the brain. The proposal of Zalkin *et al.*(4) that the function of both Vit. E and selenium can be explained on a physiological antioxidant basis is not supported by these data.

Summary. Three-week-old chicks fed either a Vit. E deficient or supplemented diet were intraperitoneally injected with Se^{75}, and distribution of the isotope was determined in various tissues at 24, 48, and 168 hours after injection. Similarly, 2-week-old chicks fed a selenium deficient or supplemented diet were given an oral dose of Se^{75} and the distribution of the isotope in several tissues was determined at 24 and 168 hours after administration. Vitamin E had no effect on distribution of selenium, but selenium itself had a marked effect on the uptake and retention of radioselenium. One-half of the dose was retained by selenium-deficient chicks at 7 days, whereas only 1/5 of the dose was retained by chicks fed 1 ppm selenium from day-of-age. Considerable selenium was deposited and retained in the cerebellum of chicks even though this element cannot prevent encephalomalacia.

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Roentgenography of the Thoracic Duct in Man by Oral Administration of Contrast Media. (28204)

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Information concerning the role of the thoracic duct in disease states of man is almost completely lacking. The present level of knowledge of this structure is comparable to that of the biliary and gastrointestinal systems prior to introduction of biliary and gastrointestinal roentgenography. A convenient oral method for identifying the thoracic duct in an X-ray film should provide new insight not only into abnormalities of the thoracic duct and intestinal lymphatics but in disease elsewhere. Recent studies suggest, for example, that alterations in the thoracic duct occur in disorders of the liver and heart and are of considerable importance(1).

Although attempts to obtain X-ray studies of the thoracic duct have been described by others using technics other than intralymphatic injection of contrast material, none have been successful(2,3). In this report a method for obtaining such studies is described. The technic is based on the consideration that adequate emulsification and dispersion of fat soluble contrast media must first be obtained *in vitro*.

Methods. The contrast material was freshly prepared for each patient by mixing 15 g of bile salts, 60 cc of polyoxyethylene (20) sorbitan monooleate (Tween 80), 50 cc of the iodinated propyl ester of poppyseed oil (Lipiodol) and 400 cc of water in a Waring Blendor for 15 minutes. This emulsion was fed to 5 patients through nasogastric tubes. Two and one half hours after the feeding tomograms of the chest were taken in the left lateral position at the level of the midline, 1 cm to the left of the midline and 1 cm to the right of the midline.

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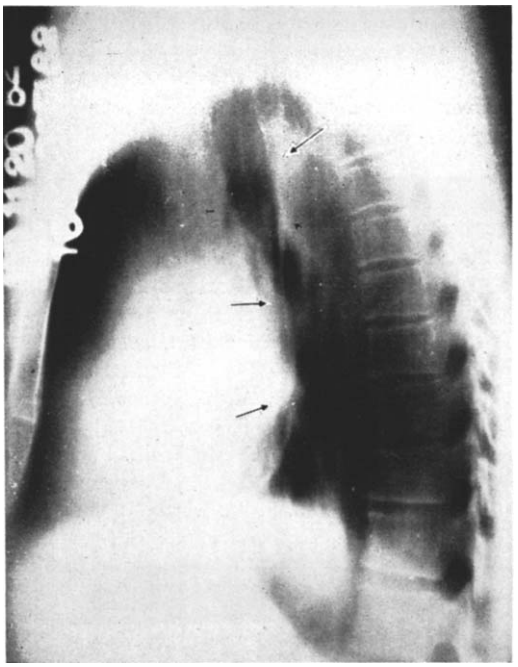

FIG. 1. Tomogram of chest taken in left lateral position at level of midline. Thoracic duct is indicated by arrows.

Results. The thoracic duct was identified in X-ray films of the chest in 4 of the 5 patients studied. Results in one patient, which are characteristic of the other 4, are shown in Fig. 1. The fifth patient regurgitated most of the contrast material soon after administration and the thoracic duct was not visualized. In the remaining 4, the material was well tolerated and vomiting, diarrhea and crampy pain were absent.

X-ray films of the chest were taken several days to several weeks after this study and no residual Lipiodol was observed in the lung fields.

Discussion. Previous attempts at oral thoracic duct radiography have employed a variety of orally administered iodinated fatty acid molecules, including Lipiodol, without success. It is reasonable to speculate that the limiting factor in such studies has been inadequate transport of iodinated fat across the gut wall into lacteals. Bile salts, Tween 80 and water when mixed with Lipiodol provide for a high degree of emulsification and dispersion prior to that which occurs *in vivo*. Microscopic examination of this emulsion with dark-field illumination demonstrated that the fat particles are comparable in size and appearance to thoracic duct chylomicrons. When fed, the emulsion is apparently absorbed and transported into lacteals in amounts sufficient to be radioopaque. Although satisfactory X-rays of the thoracic duct were obtained in these preliminary studies, improved contrast between the duct and surrounding structures can probably be achieved by measures promoting greater *in vitro* emulsification and by using contrast material in which more double bonds are replaced by iodine. Further, addition of a lipid stabilizing factor, such as lecithin would eliminate the need to prepare a fresh emulsion each time a study is performed.

There are many possible applications of this technic to problems in physiology and medicine. In the same way the X-ray studies of the gallbladder by means of oral contrast media provide information about its concentrating ability, filling of the thoracic duct following oral administration of fat soluble contrast material permits observations concerning digestion, absorption and lacteal transport of fat. The transport of fat in diseases such as regional ileitis, intestinal lipodystrophy and sprue may now be studied roentgenologically. Also, the etiology of chylous effusions and chyluria may be elicited by this method.

Recent observations of the thoracic duct at operation in patients with cirrhosis and congestive heart failure have clearly shown that the duct is capable of extreme dilation in diseases associated with overproduction of capillary filtrate. Further, these studies suggest that the limited ability of the duct to function as a safety valve for this excess fluid is related to development of venous hypertension. Much more information about thoracic duct flow is needed and it is likely that the technic described here can be applied to these problems.

Summary. X-ray views of the thoracic duct by means of orally administered contrast media have been obtained for the first time by providing for adequate emulsification and dispersion of an iodinated fat prior to administration.

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Radiation Technique for Production of Localized Myocardial Necrosis in the Intact Dog.* (28205)

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At present coronary ligation or cornary embolization is the principal technique for experimental production of myocardial infarction in laboratory animals(1,2). The former necessitates a thoracotomy, and the latter technique requires retrograde aortic catheterization. In an attempt to develop a more versatile method for production of localized myocardial lesions, the cardiac effects of a collimated beam of x-irradiation directed to the heart have been studied. The myocardium is considered a relatively radioresistant tissue, and the literature on cardiac irradiation is sparse(3,4,5,6). Warren summarized the cardiac effects of irradiation and described the non-specific changes of aseptic necrosis, hyaline fibrosis and obliterative vascular changes(4). In the aforementioned studies, the radiation dosage to the heart was less than 5,000 roentgens. Using a considerably higher dosage, a radiation technique for experimental production of localized myocardial necrosis is presented.

Methods. The study was performed on 12 adult dogs (15-20 kg). A 1,000 KVP General Electric Industrial X-ray Generator with a collimator attachment was used to deliver a roentgen beam 2.54 cm in diameter through the anterior chest wall to the heart of the dog. The radiation was delivered at a calculated rate of 210 roentgens per minute to the heart, and the half value layer of the beam was 3 mm lead. The calculated cardiac air dose of radiation for a given beam was between 2,500 to 20,000 roentgens depending on duration of irradiation. The portal of entry of the beam could be varied by simple positioning. During irradiation, the animals were anesthetized with intravenous sodium pentobarbital, 30 mg per kg of body weight.

Conventional 6 lead frontal plane electrocardiograms (ECG) were obtained before irradiation and almost daily during the first week following irradiation; thereafter, ECG tracings were taken at approximately weekly intervals until autopsy examination. The animals were sacrificed using a large intravenous dose of sodium pentobarbital and examined at arbitrary intervals after irradiation. Tissues were fixed in 10 per cent formalin, dehydrated and paraffin imbedded. Sections were stained with hematoxylin and eosin, and in a few instances phosphotungstic acid hematoxylin and phloxine-methylene blue stains were used.

Results. A preliminary study on 4 animals with varying doses of cardiac radiation (2,500, 5,000, 10,000 and 20,000 roentgens) demonstrated well-circumscribed myocardial necrosis by the 11th post-irradiation day in the animal receiving 20,000 roentgens. This latter dose was studied in greater detail. In each of 8 dogs, 20,000 roentgens were delivered through a single portal to the region of the apical cardiac impulse with the animal in the left anterior oblique position (30 degrees). The results are summarized in Table I.

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