A Special Cannula for Determination of Blood Flow in the Left Common Coronary Artery of the Dog

R. W. Eckstein, J. A. McEachen, J. Demming, and W. B. Newberry, Jr.

Department of Medicine,
Western Reserve University, Cleveland, Ohio

Gregg and Shipley (*1, 2*) have measured coronary inflow in dogs by cannulation of the left common coronary artery via the aorta with cannulae inserted through a carotid or left subclavian artery. More recently Eckstein (*3, 4*) and Eckel (*5*) have reported total left coronary flow studies made with a special cannula described by Chambliss (*6*). All these cannulae must be inserted a sufficient distance into the coronary artery to be secured by a ligature. The use of even the special cannula may be impossible because of a short left common coronary artery. Frequently the septal and other branches may be occluded. These difficulties may be circumvented by the self-retaining cannula which is shown in Fig. 1. This cannula is not tied in place, but is held over the coronary orifice by counter pressure applied to the external aortic wall.

The left common coronary artery is exposed at the aorta and the long arm of loop *G* is passed under it until the artery lies in the loop. The cannula is connected at *A* to the output tube of the rotometer and filled with heparinized blood. The cannula tip is inserted into the aorta through the left brachiocephalic artery and the artery ligated about the shaft of the cannula. Loop *G* is inserted into holes *E* and *E* in holder *D*. The tip is passed along the left aortic wall to the level of the aortic valves until the arm of holder *D* can be connected to cannula arm, *B*, by the insertion pin *C*. Spring *K* is then attached to hook *L*, thereby compressing the aortic wall. The cannula is so constructed that when all parts are joined in this manner the cannula falls into the proper position.

Several details of construction are important for ease of operation and accuracy of recording. The cross section from *I* to *L* must be uniform to prevent blood leakage around the cannula when the tip is advanced to the coronary ostium. To achieve this end the needle is soldered in a groove in the cannula wall. The orifice *I* of needle *J* is placed on the right side of the cannula to record true aortic pressure when the cannula lies in position. Holder *D* and its arm have been designed to prevent impingement upon the pulmonary artery or the heart wall by the holder.

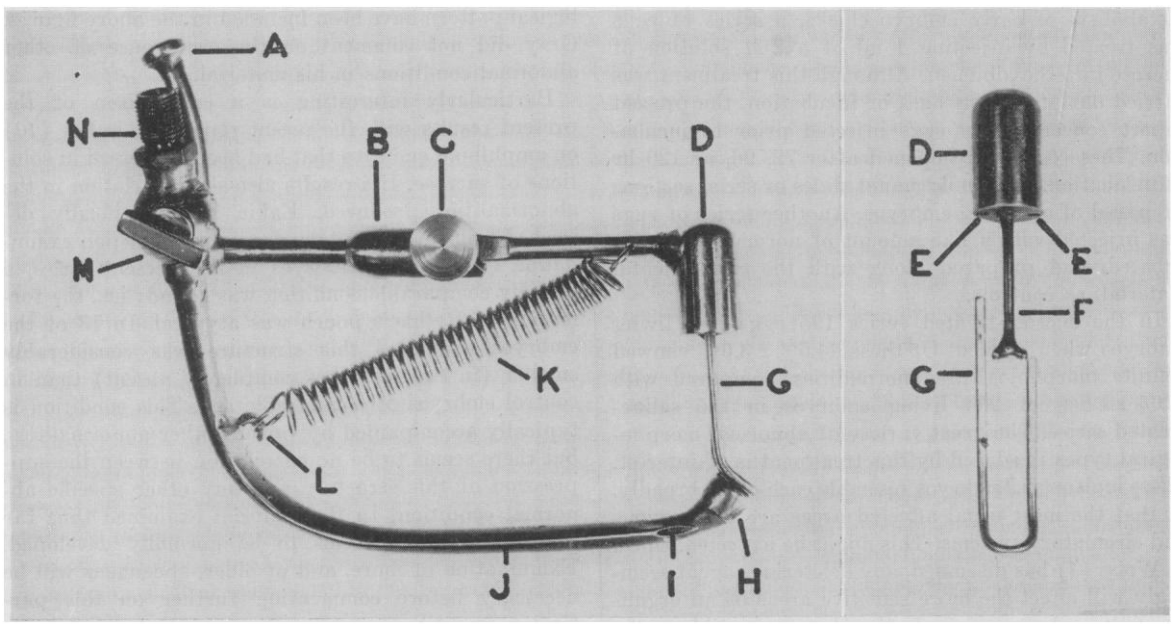

FIG. 1. Left, side view of stainless steel cannula; right, front view of holder and wire loop (both actual size). *A*, Cannula connection to rotameter; *B*, cannula arm; *C*, pin; *D*, holder soldered to holder arm; *E* and *E*, holes in holder for arms of loop *G*; *F*, centerpiece which completes ring with *G*; *G*, 1/16-in. spring steel wire loop which fits around left common coronary artery; *H*, cannula tip; *I*, orifice of needle; *J*, 17-gauge spinal needle for recording aortic pressure; *K*, steel spring; *L*, hook for spring; *M*, stopcock; and *N*, connection to aortic pressure manometer.

The proper positioning of the cannula may be tested by clamping the rotameter input and opening a side-arm in the tube connecting the cannula to the rotameter output. Any leakage from the aorta past the cannula tip into the coronary artery will be demonstrated by blood dripping from the side-arm. Post-mortem injection of India ink under pressure through the cannula has shown satisfactory perfusion of all branches of the left common coronary artery in all experiments in which the cannula has been used, and no reflux

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around the cannula tip into the aorta has been demonstrable. With this cannula it has been possible to measure total left coronary inflow in vessels impossible to cannulate by other techniques.

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Developmental Abnormalities in Chick Embryos Treated with Sugar

Ernest L. Hunt

Department of Biology, Emory University, Georgia

As a part of a problem concerning the carbohydrate metabolism of early embryo chicks, a series of eggs was treated by injecting 1 ml of a 2-*M* solution of sucrose into the albumen. Although this treatment was carried out at various ages of incubation, the present report concerns only eggs injected prior to incubation. These eggs were opened after 72, 96, or 120 hr of incubation, and whole-mount slides or serial sections prepared of all living embryos. Another series of eggs was injected with a like amount of normal saline, incubated, and prepared along with the experimental material, as controls.

In the sucrose-treated series 195 eggs had living embryos when opened. Of these 44.5% ± 3.6% showed definite morphological abnormalities, compared with 8.3% ± 1.8% of 234 living embryos in the saline-treated series. The great variety of abnormal morphological types produced by this treatment is of interest. These malformed embryos resemble each other broadly, in that the most usual affected areas are the nervous and circulatory systems. This might be expected, since, as Weiss (*1*) has discussed, any deleterious agent seemingly will affect the more sensitive areas of an organism first, and more severely than less susceptible parts. The stages treated here—0–72 hr, 0–96 hr, and 0–120 hr—cover the period when these two systems are particularly active in growth and differentiation. However, the specific syndromes of abnormality found within this broad general pattern show extreme variation, ranging from suppression or atypical development of a single region, such as the eye, to a completely amorphous mass, or to complete absence of an embryo from the blastoderm. No one specific syndrome of abnormality occurs in a significant percentage of the material; rather a large number of abnormal conditions reported in the literature of being produced by experimental treatment of various types seem to have been closely duplicated here.

To cite a few such examples: The "rumplessness" produced by Landauer (*2*) by injection of insulin or other chemicals, and described by Moseley (*3*) appears in 8 embryos. The various abnormalities of the central nervous system, particularly the "sinuous nervous system" described by Catizone and Gray (*4*) after treatment with lead salts, and by Hansborough (*5*) as being produced by nicotinic acid, appear to be duplicated in 13 embryos. The presence of a double heart, shown by Szepsenwol (*6*) and by Waddington (*7*) to be brought about by operative injury, occurs in two examples. The author believes, however, that he has ruled out mechanical injury as a factor in the present work. Gray and his co-workers (*8, 9*), in two interesting abstracts, have shown that the injection of certain optically active compounds will significantly change the percentage of occurrence of heterotaxic embryos. In the present experiment, 9.7% ± 2.1% of the treated embryos were heterotaxic compared with 2.8% ± 1.1% in the saline-treated controls. These heterotaxic embryos often show other abnormalities in varying degrees, but only embryos that were nearly enough "normal" to determine their essential morphological pattern have been included in the above figures. Gray did not comment on the occurrence of other abnormal conditions in his material.

Particularly interesting is a comparison of the present results with the recent report by Eakin (*10*) on amphibian embryos that had been immersed in solutions of sucrose. His results also show variation in the abnormalities produced. Eakin has specifically described failure of pituitary development. Upon examination of sectioned embryos in the present series, a broadly comparable condition was found; i.e., the formation of Rathke's pouch was atypical. In 13 of the embryos examined this structure was considerably smaller (in two instances completely absent) than in control embryos of comparable age. This condition is typically accompanied by various other abnormalities, but there seems to be no correlation between the suppression of this structure and any other specific abnormal condition. In the material examined thus far the infundibulum seems to be normally developed. Examination of more, and of older, specimens will be necessary before commenting further on this particular condition.

Eakin (*10*) has offered several possible suggestions as to the cause of the anomalies produced in his experiments, without specifically attempting an analysis of those causes. The present author can do little better. According to Needham (*11*), the chick embryo during the stages under discussion is largely dependent on a carbohydrate metabolism as a source of energy for growth and differentiation. Landauer (*12*) believes that the various abnormalities produced in his work result from interference with this metabolism. It would seem possible that sucrose reacts with the embryonic system in some such fashion, disturbing the basic developmental patterns, and being remarkably nonspecific in its effects. When any material is injected into an egg, as in this work, there is obviously no control over its subsequent distribution. Time and spatial factors may enter in, so that the embryo or a region of the embryo may well be exposed to dif-