Angiocardiographic Demonstration of Occlusive Auricular Thrombi in Dogs

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Simulated occlusive auricular thrombi were produced in six dogs by surgically invaginating the left auricular appendage. Angiocardiographic studies were performed in five of the dogs and in each case revealed these thrombi as clear cut filling defects. The significance and clinical application of these observations is discussed.

In a previous paper it was postulated that in view of the encouraging progress made in both the diagnosis and surgical alleviation of a variety of cardiovascular lesions, it might be hoped that ultimately such thrombi could be demonstrated by angiocardiographic technique and subsequently removed in conjunction with a mitral valvotomy. Since such thrombi have invariably terminated fatally, early and accurate diagnosis could conceivably represent a lifesaving measure.

The incidence of occlusive auricular thrombi has been variously reported to range from 1 in 3000 to 1 in 540 autopsies. The incidence of such thrombi in patients with rheumatic heart disease has been reported as 1 in 32 cases by Garvin and 1 in 32 cases by Wallach and coworkers. Evans and Benson found an incidence of one out of eight patients coming to autopsy with mitral stenosis.

The value of angiocardiography in detecting a similar object within the heart has already been demonstrated in man by Bahnson and Newman. They presented the case of a large pedunculated myxoma, which was demonstrated as a large filling defect in the right auricle following injection of Diodrast through a number 8 catheter. The tumor was successfully removed but the patient succumbed 24 days later of postoperative complications. As a result of our experience with four cases of occlusive auricular thrombi, we decided to study the diagnostic efficacy of angiocardiography in dogs following the insertion of an artificial thrombus into the left auricle.

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Fig. 1. The heart from dog 1 is shown viewed from apex to base with the lower two thirds of both ventricles removed. The invaginated left auricular appendage, T, can be seen protruding into the left auricular cavity. LA, RV, right ventricle; IVS, intraventricular septum; LV, left ventricle; MV, mitral valve; AV, aortic valve.
MATERIAL AND METHODS

Six dogs, ranging in weight from 25 to 35 kg., were selected for this study. Using aseptic technique, the left auricular appendage was inverted and tightly ligated so as to simulate a pedunculated thrombus of the left auricle. The first dog was sacrificed immediately following this operation in order to examine the appearance of the simulated thrombus (see fig. 1). At least one angiographic study was performed in each of the five remaining dogs following inversion of the left auricular appendage. One of the dogs had, in addition, a ligature passed around the base of the mitral valve according to the technic of Ellison and associates. Thus, it was possible to gradually narrow this orifice, and to produce varying degrees of mitral stenosis and simultaneously to record pressures within various segments of the vascular tree.

For the angiographic studies, the dogs were placed in the left lateral decubitus position with the thorax resting on the cassette of a Fairchild roentgen camera. The camera was adjusted so that frames were automatically changed every half second.

Twenty c.c. of a 60 per cent Diodrast solution were injected rapidly through the tip of a number 8 cardiac catheter or through a needle in the jugular vein. Figure 2 demonstrates the serial findings observed in one dog. In this dog, the anterior and

![Figure 2](http://circ.ahajournals.org/)

Fig. 2. (A) After one second the contrast material fills the superior vena cava, right auricle, right ventricle, and pulmonary vessels. (B) After one and one-half seconds, the contrast material has been distributed throughout the pulmonary vascular bed. Arrows indicate radiopaque material used to localize the point of invagination of the auricular appendage. (C) After three seconds, the contrast material fills the left auricle, left ventricle and aorta. A filling defect can be distinctly visualized in the left auricle. (D) After four and one-half seconds, the contrast material is beginning to fade from the left auricle but still outlines a filling defect.
posterior boundaries of the auricular appendage have been marked by strips of radiopaque gauze in order to show that the filling defect observed actually appeared in this position. Figure 3 is an angiocardiogram in another dog. The Diodrast in this case was injected through the tip of a number 8 catheter placed in the pulmonary artery. The radiopaque material could not be injected as rapidly through the catheter as it could through a large needle in the jugular vein and, therefore, the contrast was not so marked as shown in figure 1 where Diodrast was injected through an intrajugular needle.

**Discussion**

It has been shown that occlusive thrombi of the left auricle can be demonstrated consistently as clear-cut filling defects by angiocardiography. Since occlusive thrombi of the left auricle have been found in approximately 1 out of every 8 autopsied cases of mitral stenosis and 1 out of every 10 cases in our series, the use of angiocardiography may be of considerable value in demonstrating such thrombi in human subjects whose clinical picture might suggest this condition. The growing popularity of angiocardiography in the selection of patients for mitral surgery makes it highly probable that such a thrombus will ultimately be both demonstrated as a filling defect by Diodrast injection and successfully removed through an auricular incision. Further studies relating to the hemodynamics in patients with occlusive thrombi of the auricles are in progress in an attempt to better delineate the clinical syndrome.

**Summary**

Simulated occlusive thrombi of the left auricle were created surgically in six dogs by invaginating the left auricular appendage. Angiocardiographic studies were performed in five of the dogs. In each case, the thrombus was demonstrated as a clear cut filling defect. The significance of this procedure and its human application is discussed.

**Summario in Interlingua**

Thrombos occlusive del auriculo sinistre esseva simulate chirurgicamente in sex canes per invagination del sinistre annexe auricular. In cinque casos studios angiocardiographic esseva executate. In omne casos le thrombo se manifestava claramente per un defecto de replenamento. Es discutite le signification de nostre technica e su application a humanos.

**REFERENCES**

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