CAD is well-known.[3] If the placement of intravascular cannulae in unanesthetized patients invariably produced substantial hemodynamic changes, such a practice would be ill-advised.

A report previously published by Lunn *et al.* documents increases in heart rate and systolic arterial pressure associated with the placement of monitoring catheters in patients with CAD before induction of anesthesia.[1] The patients in that series who received propranolol preoperatively exhibited significant increases in heart rate and systolic arterial pressure during pulmonary artery catheterization, even though none of them experienced chest pain or electrocardiographic evidence of ischemia. Those not maintained on propranolol experienced proportionally greater increases in heart rate and systolic arterial pressure, and 50 per cent experienced angina requiring treatment with nitroglycerin during pulmonary artery catheter insertion. Conversely, we found that it is possible to place intravascular cannulae in unanesthetized patients with severe CAD without producing cardiovascular stimulation. Differences in patients' preoperative sedative and cardiovascular medications, in patient population, and in the skill of the involved personnel are possible explanations for our findings being different from those in the previous study.

Standard preoperative medication produced adequate sedation in 75 per cent of our patients, and intravenous supplements adequately sedated the remaining 25 per cent. Therapy with beta blockers and nitrates was maintained in full dosage until shortly before surgery, and nitroglycerin ointment was administered topically as part of premedication. Although the use of nitroglycerin ointment in this setting has not been studied specifically, it may have helped to prevent chest pain and hypertension during vascular cannulation.[4,5]

All patients in this study received propranolol until 12 hours before surgery. The mean dose of 118 ± 10 mg/day probably would not have been sufficient to obliterate cardiovascular stimulation induced by substantial sympathetic nervous system responses. However, residual propranolol may have lowered initial heart rates and blood pressures and attenuated cardiovascular responses to stimulation.[5-8] We now take greater advantage of this effect by administering an additional dose of propranolol with the preoperative sedative medications.

All personnel placing the cannulae in this study were thoroughly trained and experienced in vascular cannulation techniques. However, we have also found that similar results can be obtained when carefully supervised but relatively inexperienced anesthesiology residents insert such cannulae.[9] Therefore, we believe that results such as these should be obtainable in most centers doing cardiac surgery.

A discussion of indications for and contraindications to the use of radial and pulmonary arterial catheters is beyond the scope of this paper. Once the decision to use such monitors has been made, their availability during induction of anesthesia and endotracheal intubation is desirable. We found that such cannulae can be inserted prior to anesthetic induction without causing cardiovascular stimulation or consuming an excessive amount of time. We believe that the accomplishment of these goals requires adequate rapport with patients; judicious use of anti-anginal and sedative medications; and adequate supervision, training, experience, and skill of personnel. With these precautions, we believe that it is both safe and prudent to insert monitoring cannulae before induction of anesthesia.

References

1. Lunn JK, Stanley TH, Webster LR, et al: Arterial blood-pressure and pulse-rate responses to pulmonary and radial arterial catheterization prior to cardiac and major vascular operations. ANESTHESIOLOGY 51:265–269, 1979
2. Pace NL: A critique of flow-directed pulmonary artery catheterization. ANESTHESIOLOGY 47:455–465, 1977
3. Waller JL, Kaplan JA, Jones EL: Anesthesia for coronary revascularization, Cardiac Anesthesia. Edited by Kaplan JA. New York, Grune and Stratton, 1979, pp 241–281
4. Miner JA, Conti CR: Topical nitroglycerin for ischemic heart disease. JAMA 239:2166–2167, 1978
5. Hug CC, Kaplan JA: Pharmacology-cardiac drugs, Cardiac Anesthesia. Edited by Kaplan JA. New York, Grune and Stratton, 1979, pp 39–71
6. Nies AS, Shand DG: Clinical pharmacology of propranolol. Circulation 52:6–15, 1975
7. Nattel S, Rangno RE, VanLoon G: Mechanism of propranolol withdrawal phenomena. Circulation 59:1158–1164, 1979
8. Kaplan JA, Dunbar RW: Propranolol and surgical anesthesia. Anesth Analg (Cleve) 55:1–5, 1976
9. Waller JL, Zaidan JR, Kaplan JA, et al: Hemodynamic effects of vascular cannulation by residents. ANESTHESIOLOGY 53: S114, 1980