Perforation during Indwelling Catheter Pacing

By David A. Nathan, M.D., Sol Center, M.D., Raúl E. Pina, M.D., Aaron Medow, M.D., and Walter Keller, Jr., M.S.

Stimulation of the right ventricular endocardial surface via an indwelling cardiac catheter was first successfully employed in 1958. It has since been utilized as a method for long-term pacing and, more recently, as a useful preoperative procedure for cardiac pacing prior to permanent correction of heart block with an implantable pacer. Electrode catheters, either unipolar requiring direct endocardial surface contact, or bipolar allegedly requiring no such contact, have successfully been employed. As experience with this modality of therapy has increased, complications have been reported such as skin infection at the site of catheter insertion, thrombophlebitis, catheter tract and valvular ulcerations, endocarditis with sepsisemia, blood clot formation on the electrode, catheter wire fracture, and perforation through the ventricular wall with failure of effective stimulation. The last complication, observed at surgery, has occurred in nine or 20 per cent of 45 patients in whom a synchronous pacer was implanted. In four of these patients, areas of subepicardial and pericardial hemorrhage were present with 50 to 300 ml. of blood in the pericardial cavity.

The advantage gained by interim endocardial catheter pacing to assure against asystole during surgery warranted the use of this modality as a preoperative measure in all patients with complete heart block in whom a synchronous pacer was implanted. A no. 3- or 5-F Cournand bipolar catheter was inserted via the antecubital vein under careful fluoroscopic observation. The nine patients of this series consisted of six men and three women whose ages ranged from 58 to 78 years. Unipolar catheters were used in three and bipolar catheters were used in six patients. In one patient, the catheter was inserted on three different occasions. The catheter tip was always advanced into the pulmonary artery and then pulled back into the right ventricular chamber to avoid perforation and to permit free floating motion of the catheter tip in the outflow tract during cardiac activity. Pac- ing power was supplied by a portable battery-operated pacemaker comfortably and firmly held in place at a site of insertion on the arm. Capture was achieved at rates of 70 to 80 per minute at currents of 2.5 to 5 ma. Thereafter, careful monitoring of the heart was maintained in many patients to the time of surgery. Some patients were ambulatory when effective stimulation was observed after a few days. Catheter manipulation under fluoroscopic observation was performed to assure that the catheter was not malpositioned in the right atrium or pulmonary artery when pacing was ineffective. Despite this assurance, stimulation failed within hours or days and, on occasion, surgery was performed with only intermittent effective stimulation.

Case Report

The problem of maintaining an effective stimulus response in a patient with proven catheter perforation is exemplified in the following case report:

A 67-year-old woman was admitted to Mount Sinai Hospital November 12, 1964, because of Stokes-Adams episodes. Complete heart block with an idioventricular rate of 36 to 40 was present. An endocardial catheter, powered by a

From the Departments of Medicine and Surgery, Mount Sinai Hospital, Miami Beach, and the University of Miami School of Medicine, Coral Gables, Florida.

Supported by grants from the National Heart Institute, U. S. Public Health Service (H-7109); the New York Foundation; the Physicians and Surgeons Fund, Mount Sinai Hospital, Miami Beach, Florida; and the Harry and Hannah Posner Research Fund.

portable transistorized battery pacemaker, was inserted via the right antecubital vein. The catheter was reinserted through the external jugular vein on December 7, 1964, to provide better position for long-term pacing. This site caused considerable discomfort; further, after several days, pacing failed although it could be restored with catheter manipulation.

The patient was readmitted for implantation of a synchronous pacer January 25, 1965. The poorly functioning catheter was removed from the neck, and an endocardial catheter was inserted via the left arm on January 27, 1965. This resulted in an effective response to the pacer stimulus. A synchronous pacer was successfully implanted on January 28, 1965. When the pericardium was opened, the catheter tip was seen protruding 3 cm. through the ventricular wall. It perforated into the pericardial cavity in contact and on a plane with the epicardial surface. Adjacent to the site of perforation were areas of subepicardial hemorrhage. Three hundred milliliters of blood were present in the pericardial sac. A large area of hemorrhage involved the overlying pericardium (fig. 1). When the catheter tip touched the epicardium effective stimulation occurred, but slight manipulation at the arm resulted in occasional to total absence of response to the stimulus as contact was broken by further protrusion of the catheter tip.

**Figure 1**

Upper arrow shows site of catheter perforation through the outflow tract of the right ventricle. There are areas of subepicardial hemorrhage (right arrow) and pericardial hemorrhage (left lower arrow). Blood was present (300 ml.) in the pericardial cavity.

Circulation, Volume XXXIII, January 1966

Discussion

This paper in no manner implies that catheter pacing is not a desirable and effective means of pacing. Its utility as a safeguard to assure successful implantation of a permanent pacer has been largely responsible for the absence of mortality during operation in our series of 45 patients. Although tamponade with death has occurred, we have not observed it; and in five patients no blood was present in the pericardial cavity. The fact that hemopericardium occurs, however, is reason to alert the physician. Perforations occurred within 1 to 14 days after catheter placement and can reasonably be expected to increase in frequency with more prolonged pacing. The frequency of this complication has prompted us to initiate synchronous pacer implantation as soon as is clinically safe for the patient.

Care was taken to assure that the catheter, when pulled back from the pulmonary artery to the outflow tract of the right ventricle, was floating freely and that no pressure was exerted that might result in perforation. It may be that the catheter tip became lodged in the trabeculae carneae, where the force of ventricular systole pushed it progressively through the 2-mm. wall of the right ventricle.

Failure to pace the heart commonly occurred when an indwelling catheter was malpositioned in the right atrium or pulmonary artery. In the absence of wire fracture, perforation was the cause of ineffective stimulation when the catheter appeared to lie in the right ventricular chamber. Perforation was not suspected by fluoroscopic or x-ray studies. Moreover, precordial pain was not present in these patients to arouse clinical suspicion.

Ventricular pacing may be uninterrupted, intermittent or absent in the presence of catheter perforation. When uninterrupted, the tip remains in contact with the epicardium as it protrudes through the right ventricular wall on a horizontal plane with the epicardial surface. Intermittent or absent pacing of the heart is dependent upon the degree of catheter-tip contact with the ventricular myocardium.
Figure 2

Three patients with catheter perforation exhibiting: (A) effective stimulation, (B) intermittent effective stimulation (complexes 1-2 and 5)—ineffective stimuli (arrows). The fourth complex is a fusion complex—stimulus and idioventricular beat, (C) ineffective stimulation except at arrow.

dium. All three situations are commonly observed (fig. 2A, B, C).

Summary

Nine patients paced with an indwelling catheter as a preoperative measure prior to synchronous pacer implantation were observed at surgery to have catheter perforation into the pericardium within 1 to 14 days. Such perforation may result from mechanical systole when the catheter tip becomes fixed in the trabeculae carneae of the right ventricular outflow tract and is progressively forced through the thin myocardial wall. Stimulation may be uninterrupted, intermittent, or absent in the presence of catheter perforation. Since hemopericardium has been observed without symptoms or radiologic evidence, the physician should be aware of this possible complication and its potentially serious effect.

References

Perforation during Indwelling Catheter Pacing
DAVID A. NATHAN, SOL CENTER, RAUL E. PINA, AARON MEDOW and WALTER KELLER, JR.

Circulation. 1966;33:128-130
doi: 10.1161/01.CIR.33.1.128
Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 1966 American Heart Association, Inc. All rights reserved.
Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circ.ahajournals.org/content/33/1/128

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation is online at:
http://circ.ahajournals.org/subscriptions/