CASE REPORT

Cardiogenic shock in right ventricular infarction managed with a combined thermodilution and pacing pulmonary artery flotation catheter

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SUMMARY

When cardiogenic shock complicates right ventricular infarction it is widely appreciated that rational therapy can only be achieved by use of plasma volume expansion and inotropic agents guided by invasive monitoring (Cohn *et al.*, 1974). In these cases, there is a high incidence of symptomatic heart block and serious atrial and ventricular dysrhythmias (Cohn, 1979). Thus, venous access may be required for monitoring, pacing, infusion of fluid, and vasoactive or antiarrhythmic drugs. A case of right ventricular infarction complicated by cardiogenic shock, heart block, multiple arrhythmias and severe hypoxaemic respiratory failure is described. Technical problems in venous access were encountered and overcome by the use of a single multi-purpose catheter for haemodynamic monitoring, infusion of drugs and fluids and passage of a pacing wire. We believe that this is the first description of the use of such a catheter in the United Kingdom, although the use of a multi-purpose pulmonary artery flotation catheter with fixed pacing electrodes has been described before (Zaidan & Freniere, 1983).

CASE REPORT

The patient was a 74-year-old female managed on the Coronary Care and Intensive Care Units of the University Hospital of South Manchester, England. She was admitted with typical cardiac chest pain of 2.5 h duration. The previous medical history was of one admission for left ventricular failure, and atrial fibrillation for which she received digoxin 0.125 mg daily. On examination on admission, the apex rate was 95/min, blood pressure was 100/60 mmHg, the jugular venous pressure was elevated to

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7 cm from the sternal angle and moved paradoxically with respiration. There was prominent right ventricular third heart sound but no clinical or radiological evidence of left ventricular failure. The 12-lead electrocardiograph showed the typical appearance of acute transmural inferior myocardial infarction and subsequently the peak level of creatinine phosphokinase was 2480 international units.

Six hours after admission she developed ventricular fibrillation which responded to cardioversion. A lignocaine infusion was commenced at 4 mg/min after two bolus injections of 100 mg and 50 mg respectively. Two hours later, the rhythm changed to third degree heart block with a ventricular rate of 38/min and a systolic blood pressure of 70 mmHG. A temporary transvenous pacing electrode was inserted via the right subclavian vein using an infraclavicular approach. A good position in the right ventricle was obtained and the threshold was 0.3 V. At a rate of 80/min the blood pressure was 80/60 mmHg. The patient was cold, comatose and anuric. Arterial pO₂ on approximately 60% oxygen was 11 kPa. A pulmonary artery flotation catheter was inserted via the right internal jugular vein using a high approach. The measured and calculated haemodynamic variables at this (point A) and subsequent stages of her treatment are recorded in Table 1. These, taken with a paradoxical rise in right atrial pressure with respiration, a steep 'y' descent on the right atrial pressure tracing and an early diastolic dip in the right ventricular trace confirmed the diagnosis of right ventricular infarction (Lorell *et al.*, 1979). Plasma volume expansion with 600 ml of modified fluid gelatin improved but did not reverse the hypotension (point B). An infusion of dobutamine at 8 µg/kg/min produced a satisfactory haemodynamic picture (point C), with an increase in cardiac index from 1.5 to 2.4 l/min.

Twenty-four hours later, a typical right ventricular tachycardia developed. This did not respond to 200 mg of lignocaine or to four attempts at cardioversion. An image intensifier revealed that the pacing catheter was free in the cavity of the right ventricle. It was removed and immediately the rhythm changed to third degree heart block alternating with ventricular standstill and paroxysmal ventricular fibrillation. The trachea was intubated and manual mechanical ventilation with 100% oxygen commenced. Attempts were made to reinsert a pacing electrode. The right subclavian and internal jugular veins were cannulated several times, from a variety of routes by a highly experienced operator (J.D.E.), but a guide wire could not be advanced to the superior

Table 1 Haemodynamic progress of patient*

Point	HR	MAP	RAP	PAOP	CI	SVRI	SVI	LVSWI
A	80	68	18	4	1.1	3636	14	12
B	80	72	20	16	1.5	2773	19	14
C	80	80	20	18	2.4	2066	30	24
D	100	63	20	22	1.4	2457	14	8
E	100	75	20	16	2.6	1815	26	19

*HR: heart rate/min; MAP: mean arterial blood pressure (mmHg); RAP: right atrial pressure (mmHg); PAOP: pulmonary artery occlusion pressure (mmHg); CI: cardiac index (l/m²); SVRI: systemic vascular resistance index (dys cm⁻⁵); SVI: stroke volume index (ml/m²); LVSWI: left ventricular stroke work index (g-m/m²).

vena cava and a large haematoma developed. The rhythm changed to a sustained right ventricular tachycardia.

Amiodarone 300 mg was infused and the rhythm changed to third degree heart block alternating with ventricular standstill. The pulmonary artery flotation catheter was removed from its introducer sheath in the right internal jugular vein and a pacing electrode was introduced. Capture was achieved with a poor position in the right ventricle and an unstable threshold of 3 V. At a heart rate of 100/min, the blood pressure was 75/60 mmHg.

A Swan Ganz Thermodilution Paceport Catheter (Model 9 A-931H-7.5F, Edwards Laboratories) was introduced via the left subclavian vein. By means of the displayed transduced waveform the correct position of the Paceport lumen in the right ventricle was confirmed and the Chandler transluminal ventricular pacing probe (model 98-100H, Edwards Laboratories) was inserted. Immediate capture of the right ventricle was achieved with a threshold of 0.6 V. At a rate of 100/min, the blood pressure was 80/55 mmHg (point D). After restabilization with dobutamine 22 µg/kg/min the haemodynamics improved (point E). After 72 h controlled mechanical ventilation on the Intensive Care Unit the patient made a good recovery, and was subsequently discharged from hospital with no neurological deficit and no symptoms of cardiac failure.

The Paceport catheter provides the ability to measure pulmonary artery, pulmonary artery occlusion, right ventricular and right atrial pressures, as well as cardiac output by the thermodilution method.

A lumen that terminates 19 cm from the top is provided for insertion of a Chandler transluminal pacing probe into the right ventricle whilst the catheter tip is in the pulmonary artery, allowing endocardial pacing. The Chandler probe is a 2.4 French gauge, bipolar, coaxial wire construction of a stainless steel round wire and a teflon-coated coiled flat wire. The Paceport catheter, and the distal 20 cm of the Chandler probe are heparin coated. The Paceport catheter represents development of the earlier 'Pacing TD Catheter' described by Zaidan & Freniere (1983), for, whilst the earlier catheter had pacing electrodes embedded in the surface of the catheter and capture was, therefore, dependent upon wall contact by a catheter loop, the Paceport system allows the pacing probe tip to be in direct endocardial contact, as with the standard transvenous pacing method. Insertion of the system through a Percutaneous Catheter Insertion Kit (American Pharmasel, No. PA3800) allows manipulation of the catheter within a sterile sheath, and infusion of drugs into the chosen great vein via a side-arm attachment.

DISCUSSION

Many aspects of the management of shock associated with right ventricular infarction are highlighted by this case: shock without a critically elevated pulmonary artery occlusion pressure (Cohn *et al.*, 1974), partial response to controlled plasma volume expansion (Cohn, 1979), life threatening ventricular dysrhythmias unresponsive to anti-arrhythmic drugs, heart block with poor haemodynamic response to pacing (Lorell

et al., 1979) and hypoxaemia requiring high concentrations of oxygen and mechanical ventilation (Edwards *et al.*, 1986).

At a critical moment during the resuscitation of this patient, the multi-purpose pulmonary artery pacing catheter was crucial to the successful outcome. The unique properties of such catheters justify their relative expense in the clinical situation with which we were faced and further studies to evaluate the role of these catheters in complicated cases of right ventricular infarction are needed.

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