Effects of Injection of Opaque Media for Selective Angiocardiography in the Dog's Heart.* (23457)

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Injection of radiopaque material into specific areas of the human heart has become increasingly popular with the increasing use of diagnostic angiocardiography. Surgical therapy is frequently based upon anatomical and functional diagnoses secured in this way. Initially such opaque media were injected by hand syringe with a pressure of approximately 60 lbs./sq. inch or 3,000 mm mercury. Mechanical and compressed air syringes are now being used which inject these materials with a pressure of 360-600 lb./sq. inch. The heart could conceivably be traumatized by such an injection. The usual cardiac dynamics could be upset by such an injection, yielding misleading diagnoses and inadequate or unnecessary surgery. We thought it worthwhile to look into this problem.

Materials and methods. A standard radiopaque contrast material was injected into various chambers and great vessels on both right and left sides of the dog's heart while pressures were being recorded in 2 of the other chambers. Electrocardiographic tracings were obtained at the same time. Thirty-eight mongrel dogs weighing *7* to *18* kg were used in 68 experiments. They were anesthetized with intravenous nembutal. The *jugular* and *femoral* veins were used for insertion of #9 Cournaud cardiac catheters on the right side and the *carotid* and femoral arteries used for the left side of the heart. One cc/kg dog doses of the contrast agent was injected by a compressed air syringe(1) at 6-8 kg/cm^2 pressure. The resultant intracardiac pressures were transmitted through P 23 D Statham strain gauges and recorded on an Offner galvanometer system. In those instances where more than one injection was made into the dog, the next injection was not started until demonstrable effect of the preceding injection had disappeared. Because some of these animals seemed to be developing gross lesions in the heart, the next two procedures were performed. In 16 dogs the only procedure was a single injection of 50% Miokon. The catheter was then rapidly withdrawn. These animals were sacrificed 3 days later and the heart and great vessels were closely examined for evidence of recently acquired disease. In 2 dogs the only procedure performed was insertion of a #9 cardiac catheter into the right atrium and right ventricle respectively where it remained 45 minutes. Following this, the catheter was withdrawn and these dogs were sacrificed 3 days later. Their hearts were obviously diseased.

Results. Table I contains a summary of results of the first 48 experiments in which radiopaque material was injected into a vessel or cardiac chamber and the effect on the electrocardiogram and intracardiac pressures was observed. Ventricular extrasystoles frequently occurred with concomitant alteration in right ventricular and systemic pressures. Such an effect is illustrated in Fig. 1. This shows a reduced right ventricular pressure and ineffectual aortic pulse wave on the second, fourth and sixth systoles after injection. When injections were made into the inferior vena cava or aorta, these alterations were not observed.

In the first group of 31 experiments referred to above, the same dog was used for

TABLE I. Electrical and Pressure Changes Related to Site of Injection of Opaque Media.

Site	No. inj.	No. with abnormal ECG	No. with early pressure drop
Superior vena cava	5	3	3
Inferior " "	5	0	0
Right atrium	6	4	3
" ventricle	14	13	10
Pulmonary artery	5	2	2
Left atrium	1	1	1
" ventricle	6	5	4
Aorta	6	0	0

* Supported by funds from Los Angeles County Heart Assn.

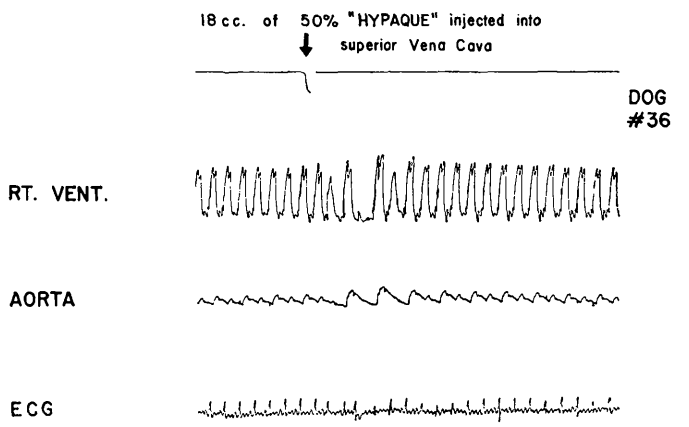

FIG. 1. Effect of inj. of opaque media on pressures and electrocardiogram.

more than one experiment. As a result, the catheters remained in the heart and great vessels for several hours. Of the 13 dogs in these experiments, 8 dogs had subendocardial hemorrhage and/or thrombosis at post mortem examination. The site and nature of the abnormality are indicated in Table II with reference to the point and numbers of injections. Fig. 2 illustrates the extensive nature of the subendocardial hemorrhage, and Fig. 3 illustrates the nature of the thrombus formation.

In the group of 16 dogs in which only the radiopaque material was injected and the catheter promptly withdrawn, no evidence of intracardiac disease was found. Thus it would appear that injection of radiopaque material under these pressures does not *per se* cause intracardiac pathology.

On the other hand, intracardiac thrombosis and hemorrhage *were found* in the 2 dogs in which the cardiac catheter remained in the heart for 45 minutes. The lesions were similar to those found in 8 of the 13 dogs in the first experiment.

Discussion. Selective angiography potentially has a number of advantages over venous angiography(2,3). The purpose of this study was to determine some of the limitations and side effects of rapidly injected, commonly used contrast agents upon the heart. When a radiopaque material is forcibly injected into the right heart, pulmonary artery or superior vena cava, momentary pressure disturbances can occur. These may be attributed in a large part to ventricular extrasystoles associated with the injection. If there were a ventricular septal defect present, opaque material would then proceed from right to left ventricle and thence out the aorta. One might erroneously imply the existence of a right to left interventricular shunt under such conditions.

It seemed reasonable to suppose that intracardiac injection of opaque media under "high" pressure might produce some sort of intracardiac pathology. No such disease was found. Some dogs had subendocardial hemorrhage and thrombi. Our studies indicate that these were related to the presence of the catheter within the heart for periods of over

TABLE II. Dogs in Which Pathological Findings Were Present at Autopsy.*

Dog #	Sites inj.	Sites recorded	Sites with pathology	Types of pathology
3	R.V. 5 times	R.V. & aorta	2 R.A., 2 R.V., mitral valve	Thrombus vegetations
4	R.V. & L.A.	R.V., aorta, carotid	Subendocardium	Hemorrhage
5	L.V.	R.V., L.V.	R.A.	Thrombus
7	R.V.†	R.V., L.V.	2 R.A., L.V.	Hemorrhage
8	P.A.	R.V., L.A.	2 R.A., aortic valve	Thrombus hemorrhage
9	P.A.	L.V., carotid	Aortic valve	Hemorrhage
12	R.A. & L.V.	R.A., fem. art.	R.A.	Thrombus
13	L.V.	R.V., L.V.	R.V., aortic valves	Hemorrhage

* Catheters in heart for a minimum of 1 hr.
† 5% glucose in distilled water inj.

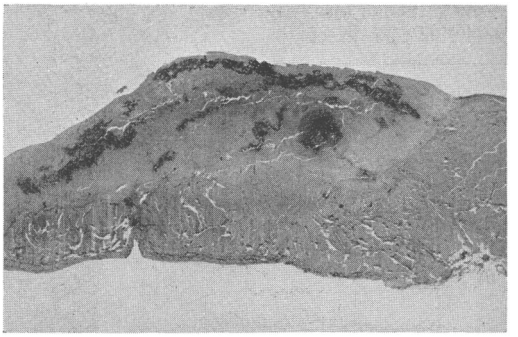

FIG. 2. Cross section of dog #5 heart showing extensive subendocardial hemorrhage.

45 minutes. These complications have not been reported previously.

Conclusions. 1. Subendocardial hemorrhage and intracardiac thrombosis are found when catheters remain in the heart for over 45 minutes. 2. No such lesions could be attributed to "high pressure" intracardiac injections of ordinarily used contrast agents. 3. Disturbed pressure relationships probably due to asynchronous ventricular extrasystoles are frequently seen with injection into the heart, superior cava or pulmonary artery. 4. Such electrical, contractile and pressure disturbances were not noted with injection into the inferior cava or aorta.

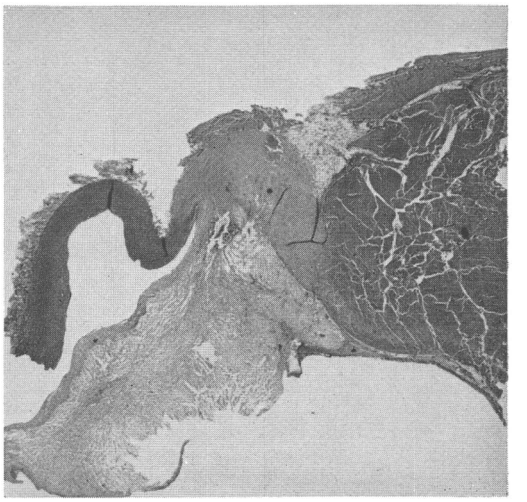

FIG. 3. Cross section of dog #5 heart in region of aortic valves showing a moderate sized thrombus.

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Growth of Several Arthropod-Borne Viruses in Tissue Culture. (23458)

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Diagnostic isolation and identification of arthropod-borne viruses, an antigenically related group with widely variable host range, is difficult for the small laboratory when infections by several types occur in the same area. A single host system susceptible to a majority of the group, conveniently available, easily manipulated, and sensitive to small amounts of virus, is desirable. Tissue culture systems for this group have not been extensively investigated. The group A viruses, eastern (EEE), western (WEE), and Venezuelan (VEE) equine encephalitis viruses have a wide host range and no particular difficulty has been experienced in infecting chick embryo fibroblasts and HeLa cells. Except for West Nile virus, the group B viruses do not produce cytopathic (CP) changes with regularity in the above tissue culture systems (1,2). Reports are lacking on the infection of other tissue culture systems with the group B viruses except for St. Louis encephalitis which produced CP effects on 2 chemically induced rodent tumors and 2 tumors of human origin(3), and Japanese B encephalitis (JBE) and West Nile (WN) which has recently been reported to cause CP effects in Detroit-6 cells (4).