A Pericardiocentesis Electrode Needle

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Pericardial aspiration is more difficult and hazardous than aspiration of other serous cavities. If the aspirating needle is introduced too far, it may injure or tear the myocardium, resulting in hæmopericardium, or induce ventricular fibrillation. The dangers are increased if the effusion is small, or if aspiration is performed as a diagnostic procedure to distinguish an effusion from a cardiomyopathy.

Bishop, Estes, and McIntosh (1956), Neill, Hurst, and Penfold (1961), and Lubell and Glass (1962) have described a procedure using a pericardial needle as an exploring electrocardiograph electrode to recognize signs of myocardial injury during pericardiocentesis. Jacobson (1963) from this clinic modified the needle, and his technique has been in routine use at Groote Schuur Hospital since 1962. The value of this method is often not appreciated.

MATERIAL AND METHOD

The modified electrode needle is shown in Fig. 1. It consists of a large bore needle (A) which is used to aspirate the pericardial cavity. This is attached to a syringe (B) to aspirate the fluid through two three-way stopcocks. C is a polythene tube for emptying the syringe. D is the indifferent præcordial lead of electrocardiograph attached to a specially constructed electrode wire (E). The wire has two attachments: a soldered junction with a male Luer-lock fitting attached to the proximal three-way stopcock, and a second screw junction for attachment to the electrocardiograph lead. The wire, therefore, connects the aspirating needle to the electrocardiograph machine so that it acts as a præcordial lead. The electrode needle is sterilized in chlorhexidine or benzalkonium chloride solution or by boiling.

Aspiration is performed through an apical needle puncture beyond the apex of the left ventricle but within the zone of cardiac dullness. An assistant monitors the electrocardiogram while the needle is

advanced into the pericardial cavity. If a large effusion is present aspiration is seldom difficult, but if the effusion is small or fluid is not present the needle is advanced into the epicardium. This produces a characteristic electrocardiographic pattern with ventricular premature systoles or an acute "current of injury" (Fig. 2). The tip of the needle is then withdrawn and the pericardial cavity explored in a different direction. The technique is also useful to assess completeness of aspiration, for the needle can be manipulated until it touches the epicardium.

Needle puncture is also performed through the fifth right intercostal space at the border of the sternum or through the xiphisternal notch. In the former position, atrial premature systoles and an atrial current of injury occur when the needle touches the atrial wall (Fig. 3).

Nearly a hundred pericardial effusions have been aspirated by this method and the following typical examples illustrate the value of the electrode needle.

CASE REPORTS

(1) *Large tuberculous pericardial effusion.* V.M., a Bantu man of 25 years was admitted with a six-week story of dyspnoea on effort and swelling of the legs and abdomen. He had the signs of a large pericardial effusion with tamponade, œdema, ascites, gross hepatomegaly, raised jugular venous pressure (+15 cm.), tachycardia (140/minute), and pulsus paradoxus. The diagnosis was confirmed by electrocardiogram and chest radiograph.

The effusion was aspirated and 500 ml. of straw-coloured fluid withdrawn on three occasions. Although acid-fast bacilli were not isolated, a diagnosis of tuberculous pericardial effusion is likely (Schrire, 1959). In this patient the electrode needle was useful in assessing the completeness of aspiration.

(2) *Tuberculous pericarditis without effusion.* J.B., a Coloured girl of 10 years, presented with cardiac failure and a large heart on palpation and radiograph. A loud third heart sound was heard and diffuse non-specific T wave inversion was present on the cardiogram. Pulsus paradoxus could not be appreciated. She had an ESR of 100 mm. in the first hour (Westergren). A diagnosis of pericardial constriction was made at cardiac catheterization. The distance between

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FIG. 1.—The pericardiocentesis electrode needle. See text for description.

the endocardial border of the right atrium and the free margin of the heart was greater than normal, suggesting an effusion. Aspiration was attempted just lateral to the apex and again to the right of the sternum in the 5th right intercostal space. No fluid was obtained, though the needle electrode touched the epicardium on several occasions. The space-occupying material, therefore, was solid and not fluid. The needle electrode, therefore, excluded pericardial effusion.

(3) *Acute tamponade following mitral valvotomy.* M.B., a Bantu boy of 12 years had a mitral valvotomy performed for critical mitral stenosis. The signs of pericardial tamponade developed on the fifth post-operative day. He had pulsus paradoxus, a tender liver enlarged 6 cm. below the right costal margin, peripheral oedema, raised jugular venous pressure (15 cm.), and an increase in cardiac dullness. 250 ml. blood-stained fluid were aspirated from the pericardial cavity.

The signs of tamponade disappeared and the patient improved. The electrode needle was useful in confirming the diagnosis, since tamponade is an uncommon complication of valvotomy.

(4) *Malignant pericardial effusion from a carcinoma of the ovary with widespread metastases.* J.E., European woman of 41 years. A carcinoma of the ovary had been removed 2 years previously and the patient then received radiotherapy. Eighteen months later pleural effusions and ascites developed: these were aspirated. The patient subsequently developed a very large left pleural effusion, but tachycardia, hepatomegaly, and distended neck veins suggested additional pericardial tamponade. She was very distressed. A litre of blood-stained fluid was aspirated from the pleural cavity. The pericardial aspiration electrode needle was used to explore the pericardial cavity, since the signs were masked by the large pleural effusion: 750 ml. of blood-stained fluid were aspirated. The patient's symptoms

FIG. 2.—Electrocardiographic changes during aspiration of an effusion. (1) Control tracing: T wave inversion is due to the pericarditis. (2) One ventricular premature systole with an acute “current of injury” produced when the tip of the electrode needle touches the epicardium. (3A) Acute current of injury occurring when the needle touches the epicardium. (3 B and C) Current of injury less well marked as the needle is withdrawn from the myocardium. (4) Five ventricular premature systoles and an acute “current of injury” (ST segment elevation) as the needle tip touches the epicardium in a different position. The changes in 2, 3, and 4 indicate epicardial damage and irritation. Aspiration should not be attempted when these are present.

FIG. 3.—Atrial premature systoles with an atrial current of injury, showing the effect of the needle electrode on right atrial muscle.

improved dramatically, and, though she died a few days later, pericardial aspiration made her more comfortable. Once again the needle electrode was useful. In this patient the pericardial effusion was masked by the large associated pleural effusion.

(5) *Cardiomyopathy*. B.S., a Coloured man of 45 years, a heavy wine drinker, presented with a three-month history of congestive heart failure in which the oedema, ascites, and hepatomegaly were out of keeping with the degree of shortness of breath. His jugular venous pressure was raised (12 cm.), and the arterial pulse pressure was small. An electrocardiogram showed extensive T wave inversion while screening showed a very large heart, with a prominent left ventricle and reduced pulsation. A pericardial effusion with tamponade was suspected: aspiration was attempted without success. The pericardial cavity was entered and electrocardiographic changes were seen on several occasions. A diagnosis of cardiomyopathy was made by exclusion: the electrode needle excluded a pericardial effusion.

(6) *Cardiomyopathy with a small pericardial effusion*. B.J., a Coloured boy of 9 years was admitted to hospital with gross anasarca and slight pulsus paradoxus. Cardiac diagram showed low voltage complexes with non-specific T wave inversion, and screening of the heart showed gross cardiomegaly with reduced pulsation. In view of the severity of the signs, pericardiocentesis was carried out to differentiate between a large pericardial effusion and myocarditis. Only 20 ml. fluid were aspirated from the pericardial cavity. The child improved on bed-rest, digitalis, and diuretics. The needle electrode had excluded a large pericardial effusion.

RESULTS

These 6 patients illustrate the value of the pericardial electrode needle in clinical practice. The authors have had a large experience in aspirating effusions, but, where the effusion is small or the diagnosis uncertain, use of the needle electrode gives the operator greater confidence, is useful in excluding an effusion, and reduces any possible damage to heart muscle.

Burch and Phillips (1962) discuss the pericardial electrode needle as a method of differentiating myocardial dilatation from pericardial effusion. In our experience this doubt can be resolved by clinical evaluation supplemented by a careful trial of aspiration whenever indicated.

SUMMARY

A modified electrode needle for aspirating the pericardial cavity is described.

Six cases are described briefly to indicate the value of the needle in clinical practice.

Blind pericardial aspiration is a potentially hazardous procedure. The electrode needle protects the patients and instils confidence in the operator.

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