ANGIOGRAPHY OF THE CORONARY ARTERIES IN THE LIVE DOG

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IMPROVEMENTS in coronary angiography are basic to further advances in diagnosis and treatment of diseased coronary arteries. Exact localization of coronary occlusions by roentgen study must become possible if restorative surgical technics ever are to be utilized. Clinically, an ideal angiographic technic must be without hazard to the patient, must produce consistent visible filling of all three major branches of the coronary arteries, and must be reproducible. As yet, such standards of excellence have not been met.[1-4] It is the purpose of this paper to report our recent experience with angiography of the coronary arteries in healthy dogs.

Material and Method

Nine healthy mongrel dogs, each approximately 10 kg. in weight, comprised the series for our experiments. The dogs were anesthetized by intravenous injections of pentobarbital sodium (Nembutal sodium, Abbott). A no. 8 cardiac catheter, 50 cm. long, was inserted through one of the carotid arteries into the root of the aorta. The tip of the catheter was bent to make guidance possible. In one experiment the placement of the catheter was guided by fluoroscopy; in all others it was guided with the help of a continuous pressure-recording device†. The strength of the pulsations (as felt through the fingers of the operator) and the form of the curve of the pressure that was being recorded indicated whether the tip of the catheter was above, against, or had gone through the aortic valve. Strong pulsations transmitted through the catheter gave evidence that its tip had not accidentally entered the ostium of one of the coronary arteries.

Roentgenographic exposures were made after rapidly injecting all but 2 or 3 cc. of the contrast medium through the catheter. The roentgenograms were made at 1/60 second without regard to the phase of the cardiac cycle. Single films with each injection proved as satisfactory as multiple films taken by means of a hand-driven tray on which three films could be rapidly moved into position for exposure.

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†*Sanborn one channel recorder, Sanborn amplifier, Stathem gauge.*

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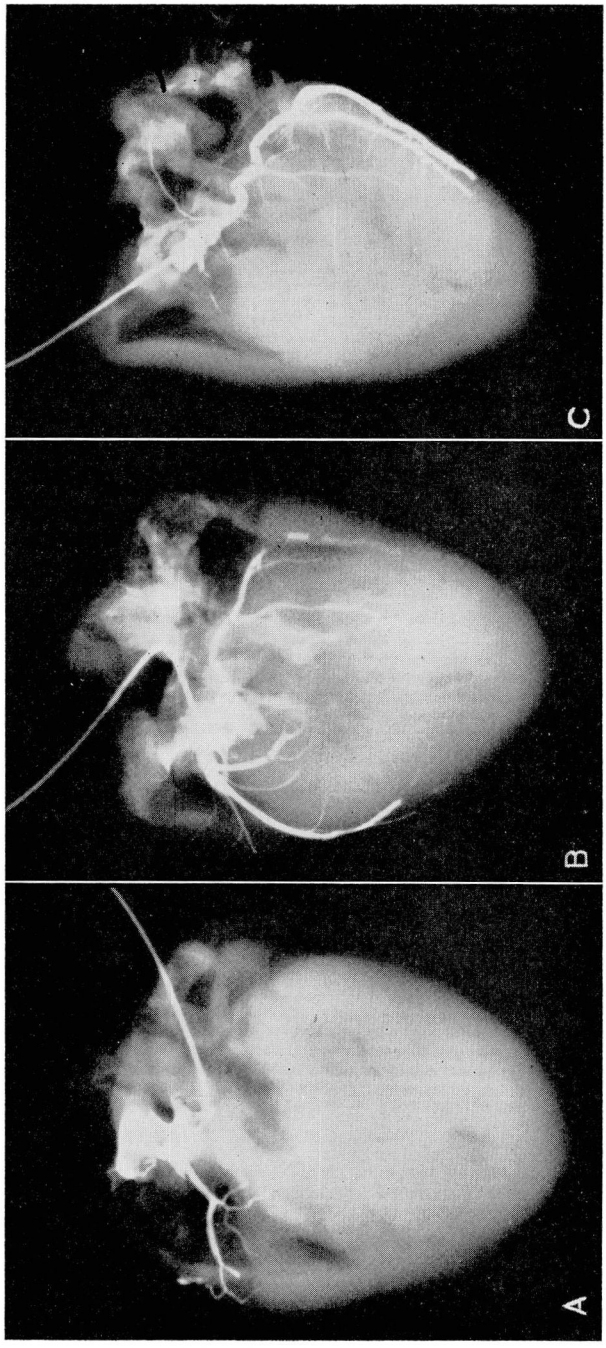

Fig. 1. Injection of individual branches of coronary arteries in isolated dog heart. (**A**) The right coronary artery goes off high and in the dog is of small caliber. (**B**) The descending branch of the left coronary artery. (**C**) The circumflex branch of the left coronary artery. **B** and **C** are of large caliber.

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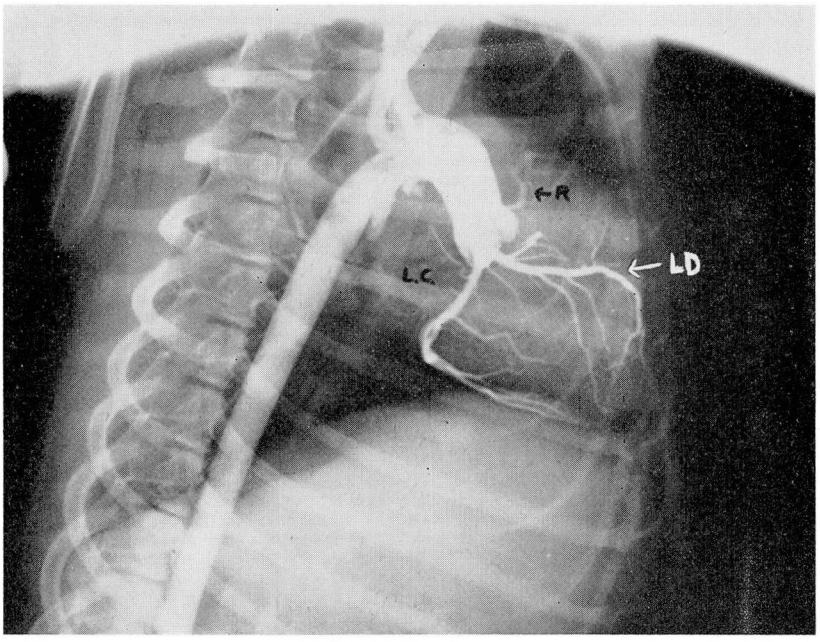

Fig. 2. Viewed with the dog in the right posterior oblique position; the right coronary artery originates from above the right sinus of Valsalva.

Ninety per cent Hypaque sodium* (sodium 3-5 diacetamido 2-4-6 triiodobenzoate) was used as the contrast medium. Thirty-three injections were given in the nine experiments. One dog received seven injections each of 10 cc. of 90 per cent Hypaque sodium without apparent ill effect. Ten cubic centimeters of 90 per cent Hypaque sodium per injection proved most satisfactory, which is approximately 1 cc. per kilogram of body weight. In two experiments Hypaque sodium was diluted with the dog's own blood in an unsuccessful attempt to obtain better filling of the coronary arteries. In one of these two experiments, 25 cc. of 90 per cent Hypaque sodium with 25 cc. of the dog's blood was given in one injection.

Results

None of the dogs died. All were allowed to survive until their wounds had healed. Experiment 2 was a complete failure because of the operator's inexperience in placing the catheter. In the other eight experiments delineation of the coronary arteries was obtained as follows: In all eight the descending branch of the left coronary artery was filled. In seven the circumflex branch of the left coronary artery was filled. In five experiments the right coronary artery was filled—although in two dogs it was hardly more than the entrance to the artery that was filled. Each of those two dogs was lying on its left side instead of in the

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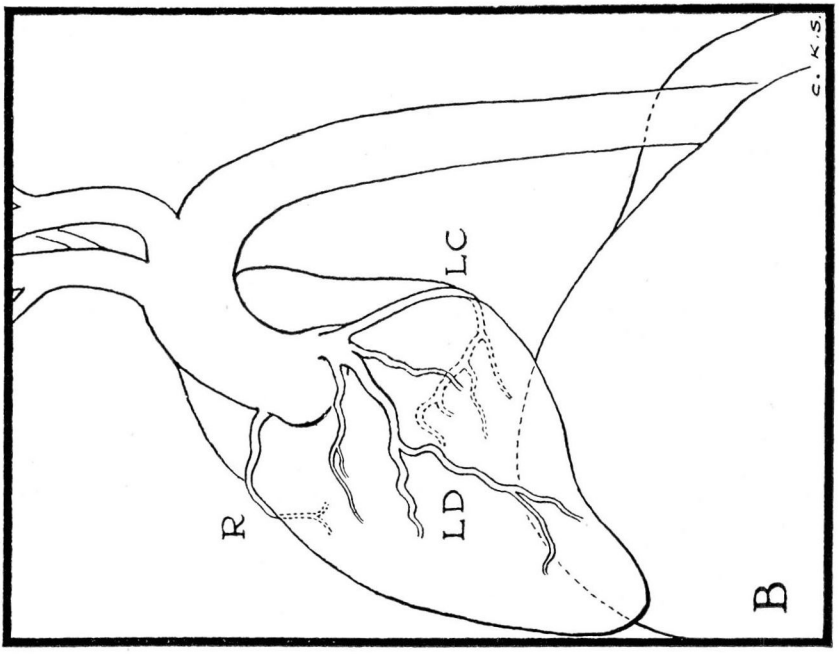

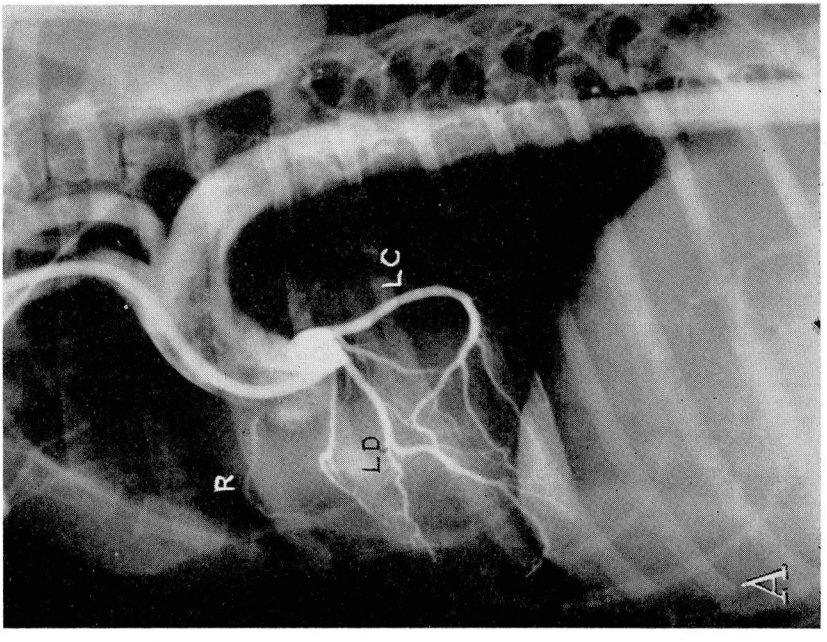

Fig. 3. (**A**) Viewed with the dog in the left posterior oblique position; the right coronary artery (R) originates higher than the left; the circumflex branch of the left (LC) tends to run parallel with the descending aorta; the descending branch of the left artery (LD) runs anteriorly. (**B**) Diagram of **A**.

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left posterior oblique position; consequently, most of the right coronary artery was projected behind the aorta and was obscured by the contrast medium in it. In three experiments the right coronary arteries were not filled; two of those failures occurred when the Hypaque sodium was diluted with the dog's blood, and the third occurred when 5 cc. (instead of 10 cc.) of Hypaque sodium was injected.

Because in the living dog the coronary arteries are roentgenographically projected more or less over one another in one plane, we performed an experiment on an isolated heart by injecting the coronary arteries individually one by one (Fig. 1). The diameter of the right coronary artery of a dog usually is only one third of the diameter of that of either of the two main branches of the left coronary artery. Moreover, the right coronary artery originates from just above the right sinus of Valsalva (Fig. 2). The left coronary artery immediately divides into two branches of about equal size—the left circumflex and the left descending. If the common origin of these two branches is obscured by contrast medium in the root of the aorta, there is danger of misinterpreting one of those branches as being the right coronary artery. Awareness that the origin of the right coronary artery usually is above the sinus of Valsalva helps one to avoid such an error. The tip of the catheter should not lie in the posterior sinus of Valsalva, the only sinus from which or above which no coronary artery originates.

In this series the left posterior oblique position proved best for visualization and interpretation of all three coronary arteries on any single angiogram. In this position the left circumflex coronary artery tends to run parallel to the descending aorta and the vertebral column. The left descending coronary artery runs anteriorly. The right coronary artery can be seen to originate much higher than the left as a small, thin, tortuous shadow arising from above the sinus of Valsalva (Fig. 3).

Summary

The results of coronary angiography are presented, in which 90 per cent Hypaque sodium was used as the contrast medium in nine healthy dogs. Ten cubic centimeters of 90 per cent Hypaque sodium rapidly injected appears to be well tolerated by the healthy dog, and to provide good delineation of all three coronary arteries. The left posterior oblique position provided the best visualization. Aortic pressure recordings were used to help to determine the position of the catheter, as a safeguard against inserting the catheter into the coronary artery itself.

References

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