

CASE REPORT

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Fatality Following Right Atrial Perforation by a Screw-in Pacemaker Electrode

ABSTRACT: This paper describes the first reported fatality from right atrial perforation complicating the insertion of a screw-in right atrial pacemaker electrode. The patient was an 84-year-old woman with the sick sinus syndrome who also had hepatic cirrhosis.

KEYWORDS: forensic science, atrial perforation, screw-in pacemaker, hemopericardium

Cardiac perforation is a recognized complication of invasive cardiac procedures such as cardiac catheterization (1) and insertion of cardioverter defibrillators (2,3). Documented right atrial perforations complicating the insertion of pacemaker leads have been previously reported (4–10). One of these was found incidentally at autopsy, six years after insertion, in a patient who died of congestive heart failure (5). The rest were confirmed at thoracotomy. All patients survived. Herein is reported the first fatality following right atrial perforation complicating the insertion of a screw-in right atrial pacemaker lead.

Case Report

An 84-year-old woman, with a history of hypertension, congestive heart failure and hepatitis C was admitted to the hospital with syncope. A diagnosis of sick sinus syndrome was made. She also was found to be in acute renal failure, and she was anemic (hemoglobin 9.6, hematocrit 28.5). Her prothrombin time (PT) was 11.8 seconds (normal 9.7–12.5) and her partial-thromboplastin time (PTT) was 29.6 seconds (normal 20–37). She had a platelet count of 161 K/UL (normal 150–400). She underwent insertion of dual-chamber screw-in (Guidant) pacemaker leads (Fig. 1). Both leads were introduced via the left subclavian vein. Following satisfactory placement of the ventricular lead, the atrial lead was advanced (under fluoroscopy) through an 8 French sheath and fixed into position in the right atrial appendage. The leads were then sutured to the pectoralis fascia. At the conclusion of the procedure she was noted to be hypotensive. An echocardiogram showed a moderate effusion. An echo-guided pericardiocentesis was performed with return of 100 cc of blood. There was no clinical improvement. She progressed to pulseless electrical activity and was diagnosed to have a cardiac tamponade. An emergency left anterior thoracotomy was done. The pericardial sac was opened and approximately 100 cc

of dark blood and blood clots were aspirated. Despite continued attempts, she could not be resuscitated.

At autopsy there was less than 50 cc of blood in the surgically opened pericardial sac. The left pleural cavity contained 400 cc of blood. Her heart weighed 320 g. The cardiac chambers were of normal size and the atrial and ventricular walls were of normal thickness. The cardiac valves, atrial and ventricular septae were unremarkable. There was minimal atherosclerotic coronary artery stenosis. A 0.5 cm perforation of the lateral right atrial wall was present, adjacent to the right atrial appendage. The tip of the atrial screw-in lead was seen at the site of the perforation (Fig. 2). The liver was cirrhotic and 800 cc of ascites was noted.

Discussion

In 1960, Schwedel et al. (11) reported on the first cardiac perforation by a ventricular endocardial electrode during temporary pacing. The patient developed a pericardial effusion and died. The location of the perforation was not documented. In 1965, Chardack et al. (12) reported the first lead-related perforation of the heart from a permanent transvenous pacemaker. Since these original reports, pacemaker components have continuously undergone modifications. In 1987, Hill (13) was able to show (over a 14-year period) a reduced incidence of myocardial perforations by electrodes and related this to improved lead technology, i.e., smaller leads with endocardial fixation devices. Active fixation leads were developed to overcome the most common problem of lead dislocation. There have been numerous lead tip designs, including grasping wires, bristles, hooks, barbs, baskets and screw-in devices (introduced in 1980).

Following a series of 150 pacemaker insertions (127 ventricular and 23 atrial) Bisping et al. (14) suggested that a possible complication when using screw-in leads, especially when placed in the right atrial appendage, is perforation. They emphasized that this may be avoided by reducing the depth of penetration by the tip from 2 mm to 1.5 mm, or by positioning the electrode at an oblique angle. In a series of 639 atrial active fixation lead insertions, Markewitz et al. (15) reported no perforations.

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FIG. 1—Screw-in tip of Guidant atrial pacemaker lead $\times 25$.



FIG. 2—Autopsy photograph showing the 0.5 cm right atrial perforation (arrow head) with protruding screw-in lead.

There have been occasional case reports of atrial perforations by pacemaker leads (4–10,16–19) (Table 1). All of them recovered following needle aspiration or open drainage of the effusion, with or without surgical repair of the defect. Most of the patients presented with hemopericardium, with or without tamponade (4,6,7,8,10,16,19). In addition, Parsonnet et al. (20) reported on 4 atrial perforations complicating pacemaker implantation (they did not elaborate).

Atrial and ventricular perforations during pacemaker insertion may both present with cardiac tamponade. However, unlike ventricular perforations, which will often seal with retraction of the pacing wire, the thin walled atrium cannot.

Atrial perforations from insertion of pacemaker leads may be recognized acutely (17) or may be delayed (4,6–10,16,19). Lees et al. (5) even reported an incidental finding in a patient who had insertion of a permanent pacemaker six years prior to dying of congestive heart failure. At autopsy the pacemaker lead extended through the right atrium into an extracardiac position. There was no associated hemopericardium and the lead was encased in fibrous tissue.

Trigano et al. (18) reported an overall incidence of 0.57% for cardiac perforations complicating transvenous pacemaker implantation. Parsonnet et al. (20) implanted 1474 pacing systems. They

TABLE 1—Case reports of atrial perforations by pacemaker leads.

Authors	Lead Type	Intervention	Outcome	Age
Pappas*	Ventricular	Surgical repair	Recovered	?
Lees**	Ventricular	N/A	N/A	74
Sussman	Tined	Surgical repair	Recovered	80
Irwin	Tined	Surgical repair	Recovered	80
Van Acker	Active fixation	Surgical repair	Recovered	70
Van Nooten	Screw-in	Needle aspiration	Recovered	64
Reedy	Temporary	Surgical repair	Recovered	Newborn
Ho	Screw-in	Lead replacement	Recovered	79
Trigano	Active fixation	Surgical repair	Recovered	44
Dilling-Boer	Active fixation	Pericardiotomy and drainage	Recovered	51
Velavan	Screw-in	Open drainage	Recovered	64

* Atrial perforation caused by a fractured ventricular lead.

** Incidental autopsy finding, 6 years after insertion.

N/A: Not applicable.

had 9 cases of cardiac perforation (0.61%), 4 atrial and 5 ventricular. Stirbys (21) reported a series of 255 cases where anchored pacemaker leads were inserted. There were 2 instances of guide catheter cardiac perforations. It was not stated if the perforations were atrial or ventricular. Because of these complications, a screw-in lead was subsequently used. However, again there were 2 perforations, 1 fatal. It was not stated if the perforations were atrial or ventricular. Glickson et al. (22) reported on the implantation of 168 screw-in atrial leads. They had two cases of perforation; they could not determine if they were atrial or ventricular. Both were treated by pericardiocentesis and recovered.

Given the relatively small numbers of even the non-fatal occurrences in the literature, this case represents a rare fatal outcome from a known potential complication of a commonly performed procedure. The patient reported here also had hepatic cirrhosis complicating hepatitis C infection. Though her PT and PTT were normal, her liver disease may have decreased her coagulating ability, making successful intervention less likely.

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