Complete Knotting of a Catheter; Nonsurgical Method of Removal*

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A nonsurgical method for disentanglement of a knot in pacemaker catheters is described and its possible wider applications are discussed.

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Table 2—Arterial PaO₂, PaCO₂, and pHa following "Recovery" from Adult Respiratory Distress Syndrome

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<th>FIO₂</th>
<th>One Month</th>
<th>Five Months</th>
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<tr>
<td>PaO₂ (torr)</td>
<td>PaCO₂ (torr)</td>
<td>pHa</td>
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<tr>
<td>0.21</td>
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*Exercise

0.5 mg, and furosemide, 100 mg, intravenously. A catheter* was inserted into the pulmonary artery and revealed a pressure of 24/15 torr and a pulmonary capillary wedge pressure (PCWP) of 15 torr. Her chest film initially showed only a left lower lobe infiltrate, but within the next six hours, opacification of all but the upper lobes was present (Fig 1). Her PaO₂ fell to 38 torr in spite of mechanical ventilation with 100 percent oxygen. Pulmonary arteriogram did not demonstrate pulmonary emboli, and the diagnosis of ARDS was made.

Methylprednisolone 30 mg/kg body weight was given intravenously and CPPV with 10 torr positive end-expiratory pressure (PEEP) was applied. Her PaO₂ rose to 250 torr on 100 percent inspired oxygen, with a PacO₂ of 23.5 torr and a pHa of 7.58. Three hours after CPPV was instituted her PaO₂ on 45 percent inspired oxygen was 160 torr, PacO₂ 34 torr, pHa 7.50, and PCWP 8 torr. A chest film the next morning showed marked clearing and the PEEP was gradually reduced to 4 torr.

Ten days following intubation, while spontaneously breathing 40 percent oxygen with 4 torr PEEP, PaO₂ was 147 torr, PacO₂ 36 torr, and she was extubated. Three days later her PaO₂ while breathing room air was 80 torr, PacO₂ 32 torr, and pHa 7.47. The oliguria began to resolve two weeks following admission, and one month later, her BUN was 20 mg/100 ml and creatinine 1.4 mg/100 ml. She was discharged 32 days following admission and is currently asymptomatic.

Pulmonary function tests were performed one, two, three, and five months after her hospitalization (Tables 1 and 2). They initially revealed a reduced total lung capacity and an elevated residual volume to total lung capacity ratio. Both the single breath carbon monoxide diffusing capacity (Dco) and alveolar capillary permeability (Kco)17 were reduced. Arterial oxygen tension was 80 torr while breathing room air and 525 torr while breathing 100 percent oxygen. By the third month all pulmonary function studies, except the Dco and Kco, had returned to normal limits. By the fifth month, these also showed a normal trend, but the Kco and PacO₂ on exercise were still out of the predicted range.

Discussion

Following surgery, this patient developed severe respiratory distress with a high alveolar-arterial O₂ difference while she breathed 100 percent oxygen, indicating marked right-to-left intrapulmonary shunting. With appropriate therapy, her PaO₂ rapidly returned to normal, but some pulmonary function studies did not. Studies performed one month after admission indicated a restrictive ventilatory defect, as evidenced by the low lung volumes. There was a derangement of alveolar gas transfer as evidenced by the reduced Dco and Kco. Lung volumes became normal by the second month; however, the impairment in alveolar-capillary permeability persisted until the fifth month. We are unable to explain the drop in pHa and elevation in PacO₂ observed during exercise.

Several important points are illustrated by this patient. First, some patients with severe ARDS may survive to lead normal lives. Second, even if arterial oxygenation and chest x-ray film appear to return to normal early, residual pulmonary dysfunction may persist for several months. Therefore, patients with successfully treated ARDS should be followed closely after discharge from the hospital.

References


Complete Knotting of a Catheter; Nonsurgical Removal*
Knotting of catheters is a rare complication of cardiac catheterization. However, with the increasing use of catheterization both as a diagnostic tool and as a therapeutic procedure, an increasing risk of this complication can be predicted.

In this paper we report a case of complete knotting of catheter used to record His bundle electrogram and the nonsurgical method of disentanglement.

Case Report

A 66-year-old diabetic woman was admitted in April, 1972, with past history of congestive heart failure which had been controlled with digoxin, 0.25 mg. The physical examination was unremarkable with the exception of the presence of hepatomegaly which had been diagnosed by a liver biopsy done during previous hospitalization as being secondary to fatty infiltration. The chest x-ray film showed mild cardiomegaly. The electrocardiogram showed normal sinus rhythm at a rate of 75 per minute, with a first degree A-V block (P-R interval of 220 msec). The QRS complexes had normal configuration and the mean QRS axis was +45 degrees. On exercise induced sinus tachycardia at a rate of 100 per minute, the QRS configuration changed to complete left bundle branch block with a mean QRS axis of -45 degrees.

Because of the presence of abnormal atrioventricular conduction and the rate related left bundle branch block, a His bundle electrogram was recorded. The procedure was done under local anesthesia. Transcutaneous catheterization of the right femoral vein was accomplished by a plastic introducer containing a puncture needle (Jelco No. 14), and a bipolar catheter (USCI No. 6) was inserted through the plastic introducer into the femoral vein. After the catheter had been advanced a few centimeters, some resistance was felt, but by manipulating the catheter back and forth it was possible to advance it a few centimeters more. At this point fluoroscopy was used and it became apparent that a complete knotting had formed near the tip of the catheter which was at the junction of the right iliac and inferior vena cava veins. The catheter was then successively advanced into the inferior vena cava and right atrium where manipulation of the catheter was done in an attempt to disentangle the knot. This attempt was ineffective and the catheter was then withdrawn from the inferior vena cava to the site of introduction. Under constant fluoroscopic control, with the plastic introducer held firmly, the catheter was then simultaneously and slowly pulled and rotated (see Figure). In a short period of time the knot progressively became disentangled and the entire catheter could then be withdrawn from the introducer which was next removed from the femoral vein. The patient had an uneventful recovery and was discharged a few days later.

Comments

When knotting of cardiac catheters occurs, it may be incomplete or complete. When it is incomplete, usually the problem is easily overcome by manipulation of the catheter in the veins, arteries or cardiac chambers. Occasionally the catheter has to be directed into the vena cava or right atrium where better maneuvering is possible. At other times final straightening of a catheter is accomplished only by bringing it to a smaller vein, subclavian or axillary. If the catheter is hollow, a semiflexible steel guide wire may be inserted and advanced to the catheter's tip. However, this is not effective for complete knotting and carries a theoretical hazard of perforating the catheter, blood vessel or cardiac chamber. When knotting is complete, withdrawal of the catheter to a peripheral vein with surgical removal has been the rule. The size of the knot will determine the

Figure 1. A: The knot is brought near the distal end of the plastic introducer which is held by the left hand. B, C and D: The catheter is pulled and rotated utilizing the right hand while the introducer is held firmly in the left hand. E: The knot is untangled. F: Final straightening of the catheter before its removal.
Complete Heart Block Occurring during Cardiac Catheterization in Patients with Preexisting Bundle Branch Block*

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A case of catheter-induced complete heart block in a patient with preexistent left bundle branch block is documented by His bundle recordings. It is recommended that a temporary pacemaker catheter on demand should be placed in the right ventricular apex in all patients with complete bundle branch block undergoing cardiac catheterization. In the coronary care units catheterists should never be passed blindly to the right heart chambers in patients with left bundle branch block.

The site of block in complete atrioventricular heart block may be at the level of the A-V node, His bundle or in both left and right bundle branches. Complete block below the His bundle is usually associated with wide QRS complexes, a slow heart rate, and may be accompanied by symptoms of heart failure or syncope. This is usually due to organic heart disease involving degenerative changes of the A-V conduction system, or severe diffuse coronary disease. It has been reported to occur occasionally during the course of cardiac catheterization when either left or right bundle branch block was preexistent and the other bundle was inadvertently injured.

A case of complete heart block occurring during the course of cardiac catheterization in a patient with preexisting left bundle branch block in which the site of block was documented by His bundle electrogram is reported.

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Type of operation required for retrieval. Most commonly the knots are removed from the subclavian, axillary or antecubital veins. In previous reports dealing with these procedures, most patients had to receive general anesthesia to relieve pain and vascular spasm as the knot is withdrawn to the most peripheral site possible for surgical intervention. Occasionally, thoracotomy will be required to remove an entangled catheter in the intrathoracic portion of the subclavian and jugular veins, and very rarely cardiotomy is necessary to remove a knotted catheter trapped in the heart. We have reproduced the same phenomenon with different types of cardiac catheters, hollow and solid, and in all instances we were able to disentangle the catheters with the technique described above. This method could also be used in cases where catheters are inserted through cutdown. An introducer of sufficient diameter could be advanced over the external end of the catheter until its proximal end is positioned well inside the vein. The maneuvering would then be identical to the one described in this communication. Whether this technique could be used for catheters positioned in the veins of the arms can only be speculated. One would anticipate more difficulty due to the smaller size of the veins but this would depend largely on the size of the knot.

The importance and the necessity of using constant fluoroscopy when manipulating catheters if complications such as this are to be prevented should be stressed. In our case the knot was formed in the very beginning of the insertion of the catheter, at the time fluoroscopy was not being used because of the close proximity of the site of insertion. The resistance offered to the advancement of the catheter was in all likelihood caused by the movement of its tip against the wall of the femoral vein during the formation of the knot. The Swan-Ganz catheter technique is of great help in obtaining pulmonary arterial and "wedge" pressures without fluoroscopic control; the catheters used are very thin and soft, which facilitates looping and knotting formation. Therefore, their use should be limited to situations in intensive and coronary care units where knowledge of those pressures is imperative in order to make definitive diagnostic and therapeutic decisions.

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REFERENCES


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