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Double Lumen Catheter for Intravenous and Intracardiac Blood Sampling and Pressure Recording.*

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As a development of the technic of large vein and intracardiac catheterization,[1,2,3] a double lumen catheter has been devised for the purpose of sampling blood and for recording pressure pulses simultaneously in two adjacent parts of the circulatory system, accessible by means of this technic. These include the internal jugular vein, superior and inferior vena cava, hepatic[4] and renal veins,[5] the right auricle, right ventricle, and pulmonary artery.

The No. 10 catheter retains all the characteristics of the single lumen catheter recently improved,[3] namely, its length, flexibility, X-ray opacity, and curved tip. It is divided internally into two channels (Fig. 1). They are separated by a rigid partition, which as preliminary tests have shown, prevents transmission from one channel to the other of pressure impacts of a magnitude much greater than observed physiologically.

The terminal opening of one lumen is at the catheter tip: the other opens 10 cm back of the tip. At the base or external end of the catheter, each channel ends in a separate tube, with adapter for connecting to syringe, pressure recording apparatus, etc.

Among some of the problems that this new catheter is helping investigate, may be mentioned the following:

1. The persistence of laminar flow in large veins and right auricle; the validity of blood samples from the right auricle as representative of truly mixed venous blood; the general location in the right atrium of the area within which such samples may be more readily obtainable. In Table I are shown all data thus far obtained concerning the CO_2 content and O_2 content in blood samples taken simultaneously from the right auricle and right ventricle.

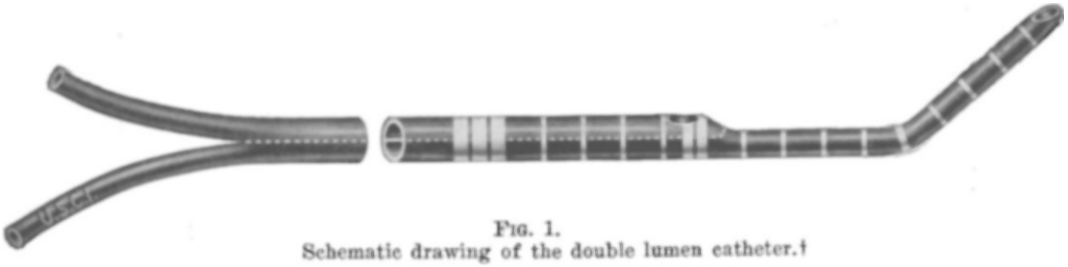

FIG. 1.
Schematic drawing of the double lumen catheter.†

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1 Cournand, A., and Ranges, H. A., PROC. SOC. EXP. BIOL. AND MED., 1941, **46**, 462.

2 Cournand, A., Lauson, H. D., Bloomfield, R. A., Breed, E. S., and Baldwin, E. deF., PROC. SOC. EXP. BIOL. AND MED., 1941, **55**, 34.

3 Cournand, A., Riley, R. L., Breed, E. S., Baldwin, E. deF., and Richards, D. W., Jr., *J. Clin. Invest.*, 1945, **24**, 106.

4 Bradley, S. E., Ingelfinger, F. Y., Bradley, G. P., and Curry, F., to be published.

5 Warren, F. V., Brannon, E. S., Merrill, A. Y., *Science*, 1944, **100**, 108.

† This catheter has been specially designed by the United States Catheter and Instrument Corporation, Glens Falls, New York.

TABLE I.
CO_2 and O_2 Content in Samples Taken Simultaneously from the Right Auricle and Right Ventricle Using a Double Lumen Catheter.

Subject	Date	O_2 content in vol. %		CO_2 content in vol. %	
		right auricle	right ventricle	right auricle	right ventricle
J.K.	6/30/44	9.1	9.3	49.1	49.5
X.B.	7/11/44	17.3	17.1	48.4	48.5
G.B.	7/17/44	8.6	8.8	52.7	52.9
P.W.	10/10/44	14.8	14.8	49.1	49.6
F.McK.	11/14/44	10.1	10.1	43.4	43.9
F.C.	12/19/44	14.4	13.9	49.7	49.7
M.D.	2/20/45	16.2	16.2	50.5	51.7
J.C.	3/20/45	16.5	16.5	48.5	48.4
"	3/20/45	16.4	16.6	47.5	47.4

2. The characteristics of simultaneous mechanical events in the right ventricle and auricle or in the right ventricle and pulmonary artery, in normal individuals, in various types of cardiac failures, or in disturbances of the cardiac rhythm. A few illustrative examples are given in Fig. 2 and 3.

3. The nature of some oscillatory waves appearing on tracings taken from the right ventricle.

4. The demonstration that the presence of the catheter in the right ventricle does not cause tricuspid insufficiency.

The technic of catheterization is not greatly complicated by the larger size of the catheter. However, it can only be used in individuals with fairly large median basilic veins, since it may cause painful veno-constriction when moved along smaller veins. Greater care must be exercised with this type of catheter than with the single lumen, to avoid obstruction by fibrin formation in one or the other of the tubes.

This device has now been used over a period of one year in approximately 20 subjects. No unfavorable side effects other than the local pain mentioned above, from veno-spasm, have been encountered.

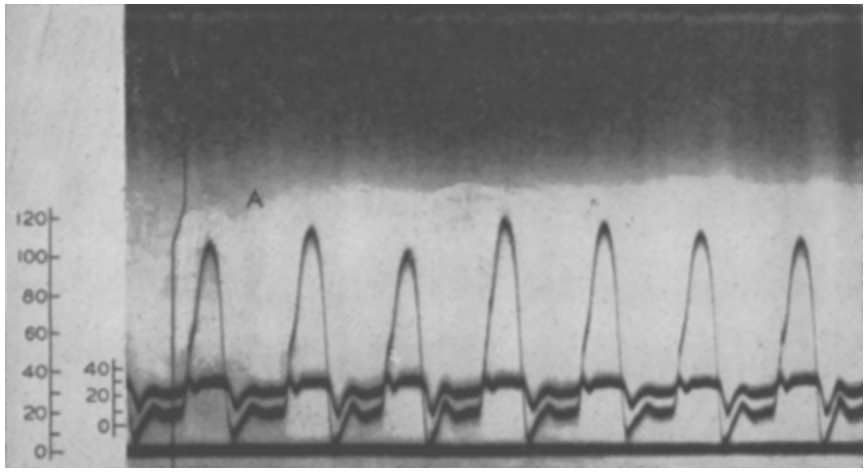

FIG. 2.
Simultaneous recordings in the right auricle and ventricle in a case of rheumatic valvulitis with cardiac decompensation.
Scales to the left in mm Hg. Note (a) the sudden and sustained elevation of pressure on the right auricular tracing during systole, indicating tricuspid regurgitation; (b) the sudden fall of pressure in the right auricle marking the opening of the tricuspid valve; (c) the time and pressure relationship between auricular and ventricular tracings during diastole.

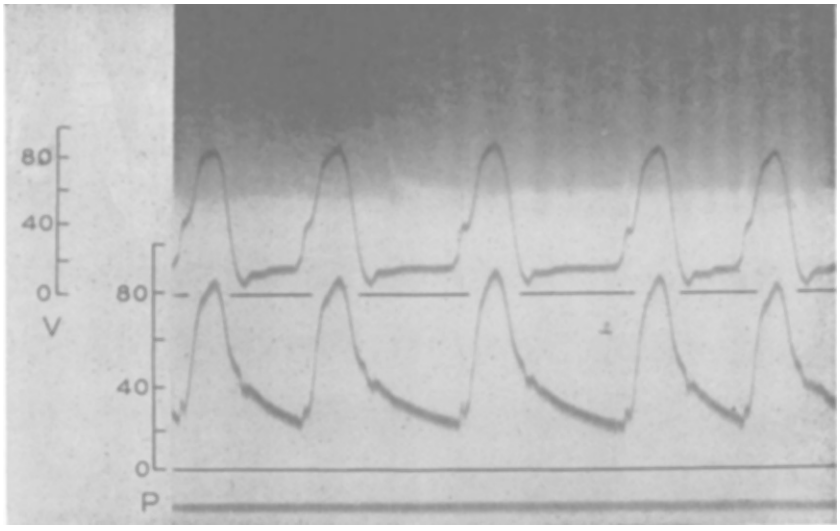

FIG. 3.
Simultaneous tracings in the right ventricle (upper) and in the pulmonary artery (lower) in a case of rheumatic valvulitis with hypertension in the lesser circulation. Note (a) the identity of form and pressure of both tracings during the later part of systole; (b) the small simultaneous oscillations on both tracings during early systole and diastole, presumably due to motion of the catheter in the heart.

Summary. 1. Simultaneous blood samplings and pressure recordings in 2 continuous segments of the circulatory system may be obtained in man by means of a specially designed double-lumen catheter. 2. The difference in oxygen content of 2 blood samples withdrawn simultaneously from 2 points located 10 cm apart in the right auricle and right ventricle was well within the limits of technical error in 8 out of 9 cases. 3. Examples are given of the recording of simultaneous mechanical events in (a) the right auricle and ventricle, (b) the right ventricle and the pulmonary artery.

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Simultaneous Registration of Intrathoracic, Right Intracardiac and Systemic Pressure in Man.*

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Study of the right intracardiac pressures in human subjects, by a technic previously described,[1] has yielded data, for the full interpretation of which a simultaneous record of

* This investigation was carried on under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Columbia University, with the collaboration of New York University.

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1 Cournand, A., Lauson, H. D., Bloomfield, R. A., Breed, E. S., and Baldwin, E. deF., PROC. SOC. EXP. BIOL. AND MED., 1944, **55**, 34.