hemoglobin, or an increase of 22.2 mg/100 ml over the seven-day plasma hemoglobin baseline of 22.3 mg/100 ml. Since hemolysis of less than 75 mg/100 ml is not considered to be of clinical significance in causing morbidity or mortality, none of the samples in our tests showed a significant degree of hemolysis.

References

Persistent Atrial Arrhythmias Associated with Placement of a Swan–Ganz Catheter

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Since the introduction of the Swan-Ganz flow-directed balloon-tipped catheter,1 bedside monitoring of pulmonary-artery (PA) and pulmonary-capillary-wedge (PCW) pressures has been employed with increasing frequency and safety. Accurate assessment of left-heart filling pressures in patients with myocardial infarction2 and valvular heart disease with decompensation and fluid replacement in a variety of noncardiac conditions, such as extensive trauma and septicaemia, can be carried out. The pulmonary capillary wedge pressure measurement can also be of particular value during the induction of anesthesia and intraoperative management of these patients, as well as those who are less seriously ill, but undergoing extensive surgery with major blood losses or fluid shifts.

Complications have included knotting of the catheter3 and perforation of the pulmonary artery.4 Arrhythmias have been encountered, but those reported have been only premature ventricular contractions (PVC’s) and, occasionally, runs of multiple PVC’s, but not sustained ventricular tachycardia5 or ventricular fibrillation.6 The following are case reports of arrhythmias in two patients, atrial fibrillation and atrial flutter with varying block, the only atrial arrhythmias which have been encountered in the placement of 180 Swan-Ganz catheters.

Report of Two Cases

Patient 1. A 60-year-old man with degenerative arthritis of the right hip was scheduled for total hip replacement under general anesthesia with induced hypotension. Preoperative evaluation disclosed no abnormality and the ECG showed sinus rhythm. Anesthetic premedication was meperidine, 50 mg, promethazine, 25 mg, and scopolamine, 0.3 mg.

Arterial and central venous cannulae were inserted, and while these pressures and the electrocardiogram were continuously monitored, a Swan-Ganz catheter was passed into the right internal jugular vein. Atrial fibrillation occurred when the catheter entered the right atrium (fig. 1A). The ventricular rate was 110/min and blood pressure was 150/80 torr. Anesthesia was then induced, but because the atrial fibrillation continued, the catheter was withdrawn. Forty minutes later, normal sinus rhythm spontaneously returned (fig. 1B). Controlled hypotension was induced with pentolinium, and the operative and postoperative courses were uneventful.

Patient 2. A 42-year-old woman with moderately
severe aortic and mitral regurgitation secondary to rheumatic heart disease was scheduled for a double valve replacement. Roentgenogram of the chest showed left atrial and left ventricular enlargement, prominent pulmonary vasculature, and mild congestive heart failure. Cardiac rhythm was regular, of sinus origin; there was no prior history of atrial fibrillation. The patient had been maintained on digoxin, 0.25 mg/day. At cardiac catheterization, pulmonary-artery pressure was 58/30 torr and mean pulmonary-capillary-wedge pressure 20 torr. Anesthetic premedication was morphine, 4 mg, and scopolamine, 0.4 mg. Prior to the induction of anesthesia, with continuous intra-arterial pressure and electrocardiographic monitoring, a Swan-Ganz catheter was passed via a 12-gauge Argyle cannula into the right internal jugular vein. During transit of the catheter through the right atrium and ventricle into the pulmonary artery, cardiac rhythm abruptly changed from normal sinus to atrial flutter with varying block (fig. 2). The patient tolerated this rhythm well and induction of anesthesia was uneventful.

The Swan-Ganz catheter was then removed, but sinus rhythm did not return until after cardiopulmonary bypass.

**DISCUSSION**

The Cooperative Study on Cardiac Catheterization revealed an incidence of arrhythmias of 1.2 per cent. Nearly half of these were ventricular tachycardia or fibrillation, and a fourth were supraventricular in origin. This low incidence was attributed to a tendency to report only those arrhythmias with serious hemodynamic alterations necessitating definitive therapy. Of the 29 supraventricular arrhythmias seen in patients other than infants, 20 were precipitated by manipulation of a catheter in the right atrium or ventricle.6

The low incidence of ventricular arrhythmias associated with placement of Swan-Ganz catheters is attributed to lessened irritation of the right ventricular endocardium afforded by the smooth, soft surface produced when the balloon is inflated and becomes flush with the catheter tip. This minimizes increases in local sympathetic efferent activity or fiber stretch which may enhance automaticity at an ectopic focus.7 Presumably, protection against supraventricular arrhythmias is provided in a similar way. The atrial architecture, however, provides a relative abundance of intercellular contacts, which allow greater opportunity for disorganized patterns of impulse transmission and may explain the persistence of disorganized rhythms such as flutter or fibrillation in atrial tissue.8 It may be that in our two cases the balloon was not fully inflated, although the described technique was used.1
The importance of atrial contraction is its contribution to ventricular filling. Thus, the end-diastolic ventricular pressure, one determinant of cardiac output, can be increased without concomitant increases in mean left atrial pressure or pulmonary venous pressure. Although the normal heart is able to compensate for the loss of atrial contraction and increase cardiac output in response to moderate stress, the diseased heart may not. Individuals with marked impairment of cardiac function, precisely those often having Swan-Ganz catheters inserted, will be unable to maintain even their resting cardiac outputs with the onset of atrial flutter, atrial fibrillation, nodal rhythm, or supraventricular tachycardia.

The need for careful balloon inflation and the importance of continuous electrocardiographic as well as Swan-Ganz catheter and arterial pressure monitoring throughout placement of the catheter should be emphasized.

REFERENCES