descending and right coronary arteries were 80–90% occluded. Prior to the induction of general anesthesia, a 7-French Gould heparin bonded balloon-tipped catheter was inserted percutaneously into the right internal jugular vein and easily floated into the pulmonary artery. The initial cardiac output was 8.1 $l \cdot min^{-1}$, pulmonary artery pressure was 22/7 mmHg, and pulmonary capillary wedge pressure was 5 mmHg. Anesthesia was maintained with 5,000 μg fentanyl, 20 mg diazepam, 10 mg pancuronium, 20 mg metocurine, while ventilation was controlled with 100% oxygen and intermittent enflurane up to 1%. Surgery was uneventful. Upon arrival in the cardiovascular intensive care unit, the pulmonary artery tracing was noted to be in the permanent wedge configuration. The catheter was pulled back and a chest roentgenogram revealed it to be properly positioned in the right pulmonary artery. The lung fields were clear.

Six hours after surgery a routine determination of cardiac output was attempted; 10 ml normal saline at room temperature (22° C) was injected through the proximal port of the pulmonary artery catheter. Ventricular fibrillation immediately ensued. Three attempts at electrical cardioversion (400 joules) were unsuccessful. The chest was then opened, whereupon the heart assumed a regular sinus rhythm. The chest cavity contained only a few milliliters of blood, and there was no evidence of cardiac tamponade. The coronary artery grafts were noted to be unkinked and in good condition. The sternal incision was closed in the operating room, where the pulmonary artery catheter was removed and found to be free of defects. The patient suffered no further episodes of ectopy during his remaining hospital stay.

One could surmise the accidental injection of epinephrine or other inappropriate substance rather than saline for the cardiac output measurement. However, these medications never are kept at bedside. The fluid for injection was drawn from a 150-ml bag of normal saline that was kept at the bedside for that particular purpose. The close temporal relationship and the absence of any arrhythmia once the pulmonary artery catheter was withdrawn strongly suggests that the ectopy was caused by a mechanical event: the saline solution being expelled with jet-like force from the proximal port, pushing the catheter against the septal wall.

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A Complication of Multipurpose Pacing Pulmonary Artery Catheterization via the External Jugular Vein Approach

To the Editor:—We observed a patient in whom a multipurpose pacing pulmonary arterial catheter (PAC) was indicated and whose removal was prevented by the partial shearing of a surface metal electrode on the PAC surface.

A 63-year-old woman was scheduled for three-vessel coronary bypass, left carotid endarterectomy, and repair of an abdominal aortic aneurysm. Numerous ECG strips documented a P-R interval of 0.20–0.22 s, with bradycardias to 40 bpm known to be induced by her cardiac medications. In view of her bradyarrythmias, a multipurpose pacing pulmonary artery catheter (Edwards Laboratory 93-200-7F) was selected. An 8.5-Fr Arrow Percutaneous Introducer Sheath Kit (#AK-09800) was used for cannulation of the right external jugular vein (EJ) and easily passed its full length. Passing of the PAC

was accomplished with some effort to the 30-cm mark. Catheter integrity was assessed because of poor tracings of the transduced distal port; no blood returned upon aspiration on the distal port with a 3-ml syringe. The PAC could not be withdrawn past the 30-cm marker, and efforts to gently withdraw it proved fruitless. Since the catheter and introducer could be moved together, the catheter and introducer were withdrawn as one. On exposing the introducer tip, the metal electrode at the 20-cm level was found to be caught on the edge of the introducer tip, thus preventing removal of the PAC. Furthermore, a significant portion of the metal electrode had separated from the catheter surface (fig. 1). With the sheath introducer returned to the EJ vein, a chest roentgenogram verified the sharp angulation at the EJ vein–subclavian vein junction.

Schwartz *et al.*[1] and Jobes *et al.*[2] stated that external jugular venous cannulation has a rate of success between 74% and 88%. Bromley and Moorthy[3] recently described a PAC failure that apparently was due to the sharp angulation of the EJ vein as it entered the subclavian vein. In response, Campbell and Schwartz[4] note that sheath withdrawal can restore PAC function. However, unreported complications with pacing catheters could include electrode dislodgement and ventricular fibrillation secondary to unprotected leads in contact with an ungrounded electrical circuit.[5]

This patient's severe carotid artery stenosis (90%) made the risk of inadvertent arterial puncture and the need to compress that puncture site for hemostasis unacceptable. Evidently, the combination of the right EJ vein approach, the sharp angulation of the introducer, and the presence of metal electrodes on the catheter surface resulted in the difficulty described. In this instance, the electrode hooked the edge of the introducer tip, but the possibility of shearing the introducer or losing the electrode within the central circulation was alarming.

This case serves as a reminder of several important points during percutaneous vascular catheterization. Though the EJ vein approach is safe, the potential for an introducer kink or catheter entanglement within the heart, unbeknown to the operator, is ever present. Resistance during positioning of a PAC and the deterioration of catheter function are indicators for this differential. Under such circumstances, the presence of metal electrodes pressed onto the PAC surface represent the potential for partial or complete electrode separation. When these difficulties are encountered, removing the catheter and introducer together, under fluoroscopic guidance as needed, maximizes patient safety. Therefore, multipurpose pacing pulmonary catheters may be relatively contraindicated in those situations where a sharp angle along the intended route of cannulation is anticipated.

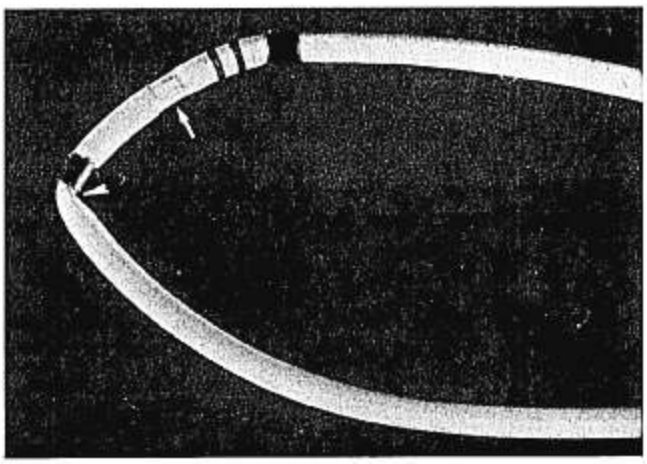

FIG. 1. Photograph of PAC after its removal from patient. The arrow points to the location where the metal electrode was removed; the electrode wires can be seen protruding away from the catheter surface. The arrowhead points to the separation of the electrode from the catheter surface, caused by the catheter being bent, an occurrence that is easily recreated *in vivo* with the use of the EJ vein approach to the central circulation.

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