The technique of coronary sinus catheterization in man

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Summary
A simple method for catheterization of the coronary sinus in man has been described. It has been used successfully in more than ninety patients.

Introduction
Although a technique for catheterization of the coronary sinus in the intact dog was reported in 1948 (Goodale et al.) elective catheterization of the coronary sinus in man has been regarded as a difficult procedure because either the Eustachian ridge or a prominent Thebesian valve is apt to overlie the entrance of the sinus (Bing, 1951). The difficulty in finding the ostium has been one of the most serious obstacles to broader applications of this technique in man. Only a few previous workers have reported their results and these have been reviewed (Bing & Castellanos, 1959). The highest incidence of successful catheterization has been reported to be 75%. It is perhaps because of the previously ‘hit-or-miss’ nature of the procedure that a satisfactory technique in man has not been described when catheterization has been successful (Bing et al., 1947; Goodale et al., 1949; Banfield, Hackle & Goodale, 1950; Bing & Daley, 1951; Miller, Kaplan & Katz, 1953; Harris & Summerhayes, 1955; Lancaster et al., 1965; Yum & Miller, 1969). However, fortuitous and inadvertent catheterization of the coronary sinus in man has been recorded (Bing et al., 1947; Sosman, 1947; Culbertson, Halperin & Wilkins, 1949; McMichael & Mounsey, 1951; Smith, Albert & Rader, 1951; Meyer & Millar, 1969; Castellanos & Castillo, 1970) and on occasion has resulted in perforation of the sinus (McMichael & Mounsey, 1951; Smith et al., 1951). Although deep catheterization of the sinus has been performed without hazard (Harris & Summerhayes, 1955) it is obviously potentially dangerous (Miller et al., 1953). This is especially so when, after inadvertent catheterization, the operator believes the catheter is positioned in the pulmonary artery and then tries to pass it on to the pulmonary ‘wedge’ position. This danger should be anticipated whenever the catheter is being viewed in the sagittal plane during a right heart study and can be avoided either by performing a retrograde venogram (Yum & Miller, 1969; Fig. 1e), or an intracardiac electrogram; (Fig. 2f).

To enable myocardial metabolism to be investigated in man (Livesley, Catley & Oram, 1972) a reliable and simple method of coronary sinus catheterization had to be devised. As a result of personal experience in earlier unpublished studies in the dog, a new technique was developed which was immediately successful in man. In more than ninety patients, on no occasion was there failure to locate the coronary ostium and catheterize the sinus when this simple method was used, despite an earlier suggestion that the presence of the Thebesian valve would make this unlikely in 25% of cases (Hellerstein & Orbison, 1951).

Materials and methods
Using an aseptic technique and local anaesthesia, a No. 6 or 7F Zucker bipolar sampling catheter (Zucker, Rothfield & Bernstein, 1965) is passed via a left or right antecubital vein previously isolated through a small skin incision. This catheter allows simultaneous pacing and sampling from the coronary sinus which is convenient for both the patient and the operator. To prevent clotting, the catheter is filled with normal saline containing 500 IU heparin/ml, some 30 min prior to the procedure. The whole period of radiographic screening leading up to positioning of the catheter in the coronary sinus usually occupies less than 4 min.

Once in the superior vena cava (Fig. 1a) the catheter is advanced into the right atrium and then rotated along the posterior atrial wall (Fig. 1b) to a site just above the septal leaflet of the tricuspid valve (Fig. 1c) as indicated by a slight resistance to the forward direction of the catheter. The ostium of the coronary sinus is located when atrial premature beats with inverted P-waves occur on the electrocardiogram. At this stage, gentle advancement of the catheter allows it to enter the coronary sinus where it is placed in a non-obstructing mid-position (Fig. 1d).
FIG. 1. From the superior vena cava (a) the catheter is advanced into the right atrium and rotated along the posterior atrial wall (b) to a site just above the septal leaflet of the tricuspid valve (c). The catheter is placed in a non-obstructing mid-position in the coronary sinus (d) and its position confirmed by retrograde venogram (e) with free wash-out of dye into the atrium (f). The alternative initial procedure for catheterization of the sinus begins with a 'hockey-stick' position of the catheter against the lateral atrial wall (g) and then the distal portion becomes horizontal (h) prior to antero-medial rotation of the catheter tip into the ostium of the coronary sinus.
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This position can be confirmed by a retrograde venogram, injecting a few millilitres of 65% Hypaque solution by hand pressure, which outlines the sinus (Fig. 1e) and its tributaries, and then the radio-opaque dye shows free washout into the atrium (Fig. 1f).

The position of the catheter can be checked during a sampling and pacing procedure using an underlying rib shadow as a reference point. At the end of the procedure a repeat venogram acts as a final check on the position of the catheter immediately prior to its withdrawal.

If, in the initial stages of the procedure, the catheter is advanced in an anterior-inferior direction the anterior cardiac veins can be entered in error. This is shown by a ventricular position of the catheter in the absence of ventricular premature beats on the electrocardiogram and can be confirmed by retrograde venogram.

The sinus could not be entered in the direct manner described above in only four of the first thirty patients. In these patients the procedure was modified as follows: a ‘hockey-stick’ position was obtained with the catheter tip against the lateral atrial wall (Fig. 1g). The catheter was then advanced until the distal portion became horizontal (Fig. 1h). The patient’s head was then turned fully away from the operator to stabilize the catheter in the superior mediastinum. The catheter was then slowly rotated antero-medially until the ostium of the coronary sinus was located as before and the catheter was then entered into the sinus. In more than sixty subsequent patients the direct approach has always been successful. Any occasional initial difficulty could be overcome by using the smaller 6F catheter.

Discussion

The complications of catheterization of the coronary sinus are those of a simple proximal right heart catheterization study. Indeed, the hazards of the procedure are much less than the intubation of the right ventricle and pulmonary artery necessitated by right heart catheterization, because the sinus is situated in the subepicardial layers of the right atrium far removed from the sensitive ventricular areas of the endocardium. The pacing–sampling procedure is carried out on out-patients who are allowed to go home after resting for 1 hr.

As the catheter is advanced along the vein in the arm, some patients experience a transient unpleasant sensation which lasts until the innominate vein is entered.

When the catheter tip touches the atrial wall, atrial premature beats occur especially when the tip is near the orifice of the coronary sinus. In this series only one patient developed a prolonged bout of atrial fibrillation which subsequently spontaneously reverted to sinus rhythm and which did not prevent catheterization of the sinus.

On the occasions when the catheter passes across the tricuspid valve, irritation of the right ventricle produces a ventricular ectopic rhythm which settles as soon as the catheter is withdrawn to the superior vena cava. This phenomenon is usual during right heart catheterization.

Using the simple technique described above there have been no other complications.

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