Temporary Transvenous Cardiac Pacemaking in Rural Family Practice

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Interested family physicians with proper training and minimal extra equipment can now employ transvenous pacemaking. Some cardiac centers have developed training programs for general internists and family physicians. We believe that this valuable procedure can, with proper physician training, be offered to patients in rural areas as well as in cardiac centers. While the number of patients in this rural family practice who require this procedure has not been great (ten patients in four years), the need is often urgent when it does occur. Use of this treatment modality with consultation in a 44-bed hospital was found to be safe and practical, although sometimes technically difficult. This paper describes the training, techniques used, results, and complications in a rural community in southeastern Nebraska. It is suggested that every hospital caring for seriously ill cardiac patients should have at least one physician trained to perform this emergency procedure.

We believe it is now possible and practical for family physicians in rural community hospitals to employ temporary transvenous pacemaking. First, most patients with heart disease are cared for by family physicians. Second, with the recent heavy educational emphasis on cardiac emergency care, many community hospitals have become quite sophisticated in cardiac monitoring, arrhythmia management, cardioversion, and treadmill exercise testing. With proper training and little extra equipment, the inclusion of transvenous pacemaking into this list is not difficult.

Patients requiring temporary pacing are not frequent in most small rural family practices, but when they do present, patients are often in real trouble and cannot be moved safely to a cardiologist because of the time factor and their clinical instability. When the need for pacing is imminent, it is reassuring for the patient and the family physician to know that effective temporary cardiac pacing can be safely instituted even miles away from an established cardiac center.

The purpose of this paper is to demonstrate the practicality of family physicians placing temporary transvenous cardiac pacemakers, and to describe an approach to obtaining proficiency in this technique.

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Training

The first two authors are in a private family practice in a community of 3,500 in southeastern Nebraska, 1½ hours from the nearest cardiologist. There is a community hospital of 44 beds, which includes three monitored intensive care beds.

One of the authors (WF) was trained in temporary transvenous pacemaking by a group of cardiologists and cardiovascular surgeons in private practice. Many trips were made to the catheterization laboratory on days off to observe the technique and to discuss indications and complications. Practice in right heart catheterization was obtained with regular cardiac catheters plus the electrodes of permanent transvenous pacemakers. Visits to other catheterization laboratories at the Mayo Clinic, the University of Iowa, and the University of Nebraska during postgraduate trips added other opinions and variations in technique.

The second author (DM) received his training at a week-long postgraduate course given by the Division of Cardiovascular Medicine at the University of Nebraska College of Medicine. This continuing education course is modified to the interest of the family physician and is taught on a one-to-one basis. Right heart catheterization is initially taught in the dog laboratory, where the family physician learns the technique by manipulation of catheters in the dog heart. This experience demonstrates the difficulties and complications of right ventricular catheter placement. The physician then moves to the human catheterization laboratory to practice and refine his skills in right heart catheterization. An intensive didactic course on indications, complications, and practical applications is included. On completion of this course most physicians have gained enough confidence in their

Table 1. Results of Temporary Pacemaker Placement in Ten Patients

Patient	Age	Sex	Diagnosis	Indication	Outcome
1	55	M	Acute anterior myocardial infarction	RBBB with left axis deviation	Survived
2	55	M	Acute anterior myocardial infarction	3° AV block and ventricular fibrillation	Died of pump failure
3	52	M	Acute inferior myocardial infarction	Syncope with 2° to 3° AV block	Survived
4	82	F	Stokes-Adams syncope	3° AV block	Survived
5	82	F	Stokes-Adams syncope	Mobitz II AV block	Survived
6	76	F	Stokes-Adams syncope	2° and 3° AV block	Unsuccessful placement — referred & survived
7	80	M	Congestive heart failure	Intractable heart failure with 3° AV block	Improved
8	73	M	Old myocardial infarction	Drug resistant ventricular tachycardia	Improved temporarily — died at home
9	68	M	Lactic acidosis and cor pulmonale	3° AV block	Unsuccessful placement — died
10	68	M	Supraventricular tachycardia with AV block	Precaution before further treatment	Converted to sinus rhythm during procedure

ability to return to their communities and begin applying this mode of treatment.

The University of Nebraska Cardiovascular Center places special emphasis on training of family physicians. A new, six-month training program has been implemented, emphasizing greater depth of experience in cardiac diagnosis, including development of new technical skills of treadmill exercise testing, Swan-Ganz catheter placement, and temporary pacemaker placement. This training emphasis is felt appropriate to the largely rural nature of medical practice in Nebraska. Only two metropolitan centers in this state (Lincoln and Omaha) have two-year trained, board certified cardiologists.

Technique of Pacemaker Placement

After completing the training, the physician continues to discuss individual patients with a cardiologist in order to verify the need for temporary transvenous pacemaking.

In the community hospital, the patients are moved from the intensive care unit to the radiology department (about 30 feet away), where the image intensification fluoroscopy unit is used to aid in catheter placement. The cardiac monitor and cardioverter are moved with the patient. Many avenues of catheter placement have been suggested, but we prefer to expose the median basilic vein in the left antecubital fossa because of direct visualization of the vessel and general familiarity with this procedure. The left arm is used because the curved pacing catheter follows more easily the curve made by the left subclavian vein into the superior vena cava. The right arm has also been used, but more difficulty is encountered entering the right atrium, due to the right angle on entrance of the right subclavian vein into the superior vena cava. Either a Medtronic 6700 catheter with stylus or a 5824 Medtronic pacing catheter is advanced into the right ventricle. It is wedged near the apex after first advancing up into the pulmonary artery to make sure it is in the right ventricle and not the coronary sinus. A demand pacer is then connected, checked for sensing, and the output set to obtain capture. The catheter is secured to the vein, the skin closed, and a sterile dressing with antibiotic ointment applied. The pulse generator is strapped to the forearm; a chest film and 12-lead electrocardiogram are done to check and record catheter tip location.

Other avenues of pacemaker approach to the right heart are available. Percutaneous puncture of the femoral vein, median basilic vein, internal jugular vein, or subclavian vein are possible. Because family physicians generally have had less experience with percutaneous puncture, this technique is less emphasized at the beginning of instruction.

Recently, the development of a semi-floating balloon pacing catheter has obviated the need for fluoroscopy and utilizes the percutaneous venapuncture technique of the subclavian or jugular veins.[1] A large Medi-Cut cannula is placed into the vein and the needle withdrawn. The pacing catheter is then advanced through the Medi-Cut cannula into the central venous circulation and the balloon inflated. The flow of blood propels the catheter with a little manipulation into the right atrium and then into the right ventricle. Catheter position is determined during passage by monitoring of an intracavitary electrocardiogram by attaching the EKG V lead to the pacing electrode. Once a ventricular complex is displayed on the tracing, the balloon is deflated and the catheter wedged. Some have feared the more flexible balloon electrode might be easily displaced and the capture lost, but its proponents claim that this has not been a problem. Pneumo-

thorax from the subclavian venapuncture is a possible complication.

Results

Our results are summarized in Table 1. Ten patients (six males, four females) have been temporarily paced over the past four years. Seven of the ten patients were successfully paced following placement of the catheter by the family physician. Difficulty in passing the catheters through the tricuspid valve occurred in three patients (6, 9, and 10). One patient (6) had to be referred to a cardiologist for proper temporary pacer placement. In one patient (10) catheter manipulation in the right atrium helped convert a supraventricular tachycardia to a sinus rhythm. Another patient (9) died secondary to associated disease while the catheter was being manipulated in the right atrium.

Three of the patients (1, 2, and 3) had suffered acute myocardial infarctions. Patient number one developed right bundle branch block (RBBB) and left axis deviation soon after anteroseptal myocardial infarction. The patient failed to progress to complete heart block, and the pacing electrode was removed on the ninth post-infarction day.

Patient number two had an acute anterolateral myocardial infarction. Despite drug therapy, repeated ventricular fibrillation developed, plus periods of third degree atrioventricular (AV) block with slow ventricular response. The patient had to be defibrillated twice while the cut-down was being performed. Even though successful right ventricular pacing was achieved, the patient died of pump failure six hours after admission.

Patient number three presented three hours after the onset of severe chest pain and had experienced three syncopal episodes prior to admission. The admitting electrocardiogram showed an acute inferior myocardial infarction complicated by second degree AV block with a fixed pulse rate (PR) interval (Mobitz type II) and a ventricular rate of 40 beats per minute. A temporary transvenous pacing electrode was placed, and the patient was paced until the block subsided.

Three patients (4, 5, and 6) were paced because of Stokes-Adams syncope secondary to high grade AV block and long periods of slow ventricular response. Patients number four and five had permanent pacemakers and did well. In patient number six, the pacing catheter could not be advanced through the tricuspid valve. The patient was transferred to the cardiologist for permanent pacing. She had several unsatisfactory transvenous permanent pacemakers, but has done well with an epicardial pacemaker.

Patient number seven had severe prolonged congestive heart failure with third degree AV block and a slow ventricular response. He finally developed cerebral symptoms and extreme lethargy. He was paced temporarily with good response, so he was referred for a permanent pacer. Significant improvement in his congestive heart failure and sensorium resulted.

Patient number eight was an elderly man with a history of several previous myocardial infarctions, and extreme ventricular irritability uncontrolled by medication. His ventricular ectopic foci were suppressed by overdrive pacing via a temporary pacer. He was then transferred to a cardiologist who continued to pace him for several days, and then implanted a permanent pacer. The patient died suddenly at home two weeks after dismissal.

Patient number nine developed third degree AV block associated with lactic acidosis and cor pulmonale. He was paced initially with an emergency transthoracic Ele-Cath Electrode. As a transvenous pacer was being manipulated in a large right atrium, capture with the Ele-Cath was lost, and the patient died before the right ventricle could be entered and paced.

Patient number ten had tricuspid insufficiency and a supraventricular tachycardia. Over 48 hours of medical treatment, second to third degree AV block developed with ventricular rate of 40 beats per minute. The patient was not taking digitalis. The cardiologist recommended placing a temporary pacemaker before further treatment was attempted. Difficulty was encountered in moving the catheter from the right atrium into the right ventricle. During catheter manipulation in the right atrium, premature atrial systoles occurred and the rhythm suddenly reverted to sinus with an adequate ventricular rate.

Complications

Serious complications of temporary transvenous pacing were infrequent, taking into consideration the small number of cases seen, and the previous inexperience with the technique. The greatest problem has been passing the electrode through the tricuspid valve in patients with a large, dilated right atrium (patients 9 and 10). Superficial phlebitis has not been a problem. Septicemia is infrequent, so that good surgical wound care and topical antibiotics at the skin site are adequate.

Ventricular irritability during catheter placement is a frequent occurrence and equipment for immediate resuscitation and defibrillation is essential.[2]

Our temporary pacers have been placed from both arms and in position for only a short time, but we have not experienced loss of pacemaker capture in any of our patients. If loss of capture occurs, repeat manipulation of catheter tip may be necessary to regain contact with the ventricular wall. This can frequently be done at the bedside without fluoroscopy.[2,3]

Perforation of the ventricular wall is infrequent but should be suspected if capture is lost. Surprisingly, perforation is not usually associated with cardiac tamponade, and simple retraction of the electrode back into the ventricular cavity is usually all that is required.[3,4] We have not seen or recognized ventricular perforation.

Five patients (4, 5, 6, 7, and 8) have had permanent pacemaker placement with four prolonged survivors.

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