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Minimizing Complications from Temporary Epicardial Pacing Wires after Cardiac Surgery

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PA-PSRS has received reports of complications from the placement of temporary epicardial pacing wires during open heart surgery. One report was of bleeding from the insertion site, leading to pericardial tamponade post-operatively. The tamponade was treated with pericardiocentesis, and the patient was returned to the OR for correction of the underlying leak. The other report was of a fatal, exsanguinating hemorrhage into the chest upon post-operative removal of an atrial pacing wire, because the removal of the wire tore the child's atrium. These two reports represent the Scylla and Charybdis of temporary epicardial pacing wire placement, leaking and binding. PA-PSRS asked Dr. James McClurken, a cardio-thoracic surgeon with expertise on this topic, to comment. John R. Clarke, M.D., Editor

For years, virtually all patients at most cardiac surgical centers received temporary epicardial pacing wires (TEPW). Although the incidence of complications from placement or removal of TEPW has been low, the adverse events can cause major morbidity and even mortality. In addition to inadequate lead function, the majority of serious morbidity reported relates to lead removal. Complications reported have included bleeding from ventricular or atrial laceration, tamponade, side branch or graft avulsion, superior epigastric artery laceration and or retention.^{1,2} Transmigration of a retained TEPW endobronchially has also been reported.³

Recently, the evolution of indications has shown a more defined pathway for TEPW use in coronary artery bypass grafting (CABG) patients.^{4,5} In fact, less than 10% of CABG patients may require post-operative use of TEPW. Predictors of necessity for TEPW on multivariate analysis of CABG patients include diabetes, preoperative arrhythmia, and pacing required to separate from bypass.⁴ Added to that list on univariate analysis were advanced age, cardiomegaly, preoperative antiarrhythmic therapy, and inotropic agents upon leaving the operating room. The need for TEPW may be greater for complex and valvular cardiac surgery,⁶ especially where decalcification of the aortic annulus may risk dysfunction of proximate conduction system fibers. Key but subtle features of the dynamics of myocardial functional recovery after cardiac surgery frequently are the indications also cited by many surgeons for use of TEPW.

Complications of TEPW can be reduced by attention

to certain details involved in both technical aspects of placement of wires and in considerations for removal. These considerations are presented in list form.

Placement of TEPW:

1. Keep electrodes at least 1.5 – 2.0 cm apart on the epicardium to maximize efficacy.
 - a) Electively, test and record threshold function for wires.
 - b) Secure the TEPW at the exit site with a suture.
2. Carefully select locations.
 - a) Avoid arterioles/venules on the right ventricle.
 - b) Pick 'thicker' spots on the right atrium on the mid and lower right atrial wall; consider Waterston's groove, left atrium.
 - c) If right atrial appendage used, be certain bare wire does not inadvertently also contact right ventricle, as simultaneous atrial and ventricular contraction could occur with resultant hemodynamic compromise.
 - d) Be ever mindful of the exit course of the wire and its relationship to nearby graft (s) – avoid "clotheslining."
 - e) Keep exit direction of pacing wire from epicardium in as straight a line as possible to epigastric exit site, to avoid Gigli saw effect or tearing upon removal.
3. If repair suture for bleeding required, use smallest suture possible (e.g. 4-0, 5-0, or even 6-0).

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- a) Consider mattress suture with or without pledgets rather than figure-of-8 sutures, in order to facilitate removal.
 - b) Don't over tighten/strangulate the hemostatic suture, as the TEPW needs to be removed.
 4. Avoid long, redundant loops of wire; prevent conduit ensnaring or lassoing which could occur at removal.
 - a) Be especially cognizant of conduit side branch clips and their relationship to the TEPW course to avoid avulsion of clip at removal.
 - b) Be certain both ventricular and/or both atrial wires are on the same side of a graft to prevent constriction at removal.
 5. Keep epigastric exit sites near the midline on each side with intra-institutional standardization for ventricular wires to the left of midline and atrial to the right. This avoids confusion for critical care/nursing staffs.
 - a) Check intrathoracic epigastric exit site carefully to avoid exit of the needle through the colon, stomach, liver or lung.
 - b) Check for epigastric artery and rectus muscle bleeding after TEPW needles passage.
 6. Keep electrode ends of TEPW electrically isolated in some fashion.
- a) If undue 'cardiac tugging' is encountered while trying to remove, consider transecting the wire after sterile prepping of skin and external wire. Then, with as much gentle traction as possible cut with sterile scissors flush with skin level. Notify the patient and family that some TEPW necessarily remains. Subsequent removal of remnant wire is infrequently required.
 4. Keep the patient in hospital ~ 24 hours after TEPW removal to watch for signs of delayed tamponade or rhythm disturbances with one hour of bed rest immediately after removal.
 - a) Keep on telemetry.
 - b) Periodic vital signs.
 - c) Consider ECG, CXR to assess voltage and mediastinal silhouette stability prior to discharge.
 - d) For any serious concerns, rapid patient evaluation and treatment must occur with possible emergent return to the OR.
 5. Avoid TEPW removal late in day or if there is concern about coverage team.

Considerations should be given to having emergency sternotomy trays stored on the unit where pacing wires are removed.

These considerations are indicative of a strategy for safety as regards TEPW. There are many ways to achieve similar results, and these considerations are by no means immutable.

Removal of TEPW:

1. Be certain TEPW is no longer needed (especially if removal is driven by a clinical pathway protocol.)
2. Be aware of coagulation status and medications.
 - a) If the patient is on intravenous heparin, discontinue temporarily.
 - b) If the patient is on warfarin, allow INR to drift down to <1.5.
 - c) If the platelet count is low, understand the reason and correct if necessary.
 - d) It is probably acceptable to continue aspirin and clopidogrel as long as no subcutaneous heparin is being given and there is no abnormal aPTT, INR, or platelet count.
3. Pull one wire out at a time, using gentle traction.

Notes

1. Del Nido P, Goldman BS. Temporary epicardial pacing after open heart surgery: complications and prevention. *J Card Surg.* 1989 Mar;4(1):99-103.
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4. Bethea BT, Salazar JD, Grega MA, et al. Determining the utility of temporary pacing wires after coronary artery bypass surgery. *Ann Thorac Surg.* 2005 Jan;79(1):104-7.
5. Puskas JD, Sharoni E, Williams WH, et al. Is routine use of temporary epicardial pacing wires necessary after either OPCAB or conventional CABG/CPB? *Heart Surg Forum.* 2003;6(6):E103-6.
6. Rho RW, Bridges CR, Kocovic D. Management of postoperative arrhythmias. *Semin Thorac Cardiovasc Surg.* 2000 Oct;12(4):349-61

Minimizing Complications from Temporary Epicardial Pacing Wires after Cardiac Surgery (Continued)

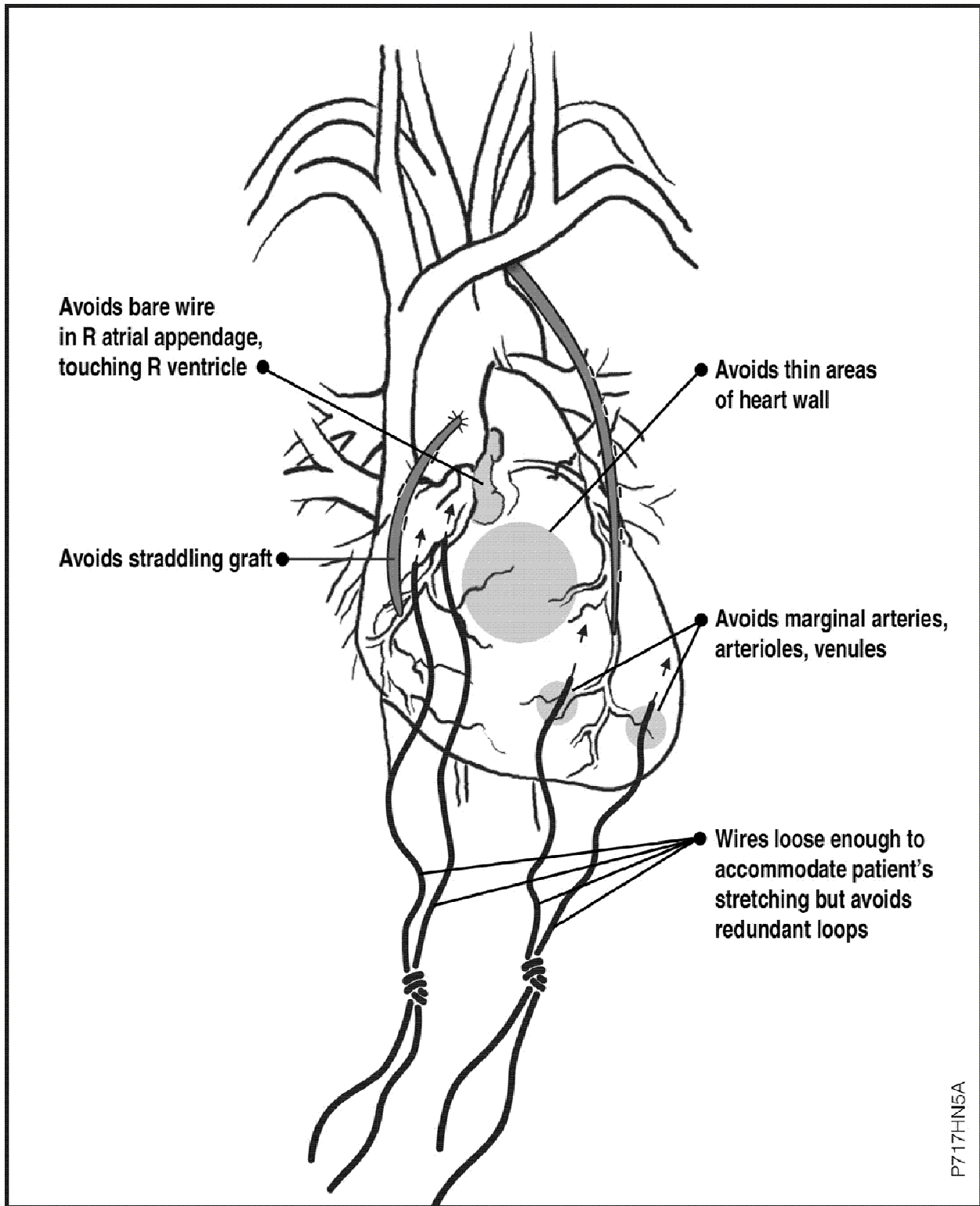


Figure 1. Correct Placement of Pacing Wires (Heart Only)

Minimizing Complications from Temporary Epicardial Pacing Wires after Cardiac Surgery (Continued)

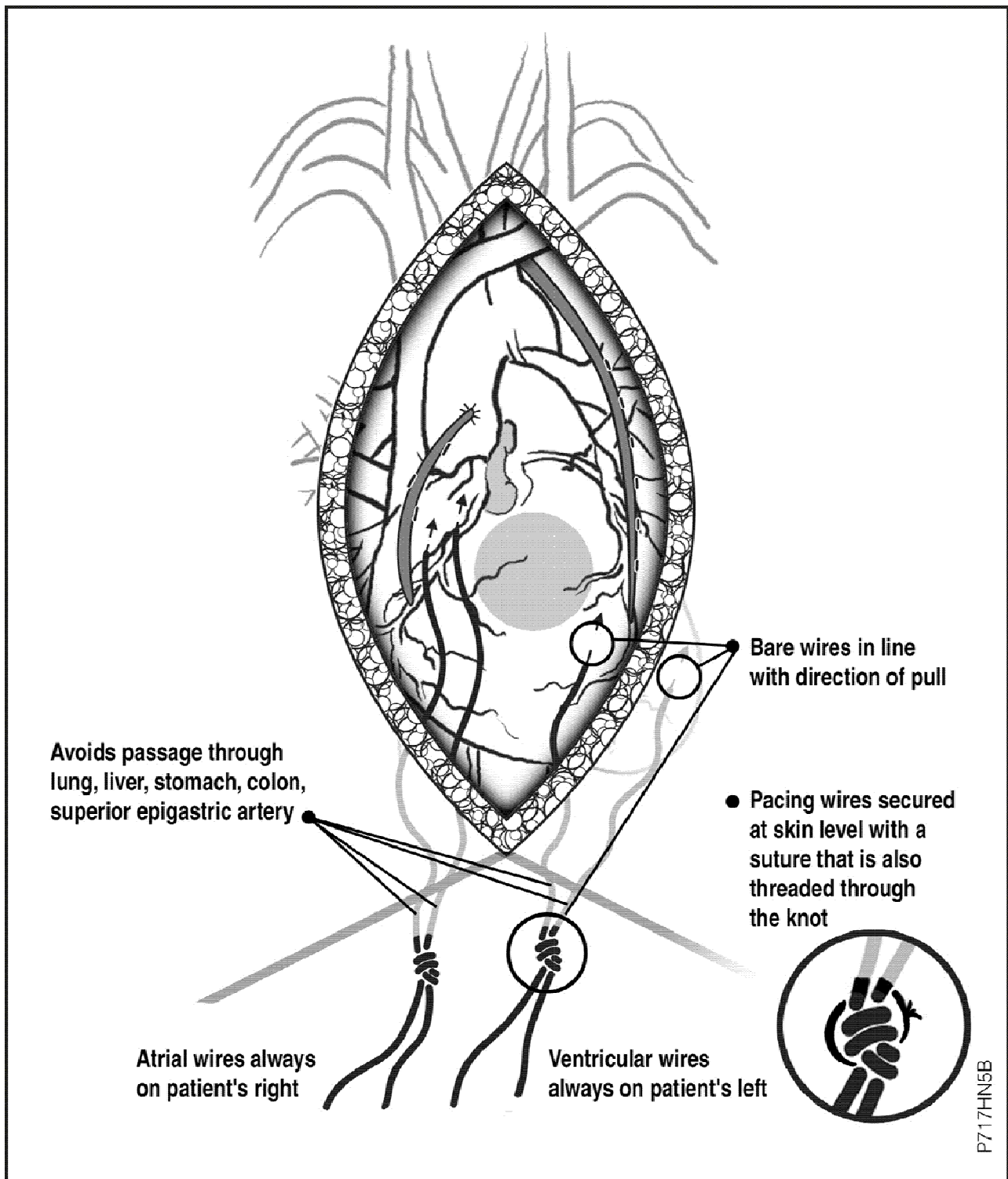


Figure 2. Correct Placement of Pacing Wires (In Situ)

Minimizing Complications from Temporary Epicardial Pacing Wires after Cardiac Surgery (Continued)

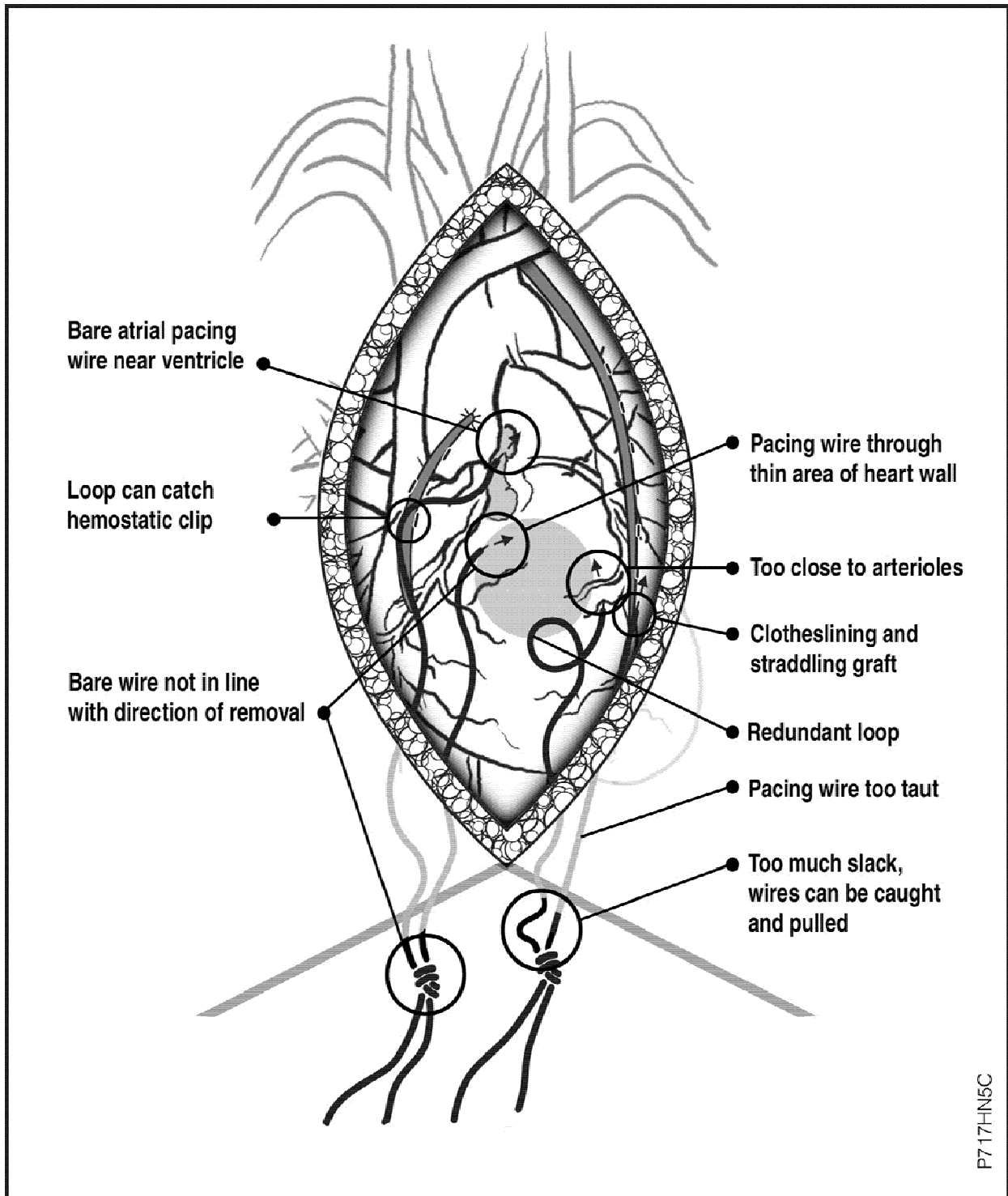


Figure 3. Potential Failure Modes—Incorrect Placement of Pacing Wires

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