Removal of a Pulmonary Artery Catheter in the Presence of Implanted Leads

In our critical care cardiovascular committee, the physicians asked if trained critical care nurses can remove a pulmonary artery catheter if the patient has an implantable cardioverter defibrillator in place. The AACN Procedure Manual for Critical Care states that critical care nurses should not remove pulmonary artery catheters if wires are present in the right side of the heart; the manual does not differentiate between temporary and permanent wires. If it is accepted practice for nurses to remove pulmonary artery catheters in patients with implantable cardioverter defibrillator wires, is there any time frame that would preclude such removal by nurses?

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Kathleen Epping, RN, MSN, ACNP-BC, and Beth Hammer, RN, MSN, ANP-BC, reply:

Currently, evidence is insufficient to support any conclusive statement about a specific time frame during which a pulmonary artery catheter should not be removed by a nurse in a patient with a permanent pacemaker or implantable cardioverter defibrillator (ICD).

The pulmonary artery catheter is a specialized central venous catheter that is inserted into the right side of the heart and then “floated” into the pulmonary artery. These catheters are usually inserted in critical care environments and allow measurement of hemodynamic indicators such as pulmonary artery pressure, cardiac output, mixed venous oxygen saturation, and right ventricular function as well as indirect measurement of pressures in the left side of the heart by pulmonary artery occlusion. Permanent pacing and defibrillation leads are typically implanted transvenously, using the subclavian or cephalic veins as a portal to the right side of the heart. Leads placed in the right atrium and right ventricle have screws at the distal end to secure them into the endocardium (see Figure). Left ventricular pacing leads are actually located in a coronary vein, thus they are not screwed in and may dislodge more readily than screw-in leads would dislodge.

Practice guidelines for pulmonary artery catheters describe potential complications during their removal: ventricular dysrhythmias, knotting or snaring of the catheter, and valvular damage.1-3 Studies designed to evaluate complications during removal of pulmonary artery catheters indicate that ventricular dysrhythmias are the most frequent complication.4-6 Cardiac dysrhythmias occurring while a pulmonary artery catheter is being removed are presumed to be caused by the mechanical irritation of the endocardium as it passes through the right ventricle.

Rountree4 evaluated the safety and complications of 215 pulmonary artery catheter removals by nurses and reported that the most frequent complication was the occurrence of ventricular dysrhythmias, with an overall complication rate of 5%. Of
the 215 pulmonary artery catheters removed, 2 patients had couplets and 3 patients had a 3-beat run of non-sustained ventricular tachycardia. In an attempt to determine the incidence, classification, and duration of dysrhythmia and the significance of hemodynamic compromise associated with removal of pulmonary artery catheters when a standard technique is used, Baldwin and Heland found a 2% incidence of nonsustained ventricular tachycardia associated with transient hypotension. In that study, 100 pulmonary artery catheters were removed; 2 patients had self-terminating ventricular tachycardia with transient hypotension, and 13 patients had isolated ventricular ectopic dysrhythmia without hypotension. Given these short runs of ventricular tachycardia, there is a very low risk of a patient with an ICD receiving a shock during catheter removal because detection of ventricular tachycardia in implantable devices requires 10 to 12 consecutive rapid beats.

Other researchers aimed to determine the occurrence and the type of complications and to indicate the differences between the procedural activities of critical care nurses and physicians during the removal of pulmonary artery catheters. Oztekin et al found that in both groups, the only type of complication was ventricular dysrhythmia, occurring in 5%. The incidence of dysrhythmias during the removal of 60 pulmonary artery catheters in this study, 30 by critical care nurses and 30 by physicians, did not differ significantly between the 2 groups. Although ventricular dysrhythmias are the most commonly reported complications during removal of pulmonary artery catheters, critical care nurses are also alerted to the potential for knotting or snaring of the catheter, valvular damage, or lead dislodgment. Each of these complications rarely occurs.

Injury of the tricuspid or pulmonary valves occurs when improper technique is used and the pulmonary artery catheter is removed with the balloon inflated. This risk is avoided when catheters are removed only by critical care nurses who have demonstrated competency in the proper technique for catheter removal. Small studies have demonstrated that critical care nurses safely removed pulmonary artery catheters without valve damage or causing knotting or looping of the catheter. Of note, both of these studies cited the AACN Procedure Manual for Critical Care as the source of the procedure used to remove the pulmonary artery catheter.

Our literature search produced only 1 case report of a pulmonary artery catheter tangled with pacing leads. In this case, an 80-year-old man with dilated cardiomyopathy and an implanted atrio-biventricular pacemaker (ie, dual-chamber pacemaker with a left-ventricular lead) was reported to have had the entanglement develop 4 days after the pulmonary artery catheter was placed. Cited risk factors for increasing the possibility of catheter knotting include dilated chambers in the right side of the heart, several wedge attempts, incomplete balloon inflation before the catheter is advanced, and blind insertion.

In general, lead dislodgement is rare and occurs in 1% of single-chamber pacemakers and 5.2% of dual-chamber pacemakers. Atrial leads tend to dislodge more often than ventricular leads (3.8% vs 1.4%).

Figure Chest radiograph shows right atrial (RA) pacing lead, right ventricular (RV) pacing lead, and pulmonary artery (PA) catheter.
Left ventricular leads have a higher rate of dislodgment because of their placement in the coronary sinus, where they cannot be screwed in (referred to as passive fixation). For this reason, extra consideration regarding the risks and benefits of a pulmonary artery catheter is encouraged. If a pulmonary artery catheter is deemed necessary, caution should be taken when placing it in patients with left ventricular transvenous leads. Expert opinion indicates that leads are at greater risk for dislodgement in the first 4 to 6 weeks after implantation.9-11

Conclusion
The question regarding a specific time frame that would preclude critical care nurses from safely removing a pulmonary artery catheter in a patient with a permanent pacemaker or ICD is a good one. The evidence to support a definitive answer is based on a few small studies and expert opinion. The most common complication, dysrhythmias, is not related to the presence of pacing or defibrillation leads, but rather to mechanical irritation of the endocardium. There is a higher rate, albeit low, of dislodgment within the first 4 to 6 weeks of lead implantation and a greater frequency of displacing passive fixation leads in general.

The key variable to safe removal of a pulmonary artery catheter seems to be the nurse/provider’s competency and adherence to recommended procedure, such as that outlined in the AACN Procedure Manual for Critical Care.9

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None reported.

References
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