Technical methods

Revitalising postmortem coronary angiography

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Although postmortem coronary angiography often provides useful information when used in cases of special interest and continues to be used as a research tool^{1,2} there is a reluctance by many pathologists to use the technique on a regular basis. The reluctance is often a reflection of pressure of work especially for those engaged in large numbers of sudden death postmortems but may be due to a misconception of the complexity of the technique. We now describe a cheap and convenient method which combines a simple injection technique with high resolution radiography to produce good quality angiograms reliably.

Examination of the coronary arteries at necropsy may be made by longitudinally opening them with "coronary artery" scissors running the blunt point within the artery lumen. This method is criticised because delicate thrombi may be dislodged before their presence is recognised. A preferred method is serial transverse cuts, 5 mm apart, starting at the ostia.³ However, this method becomes unsatisfactory in the presence of severely calcified atheroma which necessitates inconveniently prolonged decalcification. Dissection methods, however carefully performed, cannot allow evaluation of the number and calibre of anastomotic vessels, and the atrial, A-V node or sinus node arteries are not revealed by these methods.

It is for these reasons that coronary artery angiography is recommended.⁴ The radiopaque injection media that have been used include lead carbonate and mercuric sulphide in agar and barium sulphate and bismuth oxychloride in gelatin.¹ Many of these media are expensive and their preparation is tedious and with some involves the use of toxic material. Media containing gelatin must be injected with the solutions and the heart submerged in a warm water bath to prevent premature setting of the gelatin. Barium sulphate is cheap but when used without suspension in gelatin, tends to settle in the vessel lumen giving an erroneous impression of vascular narrowing unless radiographs are taken immediately.

These problems are overcome by a double con-

trast technique (Figs. 1-3) using very fine grade barium sulphate (Micropaque; Nicholas Laboratories Ltd) which adheres to the endothelial lining of the vessels. After injection, the barium sulphate is reverse flushed from each of the coronary arteries in turn with buffered formol saline. The twin manometer apparatus is based on that of Fulton⁵ and may be constructed cheaply without special workshop facilities. We have used the following method successfully in over 50 cases, mainly patients with known cardiac disease and have been able to demonstrate small, "bona fide" coronary occlusions that may have been overlooked by simple dissection methods.

The heart is removed in the usual way and the aorta transected just above the coronary ostia. The pericardial fat is scraped off by blunt dissection to reveal the adventitial surface of the root of the aorta. Ligatures are placed round both coronary arteries. Each coronary cannula which may be plastic, glass or metal must have an expansion at the tip to allow it to be tied in place. Before securing the cannulae, it is necessary to reverse flush each coronary artery⁶ by perfusing the other with phosphate buffered saline (PBS) at a pressure not exceeding 100 mm Hg until blood-free buffer flows freely from both ostia. A seal on the cannula may be achieved by raising the ligature gently. Surprisingly, residual postmortem clot within the vessels is easily displaced. The delivery tubes are then charged with recently shaken Micropaque, the ligatures tightened and the pressure in each manometer is raised to 75 mm Hg in turn. After this, a sustained pressure of 150 mm Hg is applied to both cannulae simultaneously. Before tying of the ostia 5 ml of formol saline are introduced to displace the non-adherent barium. The pressures are those recommended by Fulton¹ and are thought not to dislodge antemortem thrombus.

The heart may then be stored indefinitely in fixative until it is convenient to perform the radiography. It is possible to open the heart after the method of Fulton⁵ but some leakage of contrast media is experienced and in general techniques using solidifying media are more appropriate if this is to be undertaken.

It is common practice to use conventional x ray films and expensive fine grain industrial films may be necessary to delineate clearly the smallest vessels. We find the use of xerographic plates gives very clear images of the vascular profiles because of the boundary enhancement effect.

The heart is placed in a container with a flat bot-

Fig. 1 *Micropaque®; Xerographic plate. A view of a heart with relatively normal coronary arteries. Note the detail of the atrial circulation.*

tom without any moulding pattern. We use a five litre jerry-can from which one side has been removed. The heart is submerged in PBS or formol saline to reduce the density of the soft tissue shadows⁷ and is exposed with a Philips Mammo Diagnost. at 40 kv, 120 mA for 0.8 s and a tube distance of 50 cm.

This injection method need take no longer than 10 min and is fully compatible with the high turnover and work rate of busy postmortem rooms. It is especially suitable where many hearts are being studied carefully for epidemiological purposes.

Provided the heart is fixed within a reasonable interval of removal and that it is maintained at 4°C if there is any delay in completing the radiography, the

histological appearances are well preserved. Indeed there is less of a tendency to promote autolysis than when solidifying media are used which require the application of heat. In histological sections the presence of the Micropaque in the smaller vessels provides an opportunity to correlate the microscopic changes with the vascular patency.

Clearly, if there is a complete occlusion in the proximal part of either artery then perfusion from one ostia to the other is likely to fail. However, this drawback is common to all angiographic techniques. In cases where the occlusion is longstanding (Fig. 4) the use of Micropaque with its relatively low viscosity allows complete filling of the coronary artery circulation through collaterals.

Fig. 2 *Micropaque®; Xerographic plate. An oblique view of the heart of a patient who died suddenly after laparotomy. Occlusion of the posterior interventricular branch of the left coronary (arrow) with posterior myocardial infarction.*

Fig. 3 *Micropaque®; Xerographic plate. An enlargement of a right coronary artery to show the detail of the luminal profile with two narrowings (arrows). Note the boundary enhancement effect that is characteristic of xerography.*

Fig. 4 *Micropaque®; Conventional plate. This heart was perfused through the left coronary artery only. The right coronary was narrowed to a pinhole at its origin.*

Finally, it must be emphasised that postmortem coronary angiography is only an adjunct to careful dissection.

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