Techniques of Bedside Pacing*

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In temporary pacing the primary approach is transvenous—either percutaneous or via a cutdown in the jugular or brachial vein system. Tripolar and quadripolar pacemaker catheters which have been used for His bundle recordings are now obtainable as well as the bipolar variety. Among the latter is the floating catheter which may also be used as an intracavitary electrocardiogram. Doctor Furman of New York City has been extremely successful with this type in approximately 500 patients.

The problem with the floating catheter is the potential hazard of displacement. Thus, it may be worthwhile to consider using a stiffer or semi-floating catheter. Remember that the catheter may have to remain in place for as long as three or four days, and you want to be sure that you can depend on it to stay in position. One type of semi-floating catheter has a slight bend at the end. It is much more likely to remain securely in the trabeculae of the right ventricle, and it may be passed blindly when image intensification is not available.

The rigid bipolar catheter is too large for the percutaneous route and a cutdown must be perfomed through an invasion either in the external, internal jugular or brachial vein. But if you want to save yourself a lot of time and trouble in making these temporary pacemakers remain in place you may have to use this kind. There is one type of rigid catheter on which the electrodes are located 15cm from the tip. It is softer than the other rigid catheters, and it is to be inserted into the pulmonary artery so that right ventricular outflow pacing is possible. Figure 1 shows the electrodes in the outflow tract of the right ventricle and the tip in the right pulmonary artery. The importance of this type of catheter in addition to the position of the electrodes is its softness which doesn't irritate the ventricle. We have had a number of cases of ventricular fibrillation during catheter placement in the apex of the right ventricle in patients with an acute myocardial infarction. We have defibrillated them calmly during the

Fig 1—Catheter electrodes in the outflow tract of the right ventricle and the catheter tip in the right pulmonary artery.

Fig. 2—Percutaneous catheter needle on point of insertion at mid clavicle at a 45 degree angle.

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catheterization, but this is always a risk, and a bolus of lidocaine 100mg is administered intravenously prior to the insertion in patients with this condition. This prophylactic measure results in less ectopic beats and runs of ventricular tachycardia, and I would recommend it in such patients in order to avoid serious ventricular rhythms.

When using percutaneous catheters it is important to select a needle with a good 13-gauge lumen in order to pass the catheter. Percutaneous pacemaker catheters may be inserted at mid clavicle at a 45 degree angle as shown (Fig. 2) or above or below the clavicle. The problem in approaching the subclavian vein is that you really have to fish for it. But any third-year medical student can accomplish this, and fortunately you can get into the vein blindly. The catheter can then be placed down into the superior vena cava, right atrium, and on into the ventricle. In addition to catheter placement in the outflow tract of the right ventricle it is possible to pace from the apex, the right atrium, and the coronary sinus. Usually you can document the position of the catheter by attaching the external lead to the electrocardiogram and observing the electrocardiographic changes. It must be remembered, however, that if the electrode is touched in an ungrounded situation ventricular fibrillation may occur with the intracavitary electrode technique. Therefore, the use of image intensification is preferred.

I invariably use demand pacing particularly in patients with recent myocardial infarction to avoid competition. An exception to demand pacing during an infarction would be the use of overdrive pacing for ventricular tachycardia.

There are several types of pulse generators, and you may make your own if you like. However, to provide effective pacing rates for atrioventricular sequential pacing, rapid atrial stimulation, and paired pacing you have to use a coupled pulse generator (Fig. 3).

Fig 3—A coupled pulse generator.

Coupled or S_1S_2 paired pacing is a bedside technique that I would not recommend in ventricular pacing unless you have a computer that has measured the cycle length ahead and programmed the next S_1S_2 interval. Otherwise, ventricular fibrillation will very likely occur. Paired pacing of the atria in cases where atrial tachycardia are uncontrollable by any other means can be used to reduce the rate by one half. The problem with ventricular pacing is that there is only one pulse in the brachial artery for every two electrical stimuli and this may cause a decrease in the stroke volume which could lead to acute pulmonary edema.

Dr. Philip Samet's approach of rapid atrial stimulation as a means of converting atrial arrhythmias is of value in the digitalized or over-digitalized patient in whom electrical countershock may not be feasible. Additional indications for rapid atrial stimulation are recurrent atrial tachycardia or flutter particularly during an acute myocardial infarction as well as during cardiac catheterization when transient arrhythmias may result in changes in the oxygen determinations. The restoration of normal sinus rhythm would then allow one to obtain more reliable data. The use of rapid atrial stimulation also avoids the need for administration of an anesthetic.

One indication for the use of temporary pacing is premature ventricular beats in the presence of a prolonged QT interval. The use of drugs would further prolong the QT interval and increase the opportunity for ventricular tachycardia. I would also recommend pacing in patients with acute myocardial infarction and in patients with high-degree A-V block associated with ventricular tachycardia. In these instances overdrive pacing as a bedside technique has worked very well.

Another indication for temporary pacing is reëntry atrial tachycardia in patients with Wolff-Parkinson-White syndrome. I would recommend, however, that pacing not be performed in patients with WPW as a means of converting atrial flutter or fibrillation or to induce these arrhythmias in patients with this condition. As Dr. Neil Moore has demonstrated so beautifully, you may buzz or overdrive the atria to the point of ventricular fibrillation.

Figure 4 shows an example of a six-week-old child with paroxysmal atrial tachycardia in which overdrive pacing was used. The electrocardiogram shows delta waves during sinus rhythm and is termed the type A form of WPW syndrome. A floating catheter was placed and the rhythm converted by atrial pacing. The child was managed with a radio frequency pacemaker on a permanent basis. The aerial of the transmitter was placed over the heart and sinus rhythm was then reëstablished each time. The child's mother learned to stop the tachycardia by broadcasting the pacing at home.

Ingenuity is an important requirement in using any of the above bedside techniques because many problems will have to be solved on the spur of the moment. You should be knowledgeable about these techniques and have all the equipment around you so that you will have a system you can depend on.

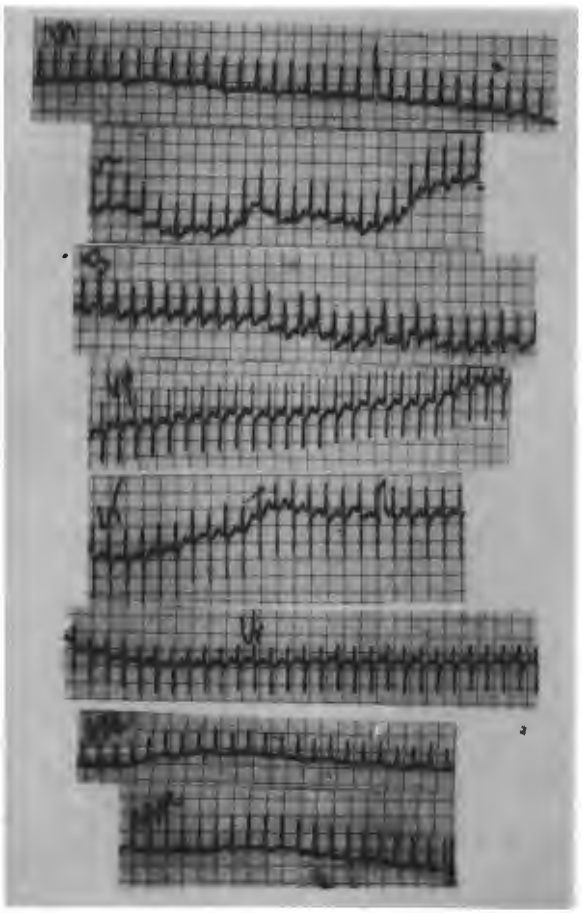

Fig 4—Type A form of Wolff-Parkinson-White syndrome complicated by PAT.

PANEL DISCUSSION

Questioner: Dr. Dreifus, what are your criteria for a floating catheter versus a rigid catheter?

Dr. Dreifus: I would use a floating catheter in the extreme emergency. I would go to the rigid or semi-rigid ones if I had a little more time to make decisions. Then I would use image intensification to get the catheter into the trabeculae, making sure it is well placed and that the threshold is adequate and low enough so that both sensing and pacing are possible. If you lose the sensing part, you then have a fixed-rate pacemaker, which will not sense premature beats and will give you a new impulse on top of a T wave. Premature ventricular beats with an acute infarction could be dangerous, so it is imperative that you get the best position so that the catheter doesn't slip out. You may need it in there for a week, two weeks, three weeks, four weeks, sometimes. I know Dr. Furman used to put them in for a year back in 1959 or so, and they remained in place and patients stayed alive because of these rigid catheters. But if I had my choice, I would choose a rigid one, and I would spend some time getting it into position with plenty of antiseptics so I wouldn't get infection.

Dr. Parsonnet: May I make one comment about the rigid catheters? We have some interest in them since the one you are talking about was designed by Dr. Zucker at our hospital and is sometimes called a Zucker catheter. We are not cutting down any longer on those. We are putting them in through the subclavian vein with a needle, and we pass a rather large sheath over the needle and then pass the catheter through the sheath. But we also feel quite strongly about the statement you've already made, Leonard, that these electrodes should be fixed and placed with anatomical control using fluoroscopy and not with the free-floating technique unless you are in a terrible hurry and unable to obtain bedside fluoroscopy.

Dr. Zoll: Dr. Dreifus has made a point of great importance and I want to take this opportunity to say that I agree with it. I think it is extremely important to use demand pacemakers in patients with acute myocardial infarction. The risk of repetitive response in fibrillation is a very serious one—indeed, so serious that I try not to use catheters at all in these circumstances. But if you are going to use one, for goodness sakes, make it a demand. In this regard, I should point out that although it seems difficult in Philadelphia, and perhaps in other places, in some areas one finds that emergency control can be accomplished readily. While you are preparing to move the patient or the bedside X-ray machine, you can manage the situation possibly with external electric stimulation and by intravenous drug therapy with epinephrine or isoproterenol. Most of the time it is a matter really of only a minute or so to control rhythm

with intravenous drug therapy. You can arouse a ventricular pacemaker, you can accelerate it, you can overdrive ectopic activity, and you can gain control very often with drugs, but then you are not in such a desperate hurry to get the catheter in place.

Dr. Baird: How reliable is demand pacing in a temporary situation as far as over-sensing or under-sensing either with the temporary floating, semi-floating, or stiff catheter electrode systems?

Mr. Berkovits: For temporary pacing you must have the electrode placed as well as you would for permanent pacing, because detection of the endocardial depolarization depends on proper electrode placement. You must have an endocardial signal to control the demand pacemaker, otherwise you don't have a demand pacemaker. The endocardial signal of the floating electrodes is not acceptable and will not be reliable for controlling demand pacing.

Dr. Samet: I would like to add something here. Anyone who is trained in catheterization can pass at least three quarters of the rigid catheters into the right ventricle blindly just by repeated manipulation. You won't be in an ideal position, but you will be in a reasonable position to capture the ventricle and then move the patient over to a catheterization laboratory with X-ray facilities in order to gain a final position. Therefore, we rarely, if ever, use a semi-floating catheter to capture the ventricle.

Dr. Richardson: Is anybody using the Swan-Ganz balloon technique? Do they make a pacemaker catheter?

Dr. Dreifus: Yes, they do make a pacemaker. (Have you used it?) Yes, we have used it. It is an excellent catheter, incidentally, because it has a little balloon that is inflated, and the stream will then carry it on its way. Its most important use of course is to put it in the pulmonary artery when you want to monitor pulmonary artery pressure or something like that, rather than as a pacemaker. But what Dr. Samet said is true. You can pass a rigid catheter into the ventricle without EKG control. Even though my machines are constantly tested, I still have the fear of leakage in a ground. We had a 3-prong plug ground on one of our new Marquettes, and we had a 65 ma leak in that machine. You never know when you are going to run into this, and I have fibrillated patients. Even with putting rigid catheters in under fluoroscopic control, they may become displaced. So you must have golden fingers.

Dr. Parsonnet: We have been playing with semi-floating catheters for a long time, and again, Dr. Zucker has one with a little parachute on the end of it, like an umbrella, which guides the catheter into the ventricle. Our experience has been much the same as most other people's with these temporary electrodes. Even though you know where the tip is and obviously you can tell that it is in the ventricle from the electrocardiogram, you don't know where the rest of the loop is. The loop of the electrode can be in the pulmonary artery, or up in the atrium, or in the ventricle. This insecure position of the loop can lead to malposition, and then it will pass with a bolus of blood and pull the tip out of position. The free-floating catheters have knotted around themselves and around trabeculae, and we have had to go after them. In our experience, and the same with Tom Killip in New York and others, about 20 percent have pacing failure, even though they have been positioned with an electrocardiogram.

Dr. Baird: Dr. Samet, how do you verify your position in blind insertion of the stiff catheter?

Dr. Samet: It is not important to verify it, because all you want to do is put it into a position where you can gain at least temporary pacing to control the situation and then move the patient.

Dr. Baird: Do you rely on intracavitary electrocardiograms?

Dr. Samet: No.

Dr. Richardson: It seems to me that it is far safer than EKG monitoring hooked up to 110 volts.

Dr. Narula: I just wanted to make a comment that if you do want to use temporary pacing by the bedside in an emergency situation, instead of hooking up the catheter to the EKG for finding out the position, a simple way may be to hook up the catheter to the pacemaker so you don't defibrillate the patient by EKG output. Then turn the pacemaker on a 5 or 10 ma, and when you get into the right atrium, you will have atrial pacing and you just record a surface EKG. When you get in the RV you will find ventricular pacing. This way you may bypass the problem of shocking the patient at the bedside. If you are in the shoulder, you may have some muscle twitching, so that it is much simpler to use this method.

Dr. Samet: I just want to emphasize one point again. The term "bedside" has been used several times this morning. When we use rapid atrial stimulation this is *not* a bedside technique. It is a technique to be used only under fluoroscopic control—not under EKG control. You don't dare turn on rapid atrial stimulation at 300, 400, 500, or 1000 without having absolute fluoroscopic control of the tip of your catheter or you fibrillate the ventricles. This was done once at our hospital and fortunately the patient was revived. So rapid atrial stimulation is not a bedside technique in the sense of a technique in the ward, or even in the ICU, away from X-ray facilities.