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Recording of Right Heart Pressures in Man.*

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(Introduced by W. W. Palmer.)

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Utilizing the right heart catheterization technic of Cournand and Ranges,[1] the cyclic pressure changes in the right auricle and right ventricle have been recorded with the Hamilton manometer[2] in 50 individuals.

Catheterization of the right auricle was performed as previously described.[1,3] The patients experienced little or no discomfort during the procedure. The level of the catheter in the heart by lateral X-ray was taken as zero pressure. Introduction of the catheter with a slightly curved tip into the right ventricle under fluoroscopic control was not difficult as a rule, and was signaled first by a rise above auricular pressure, then by large oscillations at cardiac rate in the saline manometer connected to the catheter.

Addition of the long narrow catheter (No. 8 or 9) to the manometer system decreases the natural frequency. Frequencies obtained with this system have varied from about 25 to 50 vibrations per second. Although not ideal, this range has proved fairly adequate

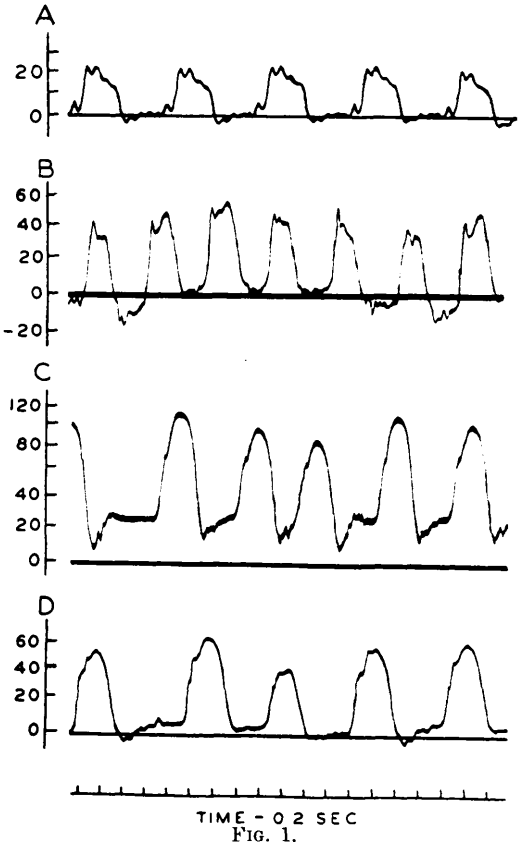

FIG. 1.

All tracings were retouched to improve contrast in reproduction. Pressures in mm of mercury.

A. Right ventricular pressure pulses from a normal young female. One respiratory cycle is shown.

B. Record from young male with extensive pulmonary fibrosis and normal-sized heart. Cardiac output and arterial pressures normal. Note marked increase in systolic pressures; large respiratory variation due to dyspnea at rest; sharp drop of systolic and diastolic levels associated with beginning of inspiration; artifacts on systolic peaks.

C. Patient with mitral stenosis and insufficiency and aortic insufficiency and auricular fibrillation in congestive failure. Note extreme elevation of systolic pressures in right ventricle. The high diastolic pressures correspond to marked increase in right auricular and peripheral venous pressures. Note respiratory variation associated with dyspnea. Cardiac output subnormal and total blood volume about twice normal. Arterial pressure was 210/90.

D. Same patient after clinical improvement due to bed rest and digitalization.

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3 Cournand, A., Riley, R. L., Breed, E. S., and Baldwin, E. de F., Interim Report, O.S.R.D. Contract OEMemr 107, 1943.

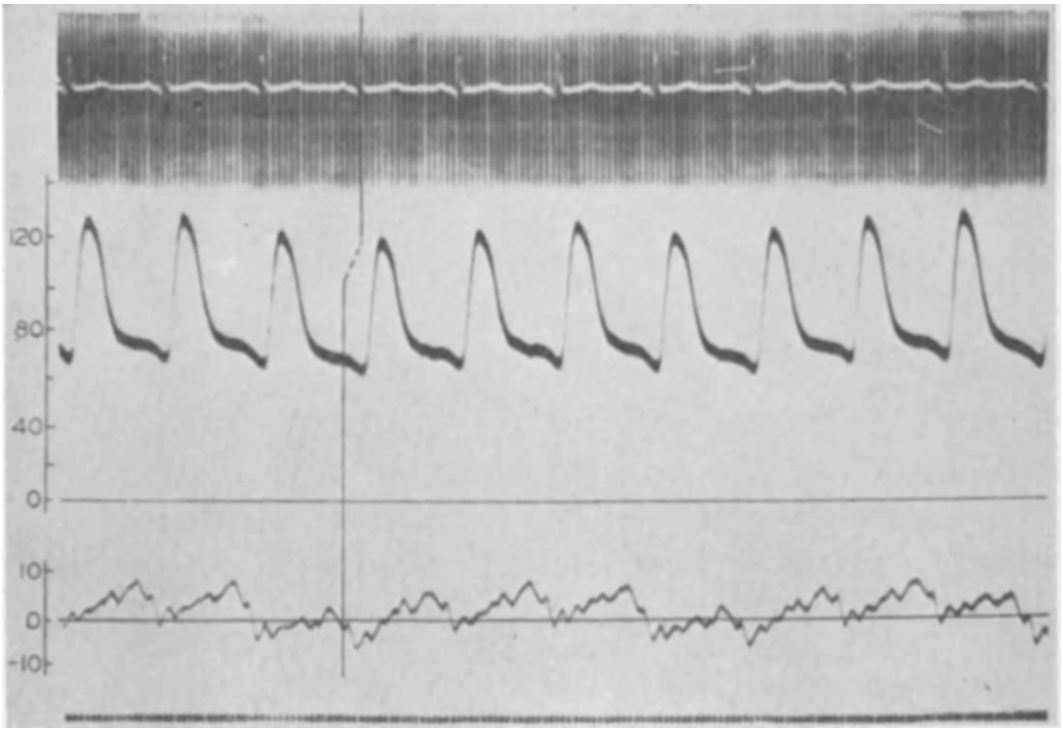

FIG. 2.
Example of simultaneous registration of electrocardiogram (upper) and pressure pulses in the femoral artery (middle) and right auricle (lower) in a patient recovering from shock. Large time divisions represent 0.2 sec. Vertical line in third cycle indicates parallax correction for the electrocardiogram. Pressures in mm mercury.

except in the presence of tachycardia or very vigorous cardiac contractions. Oscillatory phenomena were common, especially in low pressure ventricular complexes, but at present it is not certain whether some of these are artifacts dependent upon the presence of the catheter (see Fig. 1A and 2). The general contours of the pulse waves are believed to be reasonably accurate.

Results. In 8 normal subjects the right ventricular pressure averaged 22 mm mercury at the height of systole (range 18-28) and about zero during most of diastole. There was a cyclic variation of about one to 3 mm mercury due to quiet respiration (Fig. 1A). The systolic contour was full, resembling curves obtained in dogs by Wiggers.[4] In the few cases of mild and moderate essential hypertension, the pressures were not outside the normal range.

Right ventricular systolic pressures as high as 80 mm of mercury have been recorded in a case of chronic cor pulmonale. In several cases of pulmonary fibrosis or emphysema with no definite evidence of cardiac enlargement, the systolic pressure was above normal (Fig. 1B) whereas in other similar cases it was not elevated. In Fig. 1 are records of right ventricular pressure pulses from a patient with mitral stenosis and insufficiency and aortic insufficiency during decompensation (C) and after bed rest and digitalization (D).

Fig. 2 is a record of simultaneous electrocardiogram (lead II) and femoral artery and right auricular pressures from a patient recovering from shock.

Discussion. Recording pressures in the right ventricle affords a means of studying some aspects of the pulmonary circulatory

[4] Wiggers, C. J., *Pressure Pulses in the Cardiovascular System*, Longmans, Green & Co., New York and London, 1928.

dynamics in man, about which little is known. The method is being included in an investigation of the effects of pulmonary and valvular heart disease upon the cardiac output, right heart pressures, arterial pressure and peripheral resistance. Similar measurements are being made in cases of peripheral circulatory failure. The technic is also being applied to study of the cardiac cycle and its pathological alterations in man and to investigation of the pharmacological actions of some cardiovascular drugs.

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Effect of Alanine on Response of *Lactobacillus casei* to Pyridoxine and Folic Acid.

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Previous work[1] has shown that in the presence of sufficient quantities of dl-alanine, *Streptococcus lactis* R did not require pyridoxine or "pseudopyridoxine"[2,3] while in the absence of these quantities of alanine, pyridoxine or compounds with pyridoxine activity were required for growth of this organism. From structural considerations, it appeared possible that alanine might serve as a precursor for the active substance derived from pyridoxine.[1] It was further found that *Lactobacillus casei*, an organism which also requires pyridoxine[4,5] (or pseudopyridoxine) for growth, could not dispense with this substance when excess alanine was present in the medium. It was observed, however, that when limited amounts of pyridoxine were present, growth of *L. casei* was considerably heavier when alanine was also added than it was in the absence of alanine. This effect of alanine has been investigated in connection with other growth-factor requirements of *L. casei*, with results presented below.

Experimental. The medium and technic used are the same as those previously described in detail[2] except that the medium was modified by the addition of 1 mg of asparagine, 3 γ of pyridoxine hydrochloride, and 1 γ of p-aminobenzoic acid per 10 cc. With these additions, this medium becomes, except for minor variations, almost identical with that proposed by Landy and Dicken[6] for estimation of 6 B vitamins by use of *L. casei*. Various vitamins were omitted in turn from this medium, and the quantitative growth response to additions of the vitamin determined in the presence and absence of dl-alanine. This was employed at a level of 2 mg per 10 cc. Results are given in Table I. Without exception, addition of dl-alanine improved response to the vitamin in the concentration range used for assay. This improvement, scarcely detectable with riboflavin, becomes slightly more marked with pantothenic acid and nicotinic acid. With pyridoxine and folic acid, the difference becomes so great as to alter considerably the nature of the dose-response curves, especially in that portion which would be used for assay. These differences, obtained turbidimetrically after 24 hours incubation, are also evident when acidimetric measurements are made after 72 hours incubation (Table II). In the pyridoxine

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6 Landy, M., and Dicken, D. M., *Lab. Clin. Med.*, 1942, **27**, 1086.