Catheter Extrusion with Infection Complicating Permanent Endocardial Pacing*  
An Unusual Complication Reported in Three Cases


Three cases of erosion and extrusion of a pacemaker catheter with infection are reported. Treatment consisted of removing the infected catheter without delay and administering systemic antibiotics. Local antibiotics did not prevent septicemia and resultant death in one patient. Modification of our original technique by employing the cephalic vein below the clavicle or implanting the catheter behind the clavicle when the external jugular vein is employed has prevented this complication.

The use of an electrode catheter for pacing in patients with symptomatic complete heart-block is well established. In 1963, Siddons1 described a new technique for permanent internal cardiac pacing using a transvenous system. Avoidance of a thoracotomy has made this the procedure of choice for the elderly and debilitated patient.2,3 During the past two years we have used this technique in 38 patients. Although permanent endocardial pacing has proved remarkably successful, a small number of complications have occurred. This communication reports the cases of three patients in whom the pacemaker catheter was extruded as a result of tissue necrosis with resultant infection.

CASE REPORTS

CASE 1
A 55-year-old Negro man presented at Queens Hospital Center on May 7, 1967, for treatment of progressive congestive heart failure. He was first seen in December 1965 for suspected Stokes-Adams attacks. A temporary transvenous pacemaker catheter was inserted, followed by the placement of a permanent endocardial pacemaker electrode. Because of the recent onset of increasing cardiac decompensation, the patient was admitted for evaluation and treatment.

On admission the patient's blood pressure was 130/84 mm Hg. The heart rate was 74 per minute and the temperature was 99.2 F. An eroded area with extrusion of the transvenous catheter was noted in the right supraclavicular area surrounded by a yellow purulent exudate. The wound measured 1 cm in length. The heart was markedly enlarged. The liver was minimally enlarged and there was a trace of pedal edema. An electrocardiogram revealed complete capture of the heart by the pacemaker unit. A chest x-ray film revealed left ventricular enlargement with calcific deposits in the aortic arch. An electrode catheter was noted with its tip at the right ventricular apex. Culture of the wound in the supraclavicular area revealed Staphylococcus aureus, coagulate positive. Numerous blood cultures were sterile.

A temporary transvenous endocardial catheter was inserted and the permanent pacemaker catheter and battery were then removed. Cultures of the wire and battery pack not exposed to the area of erosion were sterile. Two days later a permanent transvenous pacemaker catheter was inserted through the right cephalic vein and wedged into the apex of the right ventricle. Ten days later the patient was discharged from the hospital.

CASE 2
A 74-year-old white woman was admitted to Queens Hospital Center on May 7, 1967, with progressive congestive heart failure. In January 1966, because of recurrent Stokes-Adams attacks associated with complete heart-block, a permanent endocardial pacemaker catheter was inserted. In October 1966, 3 cm of the transvenous pacemaker wire was found extruding through the subcutaneous tissue and skin in the left supraclavicular fossa. The erosion was surrounded by purulent exudate which cultured out Staphylococcus aureus, coagulate positive. Hospitalization was refused and treatment consisted of local antibiotics and soaks. In May progressively increasing shortness of breath prompted medical attention.

On admission this patient's blood pressure was 110/80 mm Hg., the pulse was regular at 75 per minute, the respiration 30 and temperature 100.8 F. Five centimeters of transvenous pacemaker catheter was visualized looped over the skin of the left supraclavicular area (Fig 1). A purulent exudate exuded from the exit points from the skin. Cervical venous distention, rales at the lung bases, an enlarged liver and peripheral edema were present. An electrocardiogram revealed complete capture of the heart by the pacemaker unit. X-ray film revealed cardiomegaly with left pleural effusion. The transvenous pacemaker catheter was well positioned in the apex of the right ventricle (Fig 2). The

*From the departments of Medicine and Thoracic Surgery, The Long Island Jewish Hospital-Queens Hospital Center Affiliation and The Long Island Jewish Hospital, Queens, New York.
white cell count was 21,000 with 89 per cent neutrophils. Cultures of the purulent material and numerous blood cultures revealed *Staphylococcus aureus*, coagulase positive.

On the day of admission a temporary transvenous catheter was inserted through the right cephalic vein and the infected pacemaker catheter and battery were removed. *Staph aureus* was cultured from the tip in the heart and the battery pocket was sterile. High doses of staphcillin and penicillin were administered intravenously. Five days after admission when the patient's temperature was 102.4 F., she became semicomatose and died. Permission for postmortem examination was not obtained.

**Case 3**

A 78-year-old Negro woman was admitted to Queens Hospital Center on November 9, 1966, for treatment of an extruded transvenous pacemaker wire in the neck. In October 1965, because of recurrent dizziness and Stokes-Adams attacks associated with complete heart-block, a permanent endocardial pacemaker catheter was inserted. In August 1966, it was noted that the pacemaker catheter had become buckled slightly in the right supraclavicular area over which the skin was taut and reddened. Three months later the catheter was found extruding through the overlying skin necessitating hospitalization.

Examination disclosed a blood pressure of 130/90 mm Hg. The pulse was regular at 75 per minute. The temperature was 99.2 F. In the right supraclavicular area, 3 cm of transvenous catheter was easily visualized lying in a gaping wound. The skin edges were hyperemic, but not grossly purulent. The battery pocket in the right pectoral area was normal. An electrocardiogram revealed complete capture of the heart by the pacemaker unit. Cultures of the neck wound revealed *Staphylococcus aureus*, coagulase positive. Numerous blood cultures were negative.

On the day after admission, a temporary transvenous pacemaker catheter was inserted and the infected catheter and battery were removed. Two days later a permanent endocardial catheter was inserted through the left cephalic vein and wedged into the apex of the right ventricle. The infected wound was treated with saline soaks and local antibiotics and healed without complications.

**Method**

After the placement of a temporary transvenous pacemaker catheter, the patient was brought to the Cardiac Catheterization Laboratory. Under sterile conditions the right cervical region and right clavicular area were prepared in the usual manner for surgical exposure. The external jugular vein was entered one inch above the clavicle and a permanent endocardial pacemaker catheter was inserted and positioned in the apex of the right ventricle. The catheter formed a smooth loop throughout its course into the heart without kinking. Multiple 2-0 Dacron ties.
were placed firmly around the vein incorporating the catheter at its insertion site. The catheter was then looped anteriorly over the clavicle.

A pocket was then created over the right anterior chest superficial to the pectoral muscles. A subcutaneous tunnel running anterior to the clavicle was created from this pouch to the incision in the neck. The catheter was then drawn through this tunnel and was attached to the pacemaker unit which was positioned in the anterior chest wall pocket. Care was taken to avoid any sharp angulations in the catheter and both incisions were closed.

Antibiotics were administered routinely to all patients for one day preceding and for one week after surgery. Removal of the temporary pacemaker electrode was performed 48 to 72 hours after insertion if the permanent endocardial pacemaker was found to be functioning well.

During the past 18 months, following the three occurrences of catheter erosion, the above technique has been modified for the last 25 patients. A horizontal incision is now made below the right clavicle. The right cephalic vein is isolated, as it lies within the delto-pectoral groove, and the pacemaker catheter is inserted and wedged into the apex of the right ventricle by passage through a transverse opening in the cephalic vein. With this technique only one incision is required since the battery pack is implanted through the same incision. Furthermore, with this procedure the catheter takes a course posterior to the clavicle in its passage via the cephalic vein to the innominate vein. Occasionally, the cephalic vein has been too small to accept the endocardial pacemaker catheter. Under these circumstances the external jugular vein is isolated through a cervical incision and the catheter is inserted as in the original technique. Upon exit from the external jugular vein, the catheter is looped behind the clavicle rather than anterior to it as in the original technique, thereby avoiding contact with the overlying skin. There have been no major technical problems related to the positioning of the catheter during surgery.

**Discussion**

Permanent endocardial pacing has proved to be simple and safer than techniques requiring an open thoracotomy in the elderly and debilitated patients with symptomatic heart-block. Originally introduced for short term use, it was thought to be fraught with the hazard of complicating septicemia, myocardial perforation or embolism when used for long-term pacing. By implanting the pacemaker unit in the axilla or chest wall thus producing a closed system, infection has been rare.

Three of the early patients in whom we implanted permanent endocardial pacemakers developed ulceration of the skin overlying the catheter in the supraclavicular area with resultant extrusion and infection. After reviewing the reported complications of implanted endocardial pacemakers in the literature, only one previously reported case similar to ours could be found. In a series of 49 cases, Bluestone et al noted that one patient developed cervical skin erosion due to an implanted pacemaker catheter. Death resulted from staphylococcal septicemia.

The treatment of a patient with an inserted transvenous pacemaker in whom infection develops at the skin margin is well established. In a series reported by Furman, 6 of 115 patients subjected to transvenous pacing with an external pulse generator, 14 developed troublesome infection. In each case the infected catheter was removed and simultaneously replaced by a catheter electrode from another site. Large doses of antibiotics were administered intravenously. Two treated in this manner died. Two others were treated elsewhere for infection with intravenous antibiotics, but without removing the infected catheter, succumbed. Gordon’s patient, on the other hand, with blood cultures positive for Staphylococcus aureus survived without removal of the catheter.

We feel that removal of the infected foreign body will ensure prompt control of the infection. Therefore, in treating the three patients in this report, the infected pacemaker catheter and battery were removed after replacement with a temporary transvenous catheter. High doses of intravenous antibiotics were administered in one patient in whom the blood cultures were positive. Local antibiotics probably had no appreciable effect in preventing spread of the infection to the bloodstream and should not be relied upon for sterilization.

In attempting to determine the cause for the catheter erosion in these cases, the surgical technique used in the insertion of the permanent endocardial pacemaker in other series was reviewed. No major differences were noted. It is, therefore, surprising that this complication has not been reported more frequently. In the one case reported by Bluestone et al it was thought that the course of the catheter was too superficial in the neck.

To prevent this complication we have modified our original technique as described above. By inserting the catheter inferior to the clavicle and using the cephalic vein or by looping the catheter behind the clavicle as it emerges from the external jugular vein, pressure against the overlying skin is avoided. Furman and associates elected the cephalic vein as the method of choice for implanted transvenous pacemakers. In 27 per cent of their cases because of technical problems the external jugular vein was used. The pacemaker catheter was looped over the clavicle. Although erosion did not occur, the presence of this complication in three of our patients would add support to the initial use of the cephalic vein in the 18 months. Since our modifications have been used, no further catheter erosion has occurred.

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DIS. CHEST, VOL. 54, NO. 6, DECEMBER 1968
ACKNOWLEDGEMENTS: The authors wish to thank Phyllis G. Frank and Brenda Redisch for their assistance.

REFERENCES

Reprint requests: Dr. Schwartz, 600 Fulton Avenue, Hempstead, New York 11550.

ANNOUNCEMENTS

Postgraduate Course: The Physician and Intensive Coronary Care
Baptist Hospital, Nashville, January 20–24, 1969
This program will provide the physician with knowledge of modern methods and materials uniquely used in coronary care units. Special emphasis will be placed on unit design, staffing, management, legal aspects, indications and use of pacing, prevention and management of arrhythmias, resuscitation techniques, cardioversion, defibrillation, pathophysiology and treatment of congestive heart failure and shock, biochemistry of the myocardium, metabolic acidosis, drug use, adverse drug effects, optimum utilization of the cardiac nurse, behavioral patterns and progressive rehabilitation of the patient with coronary heart disease. Opportunity for individual consultation with faculty will be afforded through group sessions, luncheons, question and answer periods and social hours. Contact Dr. Fred D. Ownby, co-director, at the Baptist Hospital, Nashville, Tennessee 27302 for further information.

Postgraduate Course: Clinical Chest Diseases
Mount Sinai Hospital, New York City, January 2–March 6 (Thursdays)
A comprehensive review of current diagnostic and therapeutic practices in the field of chest diseases will be provided. Clinical and radiologic manifestations of pulmonary neoplasms, tuberculosis, bronchitis and emphysema, asthma, pulmonary suppuration, etc. will be analyzed in light of recent advances in pulmonary physiology and histopathology. Case presentations will illustrate the medical, surgical and radiotherapeutic approaches to these ailments. For information and application, write the Registrar, The Page and William Black Postgraduate School of Medicine, Fifth Avenue and 100th Street, New York, New York 10029.

Fifth International Conference on Sarcoidosis
Prague, Czechoslovakia, June 16–21, 1969
The program committee for the Fifth International Conference on Sarcoidosis invites submission of ten-minute communications for presentation on all aspects of sarcoidosis (etiology, epidemiology, electron-microscopy, histology, immunology, metabolism, pathophysiology, treatment). Abstracts should be submitted (in English) before January 15 to: Ladislav Levinsky, University Clinic for Tuberculosis and Respiratory Diseases, 19 Katerinska, Prague 2, Czechoslovakia. Papers must be original contributions not previously presented or published. Abstracts should be submitted in quadruplicate and should be limited to 150 words.