Technique of endomyocardial biopsy—including a description of a new form of endomyocardial bioptome

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THE technique of endomyocardial biopsy which was developed by Konno and Sakakibara, 1963, and was further reported by Sekiguchi and Konno, 1969; Konno, Sekiguchi and Sakakibara, 1971, and Somers *et al.*, 1971, has meant that it is now possible to study the myocardium of patients suspected of having intrinsic abnormality of the muscle structure by histological, histochemical and electron microscopic examination. This is particularly applicable to the cardiomyopathies, and it is in this context that the majority of biopsies which we have performed have been done (Table 1). The advantage of

TABLE 1. Suspected clinical diagnoses

Congestive cardiomyopathy	17
Hypertrophic cardiomyopathy	2
Endomyocardial fibrosis	2
Valvular disease and cardiomyopathy	4
Myocarditis	1
Specific heart disease	1

the Konno technique over limited thoracotomy (Weinberg *et al.*, 1963; Sutton *et al.*, 1964) is that it avoids an anaesthetic and a relatively major operation, and unlike transthoracic needle biopsy (Sutton, Sutton and Kent, 1956; Sutton and Sutton, 1960) the samples obtained usually contain endocardium, in addition to myocardium, sufficient for examination.

The Konno endomyocardial bioptome was found to have certain disadvantages and we have developed a new form of bioptome in an attempt to overcome these.

Technique

We have used the method that was devised by Konno and we have used the intracardiac endomyocardial bioptome which he developed. The majority of samples have been from the right ventricle. One patient only has had left ventricular biopsy as it was felt that this was a more hazardous procedure with the risk of embolic complications.

To obtain right ventricular samples, catheterization is performed from the left arm, usually through the median antecubital vein. The catheter is passed in

the routine manner to the right atrium. The Konno catheter is rather rigid and, because of this, one has to produce a bend in the catheter before the instrument is introduced, otherwise difficulties may be experienced in manipulating the catheter tip through the tricuspid valve.

We have found that manipulation in the right atrium on occasions may produce a series of atrial dysrhythmias, including atrial fibrillation, nodal rhythm and supraventricular tachycardia, as the catheter impinges against the atrial wall.

When it is thought that the catheter is positioned in a suitable place in the right ventricle to obtain a myocardial sample, it is essential to check the site of the catheter tip. In normal circumstances, when the catheter tip is correctly positioned in the right ventricle, the following intracardiac electrocardiogram is found (Fig. 1a). The record of the intracardiac electrocardiogram is an important part of the technique, and we have used the battery operated Siemens Cardiostat 'T' electrocardiogram. The intracardiac electrogram is recorded in the standard manner, the limb leads being fitted as usual, and then the chest lead is attached by means of a wire with crocodile clips at either end so that one clip is attached to the chest lead and the other to the handle of the biopsy forceps. The injury potential with marked ST elevation indicates that the bioptome is in contact with the myocardial wall. We have found occasionally when the catheter appeared radiologically to be in the right ventricle it was in fact in the anterior cardiac vein (Fig. 1b) and on one occasion in the coronary sinus (Fig. 1c). The absence of ST segment elevation indicates that the bioptome is not in contact with the right ventricular wall.

Once the position of the catheter has been confirmed within the right ventricle, the catheter should be withdrawn a short distance to allow the jaws of the instrument to be opened. If this is not done then the jaws may be entangled within the trabeculae, which would hinder the opening of the jaws. The jaws are now in an open position and the catheter is advanced so that the open jaws come into contact with the myocardial wall. The jaws are now closed and if a

FIG. 1.

satisfactory sample has been obtained it is usual to feel a slight resistance when one pulls the catheter away from the myocardial wall. The catheter is now withdrawn rapidly and the sample retrieved from the jaws. It is quite common to find that in spite of adhering closely to the technique that there is in fact no sample present, and that only fragments of blood clot are found. After a number of biopsies, however, it becomes easier to recognize whether one has got any myocardial tissue in the suspected biopsy since one may see both myocardium and endocardium on naked eye inspection.

The Konno biptome may also be used for left ventricular biopsy, but we have found that this instrument is sometimes rather difficult to introduce into a brachial arteriotomy without causing trauma to the artery. However, once the arteriotomy itself has been negotiated the catheter passes quite easily along the right brachial artery into the ascending aorta and thence to the region of the aortic valve. It is not possible to inject contrast through the catheter and, therefore, it is sometimes difficult to know precisely the position of the biptome tip in relation to the aortic valve orifice. We have found it helpful to locate this whilst we were doing routine aortic

valve catheterization, and then to put a marker on the anterior chest wall in the line of the aortic valve orifice, and, thus, facilitate the manipulation of the biptome through the aortic valve.

Results

A total of twenty-seven patients have now been investigated by endomyocardial biopsies. This has involved twenty-eight interventions as one of the patients has had both right ventricular and left ventricular biopsies. A total of fifty satisfactory samples were obtained from the right ventricle, and two samples were obtained from the left ventricle (Table 2). These samples were of sufficient quality to allow pathological interpretation. In addition, there were approximately twelve attempts in which only blood clots were retrieved but, as we have stated already, it is usually possible to recognize myocardium when it is present with the naked eye.

TABLE 2.

Total no. of patients biopsied	27
Total no. of interventions	28
Total right ventricular samples	50
Total left ventricular samples	2

In two patients, although apparent samples were obtained, they were not sufficient for histological interpretation.

In one patient the catheterization had to be terminated because manipulation within the right atrium caused supraventricular tachycardia and produced left ventricular failure, necessitating DC conversion. The other complications encountered included a short run of atrial fibrillation in one patient which reverted spontaneously to sinus rhythm; multiple ventricular premature contractions are common when the catheter passes into the right ventricle, but these usually settle quickly. Some patients have noticed that during instrumentation they developed discomfort across the centre of the chest, but this is usually of short duration, and very occasionally pericardial pain may develop which lasts for approximately 24 hr, and in two instances this was associated with a pericardial rub.

King's endomyocardial bioptome

The Konno bioptome was used to biopsy sixteen patients, and the remaining eleven patients were biopsied with the King's instrument (Fig. 2). The reason why it was decided to try to find an alternative instrument for endomyocardial biopsy was that we had encountered the following disadvantages with the Konno bioptome.

- (1) The introduction of the tip of the catheter into the vessels was difficult and this was related to the design of the catheter jaws.
- (2) The rigidity of the instrument had limited the intracardiac manipulation.

FIG. 2.

TABLE 3. Advantages of King's bioptome

(1) Design of jaws allows easier introduction into vessels.
(2) Increased flexibility facilitates intracardiac manipulation.
(3) Mechanical problems are reduced.
(4) Myocardial samples are more suitable for pathological interpretation.

(3) There were frequent mechanical problems related to operating the jaws and handle of the instrument.

(4) The samples obtained were often not of a suitable size for pathological interpretation and contained clot.

In collaboration with KeyMed we have developed the Olympus Fibreoptic bronchoscope biopsy forceps FB1C which has a length of 105 cm, a jaw diameter of 1.8 mm and a catheter diameter of 2.0 mm (Fig. 3). This figure shows the jaws of the King's and Konno instruments alongside each other, and one can see that the tip of the King's bioptome is more finely constructed and there is no projecting flange to catch on the vessel wall during instrumentation.

FIG. 3.

The biopsy instrument is more flexible and even with the catheter curled in a fairly tight circle, the jaws of the instrument open readily. We had to find a covering which did not reduce flexibility, and we have used an irradiated polyolefin covering which is heat labile and shrinks after heating to 120°C. It has been possible to maintain the flexibility of the instrument since one can bend the catheter within the right atrium, and the catheterization may be performed from the right arm. It, therefore, has the advantage that the biopsy may be carried out at the same time as catheterization.

We have now carried out biopsies on eleven patients with the King's instrument and have had no dysrhythmias and no pericarditis. In only two patients was there some slight transient chest discomfort through right atrial manipulation.

Conclusion

The Konno technique appears to be a relatively safe procedure for obtaining myocardial muscle samples but can be made safer by using the new forceps. It is useful not only in the purely clinical

application for the diagnosis of either specific heart disease or suspected cardiomyopathy, but also from the research point of view we now appear to have a technique which allows us to study muscle samples from patients with intrinsic myocardial abnormality.

The development of a finer and more flexible instrument has made it possible to obtain samples with greater ease and less morbidity at the same time as routine cardiac catheterization is carried out.

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