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Coronary Artery Bed Photoscanning Using Radioiodine Albumin Macroaggregates (RAMA)[3]

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Since the introduction of radioiodinated albumin macroaggregates, (RAMA) ^{131}I (1), these particles are used to study the arteriolar-capillary beds in a variety of organ systems including the lung (2-6), the femoral arterial tree (7), the brain (8), and the kidney (9). This report describes the application of RAMA in depicting coronary artery branch occlusions in dogs.

MATERIALS AND METHODS

Fourteen mongrel dogs were used; six in preliminary studies to evaluate the technique and establish the clearance time of the material from the coronary artery bed, and eight before and after a branch of the left coronary artery was ligated. Six of the eight experimental animals had interventricular branch and two had circumflex branch ligations. Coronary artery bed photoscans and coro nary arteriograms were performed before and after the occlusion. The ascending aorta was catheterized through the left carotid artery. Cardiac asystole was induced using acetylcholine. Following balloon occlusion of the ascending aorta, a mixture of 50 μC of RAMA[1] containing 0.05 mg of albumin, 8-10 cc of Angio-Conray (R) and atropine sulfate was introduced by manual injection. Coronary cinearteriography was performed immediately and photoscanning of the precordium was started 15-30 minutes later. A Nuclear-Chicago three by two inch sodium iodide crystal scanner with photorecording and focused collimation was used for the scans. The photoscans were performed in the anterior and left anterior oblique positions with the dog in a supine position.

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RESULTS

The normal distribution of the left coronary artery and its branches is seen in Figure 1. After supravalvular injection of RAMA into the coronary artery system the majority of the activity is located in the left ventricular muscle mass with less activity seen in the right ventricular region. Minimal activity is seen in the region of the atria (Fig. 2). Following selective catheterization and injection of RAMA, the arteriolar-capillary bed of the interventricular branch of the left coronary artery was seen on the photoscan (Fig. 3).

In five out of six instances of left interventricular branch occlusion, the scan depicted the area of ischemia satisfactorily (Fig. 4). The one instance where the scan did not show the area of infarct was when the resultant myocardial ischemia was less than one centimeter in diameter. In both instances where the circumflex artery was tied off midway in its course, the scan depicted the area of myocardial ischemia (Fig. 5). Coronary arteriography demonstrated the site of occlusion in the eight experimental animals.

Transient electrocardiogram changes with premature ventricular contractions and T-wave inversion occurred immediately after the injection of the

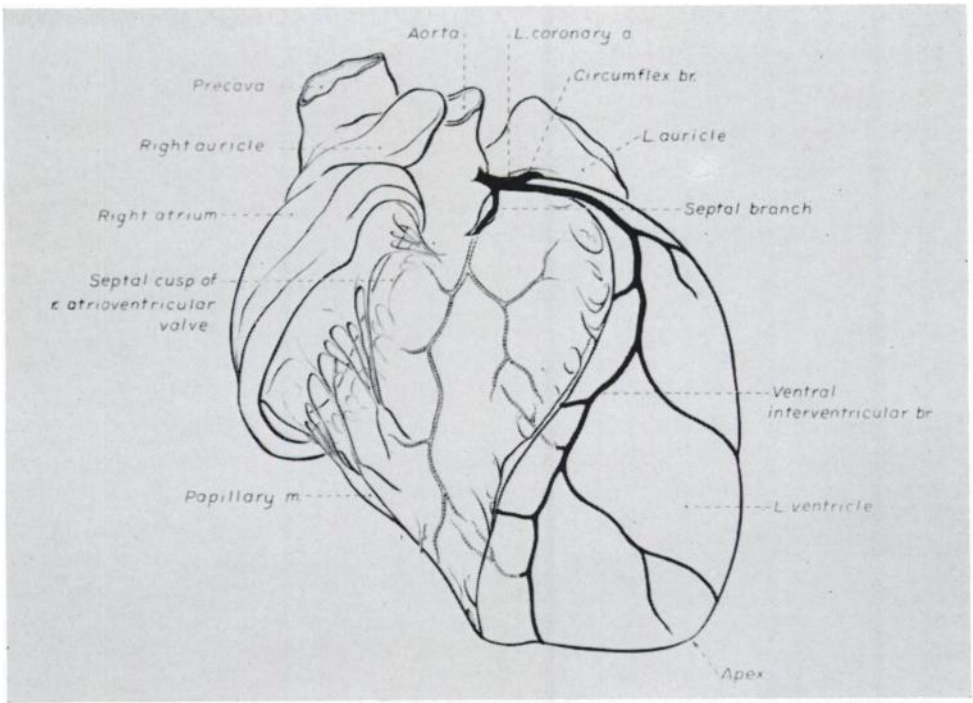

Fig. 1. The left coronary artery and its branches in the dog. The right ventricle has been removed. Miller, Christiansen and Evans, *Anatomy of the Dog*, W. B. Saunders, Philadelphia, 1964.

[1]Kindly supplied by E. R. Squibb and Sons, New Brunswick, New Jersey.

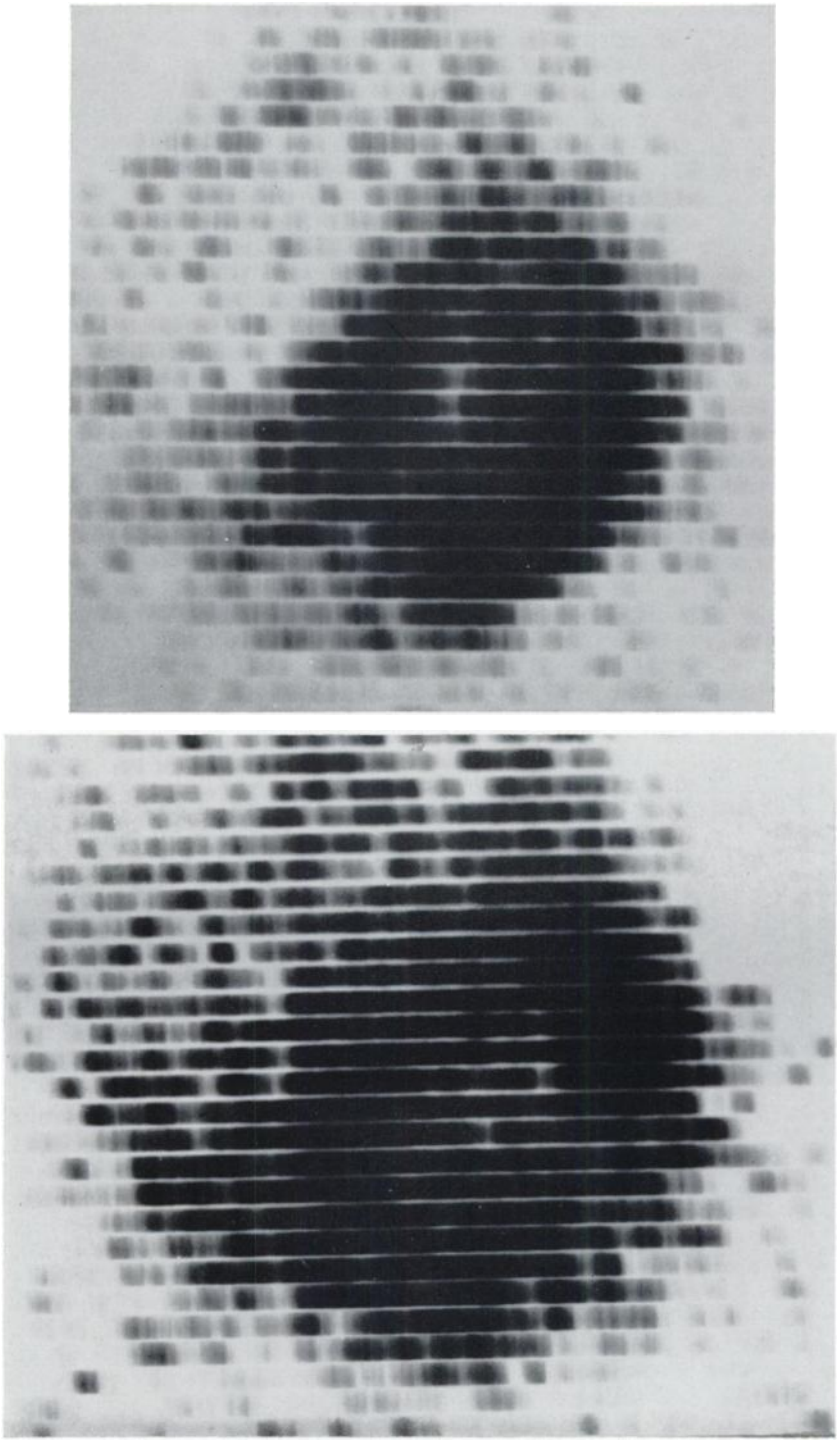

Fig. 2. Anterior and left anterior oblique scans of the coronary arteriolarcapillary bed using radioiodine albumin macroaggregates.

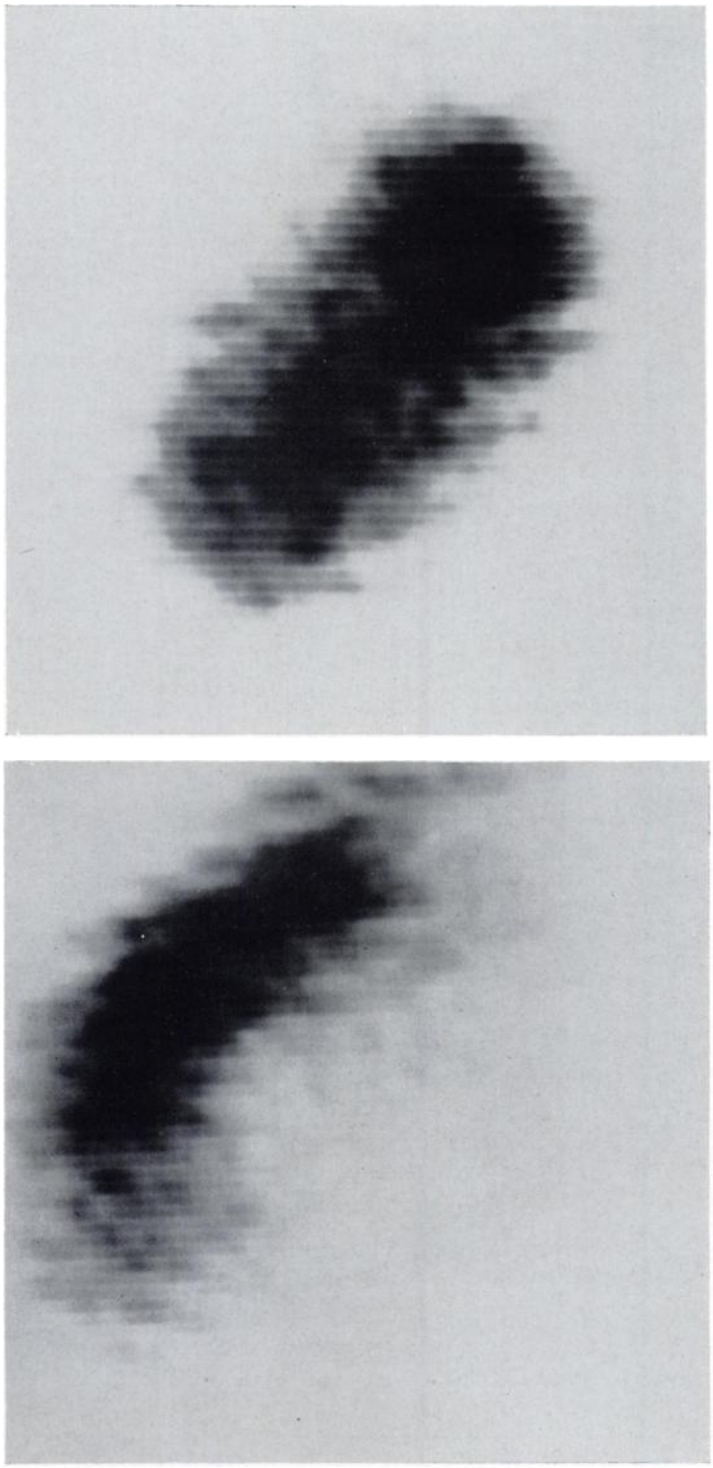

Fig. 3. Anterior and left anterior oblique cardiac scans after selective injection into the interventricular branch of the left coronary artery.

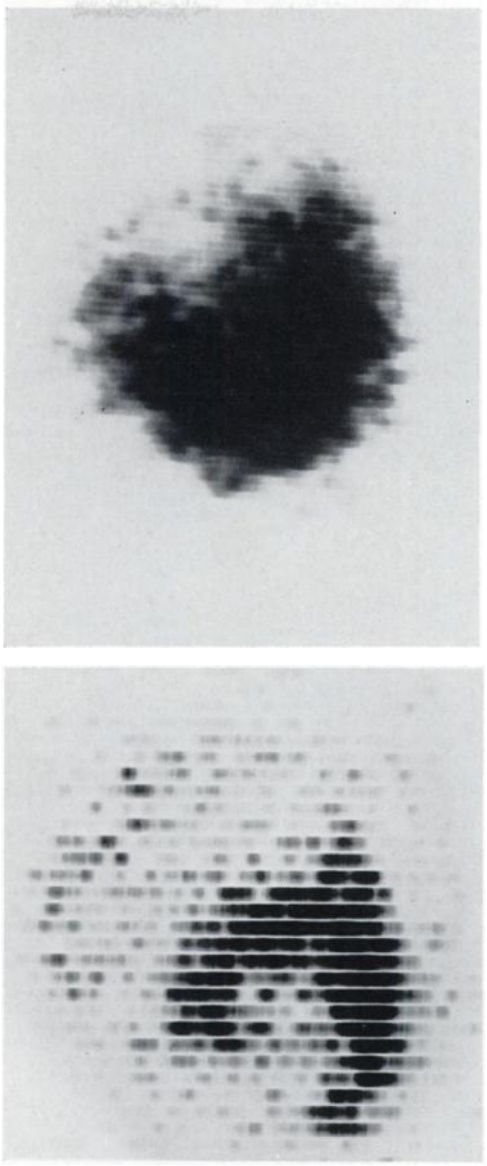

Fig. 4. Anterior heart scans before and after ligation of the distal portion of the interventricular branch left coronary arteries showing a large defect along the medial aspect of the cardiac apex.

RAMA-contrast-atropine mixture. The tracings returned to normal after 15 minutes. Coronary artery occlusion was performed one to six weeks after the initial study in the eight experimental animals. There was no evidence of myocardial damage which might have been related to previous injection in these dogs. Since the albumin injected into the coronary system was less than 0.05 mg, the absence of demonstrable myocardial injury is expected. No studies were performed in reference to toxic levels of albumin aggregates for intracoronary injection. These studies are currently under way.

DISCUSSION

Myocardial scanning has been performed using rubidium-86 (10), mercury-203 chlormerodrin (11), cesium-131 acetate (12), and radioiodinated fatty acid (13). With the exception of chlormerodrin, all these agents demonstrated absence of activity in the area of myocardial infarct or scarring. Chlormerodrin was concentrated in the area of myocardial infarct. Chlormerodrin was a useful agent in depicting myocardial damage in dogs, but the results in man were unpredictable. Cesium-131 acetate and radioiodinated fatty acid show promise and are currently undergoing clinical investigation. All of these agents concentrate in organs contiguous to the heart, stomach, liver, and kidney, which may limit the inherent resolution of the myocardial scan. The technique described in this report

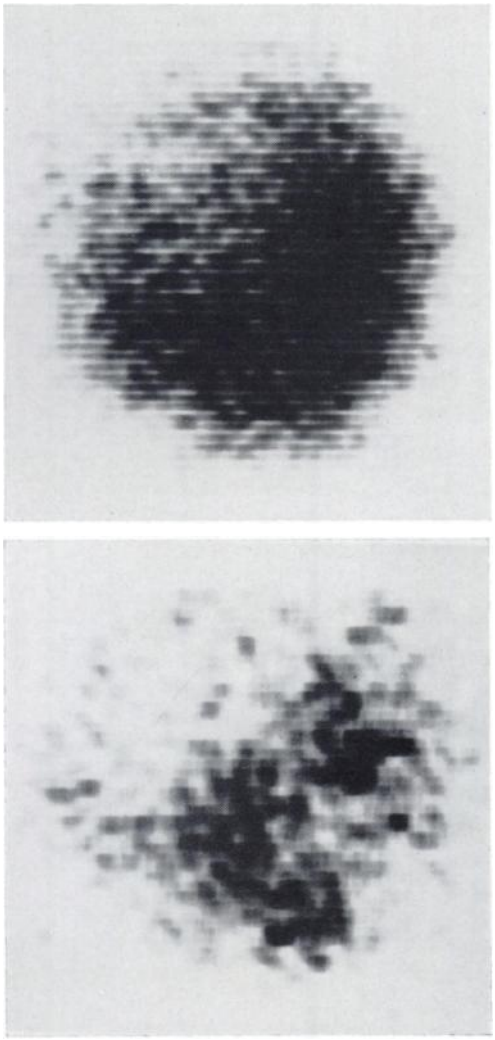

Fig. 5. Anterior cardiac scans before and after ligation of the distal portion of the circumflex branch left coronary arteries showing a large defect in the lateral aspect of the cardiac apex.

does not have this potential disadvantage since there is no contiguous radioactivity until the particles are reduced in size and pass through the coronary bed to be cleared by the liver. A distinct disadvantage to this technique is the necessity for placing the macroaggregates in the coronary arteries using a retrograde catheter technique rather than a simple intravenous injection.

SUMMARY AND CONCLUSION

Following the injection of radioiodinated albumin macroaggregates into the coronary artery system, radioisotope photoscanning demonstrated artificially created myocardial infarcts in mongrel dogs. There was no demonstrable myocardial damage with the albumin dose used (0.05 mg). The toxic level of the albumin injection into the coronary artery system in dogs was not determined at this time.

This technique is satisfactory for investigating the integrity of the coronary arteriolar-capillary bed without interference from contiguous organ uptake.

This procedure should not be used in humans until extensive toxicity studies are completed to establish the safety limits of the injected macroaggregated albumin. Even then, one must proceed with caution if considering coronary injection in a patient with suspected myocardial infarct.

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