# Technic for Measuring Cardiac Output Directly by Cannulation of the Pulmonary Artery. (17650)

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Cardiac output has been measured directly in the experimental animal by inserting flow meters into the aorta(1,2), or into the venae cavae(3,4). Such procedures, however, do not determine total cardiac output, since they fail to measure coronary flow. By measuring aortic plus coronary flow simultaneously, the total output of the heart can be obtained, but this requires the added operation of cannulating both coronary arteries successfully. Since these difficulties could be avoided if the pulmonary artery were cannulated and flow through it measured, a technic to do this in the dog has been devised and is presented here.

Under anesthesia and artificial respiration, the left side of the chest is opened (ribs 3 to 6 removed) and the pulmonary artery exposed. The artery is dissected free from its origin out onto the right and left branches about ¾ of an inch. After heparinization (10 mg per kilo), the right branch is ligated at its origin, cannulated peripherally, and cut free from the bifurcation (Fig. 1). A continuous vessel, long enough for cannulation, is now formed by the pulmonary artery and its left branch. This structure may be cannulated without bleeding by one of 2 procedures.

In the technic which has been most often successful, a shunt around the pulmonary artery is provided during cannulation. To do this, a pump, primed with compatible, donor blood, is connected between the right atrial appendage and the previously cannulated peripheral end of the right pulmonary artery (see dashed lines in Fig. 1). When ligature D is tightened just above the pulmonic valves, the main pulmonary artery and left branch can be cannulated, while the circulation is maintained via the pump-shunt system. The rotameter assembly unit is then attached to the cannula. Ligature D is released, the pump stopped, and flow reestablished through the pulmonary artery, rotameter, and left branch. The right pulmonary artery cannula is disconnected from the pump and joined to the outflow side of the rotameter. This reestablishes flow to the right lung. When stopcock C is closed, the output of the right heart passes through the rotameter and is distributed to both lungs. Zero flow levels may be recorded by opening stopcock C and closing clamps A and B.

To permit cannulation without hemorrhage, an alternative to the pump-shunt procedure has been used successfully in a few exploratory

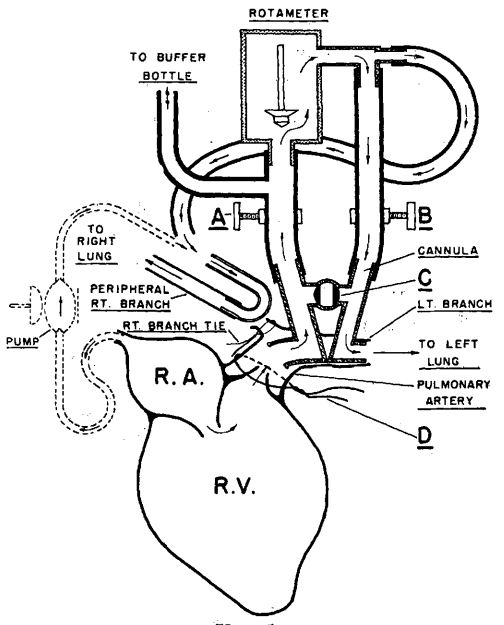


FIG. 1.
Description in text. Buffer bottle (not shown) is added to diminish oscillations of rotameter float.

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3. Gregg, D. E., and Shipley, R. E., *Am. J. Physiol.*, 1944, v142, 44.

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experiments. After the pulmonary artery and its branches have been freed and the right branch prepared as above, the main artery is occluded centrally, and the heart is fibrillated by means of an inductorium. A cannula, like that in Fig. 1, is quickly inserted into the artery and tied in place with the circulation at a standstill. The heart is then defibrillated with countershock, according to the method of Wiggers(5), and an active circulation is reestablished. The rotameter assembly unit is finally attached to the cannula. Success with this approach is limited by the time necessary for cannulation; for if fibrillation persists longer than 1 to 2 minutes, countershock alone is usually ineffective in terminating the fibrillation. Cardiac massage must then be combined with countershock to restore the heartbeat, and the reestablished circulation may not be adequate. However, if cannulation is completed within 1 to 1½ minutes, revival is usually easy and the beat is sufficient to maintain an adequate output.

The pulmonary artery has been cannulated successfully in 9 of 12 dogs, and flows recorded by the rotameter range from 40 to 100 cc per kilo.

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## Antagonistic Action of Certain Neurotropic Viruses Toward a Lymphoid Tumor in Chickens with Resulting Immunity.* (17651)

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Moore(1) reviewed the literature on the growth of viruses in tumors and reported the tumor-necrotizing action of the Russian Far East encephalitis virus on mouse sarcoma 180(2). In the report that follows, results are presented of experiments carried out with the Russian Spring-Summer encephalitis virus (RSS) in domestic chickens infected with a transplantable malignant lymphoid tumor (3,4). A number of other viral and rickettsial agents also were tested, results of which are recorded briefly.

*Experimental tumor.* The RPL-12 lymphoid tumor(5) originally described by Olson (6) was received through the kindness of Drs. B. R. Burmester, G. E. Cottral and B. Winton, Regional Poultry Research Laboratory, U. S. Department of Agriculture, East Lansing, Mich. Because on storage there is considerable loss of infectivity, freshly harvested tumors were used in each experiment. Tumors were removed in early stage of growth and homogenized with saline solution in a TenBroeck grinder(7). Unless otherwise stated, the infecting dose used was 0.25 ml of 1:1,000 suspension of tumor tissue injected into the pectoral muscle.

*Viral and rickettsial inocula.* The following viruses were used: mumps (Enders strain), swine influenza (Shope strain No. 15) in form of infected allantoic fluid from chick embryos; canine distemper (Lederle strain) as infected chorioallantoic membrane; Columbia-SK, Bwamba (M483 strain(8)), Semliki Forest (9), Ilheus encephalitis(10), Theiler's GD VII mouse encephalomyelitis(11), eastern

* Our interest in virus-tumor antagonism was stimulated by personal communications from Dr. C. P. Rhoads, Director, Memorial Hospital, and the Sloan-Kettering Institute for Cancer Research, prior to the publication of Dr. Moore's results.

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