Ventricular Entrapment of a Swan-Ganz Catheter: A Technique for Nonsurgical Removal

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Entrapment of a balloon-tipped flow-directed catheter by atrial sutures during open heart surgery is a rare but serious complication. Several methods have been used to free such catheters with nonsurgical techniques. A case of entrapment in the right ventricle after repair of a ventricular septal defect is presented and a method for percutaneous removal described.

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Right heart catheterization with a balloon-tipped flow-directed catheter has been performed in humans since 1970. Although it is a procedure that yields valuable information with little morbidity or mortality, complications may occur, including hematoma, carotid artery puncture, thrombosis, Horner's syndrome, arrhythmias, conduction disturbances, pulmonary artery embolism or rupture, sepsis, pneumothorax and knotting of the catheter (1,2). Resistance to withdrawal of the catheter may be due to this latter complication and should be verified by chest roentgenograms. Several case reports (3-12) have described nonsurgical techniques for untying knots. Another cause for resistance may be entrapment by sutures placed during open heart surgery as illustrated by the following case.

Case Report

A 73 year old woman was referred to Mount Sinai Medical Center for right heart catheterization and open heart surgery because of the sudden onset of pulmonary edema 5 weeks after an anteroseptal myocardial infarction. At the referring hospital, a new murmur was heard on auscultation and an echocardiogram revealed a ventricular septal defect. Pertinent findings on physical examination included the absence of cyanosis or clubbing, the presence of rales at the right base on auscultation of the chest, an elevated jugular venous pressure to the angle of the jaw, a systolic thrill at the left sternal border, a soft first heart sound and loud pulmonary component of the second heart sound, and a grade 4/6 holosystolic murmur over the apex and left sternal border.

Neurologic examination disclosed evidence of a prior left cerebrovascular event. The electrocardiogram (ECG) showed normal sinus rhythm, evidence of an old inferior and recent anteroseptal infarction as well as nonspecific repolarization abnormalities. On chest X-ray examination, the cardiomegaly silhouette was enlarged and there was pulmonary congestion.

Cardiac catheterization. Right heart catheterization revealed moderate pulmonary hypertension and a pulmonary capillary wedge pressure of 20 mm Hg with a V wave of 25 mm Hg. The cardiac output (determined by Fick technique) was 3.8 liters/min. An oxygen saturation stepup ≤21% was noted at the level of the right ventricle; pulmonary blood flow was 14 liters/min, whereas systemic flow was 3.8 liters/min for a shunt ratio of 3.7:1. Coronary angiography demonstrated total occlusion of the proximal left anterior descending, left circumflex and first obtuse marginal arteries as well as moderate diffuse disease of the right coronary artery. Left ventriculography revealed akinesia of the apical, apical-septal and diaphragmatic segments with an ejection fraction of 0.43. A large ventricular septal defect was noted in the apical septum.

Surgical procedure. The patient underwent surgical correction of the ventricular septal defect 6 weeks after infarction. A Swan-Ganz catheter was easily passed preoperatively into the wedge position through the right internal jugular vein. A defect measuring 2 cm in its widest diameter was seen anteriorly in the mid-septum and repaired with a Teflon patch sutured to the inferior rim of the defect. Aortocoronary saphenous vein bypass grafting was then

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A

B

Figure 1. A. A kink in the Swan-Ganz catheter with resultant acute angulation is shown (arrow) in the area of the ventricular septal defect repair in the right ventricle. B. After the sheath is positioned through the encircling suture, the acute angulation is relieved and traction on the Swan-Ganz catheter now allows it to slide easily between the suture and ventricular septum. With the catheter in the sheath, both were removed simultaneously with the guide wire trailing behind.

Nonsurgical removal. The following day the patient was taken to the catheterization laboratory in an attempt to remove the catheter without reoperation. First, a guide wire was inserted into the Swan-Ganz catheter to a point beyond the acute angulation in an attempt to relieve the acute angle and make the catheter more rigid; however, resistance to traction was still encountered. The protruding Swan-Ganz catheter was then cut and disinfected with Betadine to allow passage of an 8F USCI Mullins transseptal sheath over the catheter to a point just through the acute angulation in the right ventricle (Fig. 1B). With the sheath maintained at this point, traction on the Swan-Ganz catheter resulted in an initial downward force, with the catheter sliding easily between the encircling suture and septum into the sheath. The curve in the sheath did have to be cut 3 to 4 cm back from the tip to obtain an "ideal angle" in the right ventricle for this internal jugular approach. The catheter and sheath were then removed. The procedure was uncomplicated and no new murmur was auscultated. A subsequent echocardiogram revealed the septal defect repair to be intact. The patient continued to do well and was discharged home 2 weeks after the initial surgery.

Discussion

Percutaneous removal from right atrium. Entrapment of a Swan-Ganz catheter by a suture is rare; the first known case was described in 1976 (13). In attempting to remove the catheter by applying cephalad traction through a 9F Teflon sheath, the catheter broke at the suture, requiring removal of the retained distal segment with a Caves-Shulz biotome inserted percutaneously from the femoral vein. In a subsequent letter in 1985 (14), two further cases were reported of successful extraction of entrapped catheters by use of this percutaneous method. In all three cases the catheter was entrapped in the right atrium. Nonsurgical relief of catheter entrapment in the right atrium has also been obtained by manipulating the distal end of the catheter with a stone-retriever basket, grasping it with a loop-snare catheter and then pulling from both proximal and distal ends until it slid free (12). In an additional reported case of right atrial entrapment (15), a 15 scalpel blade attached to a 14F dilator was used to resect the Swan-Ganz catheter, thereby allowing its removal.

Surgical removal from right atrium. Catheter entrapment and perforation by suture in the right atrial wall have also been reported (16); however, because the catheter no longer functioned, this problem was noted while the chest was open and correction was made intraoperatively. Two cases of sutures piercing the Swan-Ganz catheter in the right atrium, which required reoperation, were reported by Vucius et al. (17). These authors question whether percutaneous removal of suture-entrapped catheters should be attempted in view of the possibility of rupture of the atrial wall.
Percutaneous removal from right ventricle. To our knowledge, the present case report represents the ninth reported case of suture entrapment of a Swan-Ganz catheter and the first to describe successful relief of catheter entrapment in the right ventricle. A transseptal sheath was used for two reasons. First, its length allowed easy passage over the Swan-Ganz catheter into the right ventricle and in this case the sheath could actually be passed through the point of entrapment. Second, and perhaps most important, the rigidity of the sheath translated cephalad traction on the catheter in the internal jugular vein into a downward pull at the tip of the sheath, thus allowing the catheter to slide through the encircling suture. Our alternative plan would have been to use a snare or bioptome inserted through a femoral vein to exert the necessary downward traction on the catheter.

Conclusions. In the case of suture entrapment, percutaneous nonsurgical removal may be possible if the suture is sufficiently loose and has not perforated the catheter. The method described here is rapid and safe if these conditions apply and excessive force is not used. Thus, percutaneous removal can be attempted in such cases, and the need for reoperation can be obviated.

References