

indefinitely under these conditions must await further investigation.

We are grateful to members of the Staff of the Boston Lying-in Hospital and the Children's Hospital for supplying the tissues. We also acknowl-

edge with thanks the indispensable assistance in the experimental work of Marguerite Buckingham and Jeanette Levens.

Received August 24, 1949. P.S.E.B.M., 1949, 72.

### Fluorocardiography (Electrokymography) During Normal Respiration. (17360)

ALDO A. LUISADA AND FELIX G. FLEISCHNER.

*From the Department of Radiology, Beth Israel Hospital, Boston, Mass.*

Previous studies<sup>1,2</sup> described an apparatus, utilizing our modification of the Henny-Boone method of electrokymography,<sup>3,4</sup> and the typical patterns of tracings recorded over the major cardiovascular and pulmonary structures. Fluorocardiography was suggested as more descriptive than previously employed names for the method.

In previous studies, the tracings were recorded during voluntary apnea in an intermediate phase of respiration. Comparative observations showed that the pulsations of the lung (and, to a lesser extent, those of the hilar shadows and the pulmonary artery) were greater during inspiration than in sustained expiration. For practical purposes, an intermediate phase was chosen; a few words of instruction usually sufficed to teach the patient to hold his breath without excessive inflation or deflation of the lungs. This procedure was followed without demonstrable disadvantage in our entire series of clinical cases during 1947 and 1948. On the other hand, it was found difficult to obtain reliable tracings in children and patients with chronic diseases of the lungs who were unable to control their respiration because of age or dyspnea. For this reason, an attempt was

made to overcome this difficulty by technical means.

*Technical aspects.* The problem was presented to Maurice B. Rappaport, E.E. He suggested that a filter may be introduced to minimize respiratory effects though with the introduction of some error.

Wandering of the base line caused by respiration may be reduced considerably by altering the electrical time constant of the apparatus. When this constant is shortened, there is a proportionally greater attenuation of the coarse as compared with the more rapid waves. Respiration is represented by extremely slow waves in the fluorocardiogram, far coarser than any of those caused by cardiac action. A suitable condenser, or filter, introduced between the fluorocardiograph and the recording galvanometer, may modify the time constant of the apparatus; the smaller the condenser, the lesser is the electrical constant. Condensers of various size, which may be introduced by means of a switch, permit selection of the optimum time constant, namely the minimum value producing a fluorocardiogram that does not wander off the paper. The reduction of the electrical time constant of the apparatus does introduce a certain degree of error in the fluorocardiogram which is dependent upon the amount of reduction. The error presents itself in two forms: one is a slight error in the phase (or actual time) of registration of the component waves; the other is a slight change in their configuration. However, there is no elimination of the essential component waves present

<sup>1</sup> Luisada, A. A., Fleischner, F. G., and Rappaport, M. B., *Am. Heart J.*, 1948, **35**, 336.

<sup>2</sup> Luisada, A. A., Fleischner, F. G., and Rappaport, M. B., *Am. Heart J.*, 1948, **35**, 348.

<sup>3</sup> Henny, G. C., and Boone, B. R., *Am. J. Roentgen.*, 1945, **54**, 217.

<sup>4</sup> Henny, G. C., Boone, B. R., and Chamberlain, W. E., *Am. J. Roentgen.*, 1947, **57**, 409.

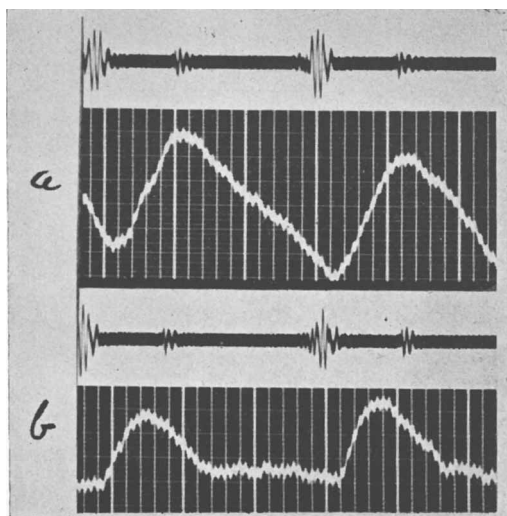


FIG. 1.

Pulsations of the pulmonary parenchyma (visible base of right lung) in a normal subject in apnea.

- (a) Conventional tracing (densogram).
- (b) Tracing obtained by adding an electrical filter.

under normal operating conditions. The filter used was arranged with an adjustable degree of low frequency damping. For optimal results, the degree of filtration was selected in each case to give a readable tracing with a minimal distortion of the fluorocardiogram.

Using this filter, it was possible to record the pulsations of the pulmonary vessels or any other cardiovascular structure during normal respiration with the following precautions:

(a) Whenever possible, the subject is instructed to breathe evenly and slowly, without sudden gasps.

(b) The roentgenologist observes the structure which is being studied and makes sure that it is not moving in and out of the slit during the respiratory movements.

In the practice, that degree of damping is chosen which will decrease the slow respiratory swing of the beam to a minimum with only slight diminution in amplitude of the waves caused by cardiac action. As shown in Fig. 1, a slight deformation of the waves is unavoidable. However, comparative studies on the height and initial rise of the pulse, made with the same degree of damping under otherwise similar conditions, proved the ob-

servations reliable. By means of the filter, several new studies were made possible.

*Results.* (A) *Fluorocardiogram of the child.* This fluorocardiogram, obtained by means of the above described filter, still presents occasional irregularities or wandering of the base line. This is due to the fact that children frequently exhibit a sharp beginning and end of inspiration with an abrupt change in phase; the filter cannot prevent slight wandering of the base line because of the irregularity and frequency of the respiratory waves. Nevertheless, clearly visible cardiac waves were obtained over all those cardiovascular and pulmonary structures which had been studied previously only in adults (Fig. 2). Now the field is open for the study of congenital heart diseases in childhood. In particular, the observation of a reduced amplitude of the pulsations of the pulmonary parenchyma is promising in the diagnosis of pulmonary stenosis.

(B) *Emphysema and pulmonary fibrosis with or without cor pulmonale.* In previous observations, we studied patients with chronic cor pulmonale who had only mild dyspnea and were able to hold the breath during the recording of fluorocardiograms. Other subjects with severe dyspnea yielded only poor tracings. By using the above described filter, two cases of chronic cor pulmonale with severe dyspnea were studied. As shown by Fig. 3, the details of the pulsations of the pulmonary and aortic knobs, as well as the pulsations of the lungs were recorded without difficulty.

(C) *Congestive failure.* Several cases of congestive failure have been studied by using this filter. These cases, which previously yielded only poor tracings, are currently studied and interesting observations are made concerning the lesser circulation.

(D) *Elimination of slow waves of cardiac origin.* In certain cases, a combination of cardiac disorders in an individual hinders a careful study of each. One patient observed by us had tricuspid insufficiency and auricular flutter. The study of the right auricle by means of the conventional apparatus revealed a systolic plateau similar to that previously described by us in the left auricle of patients

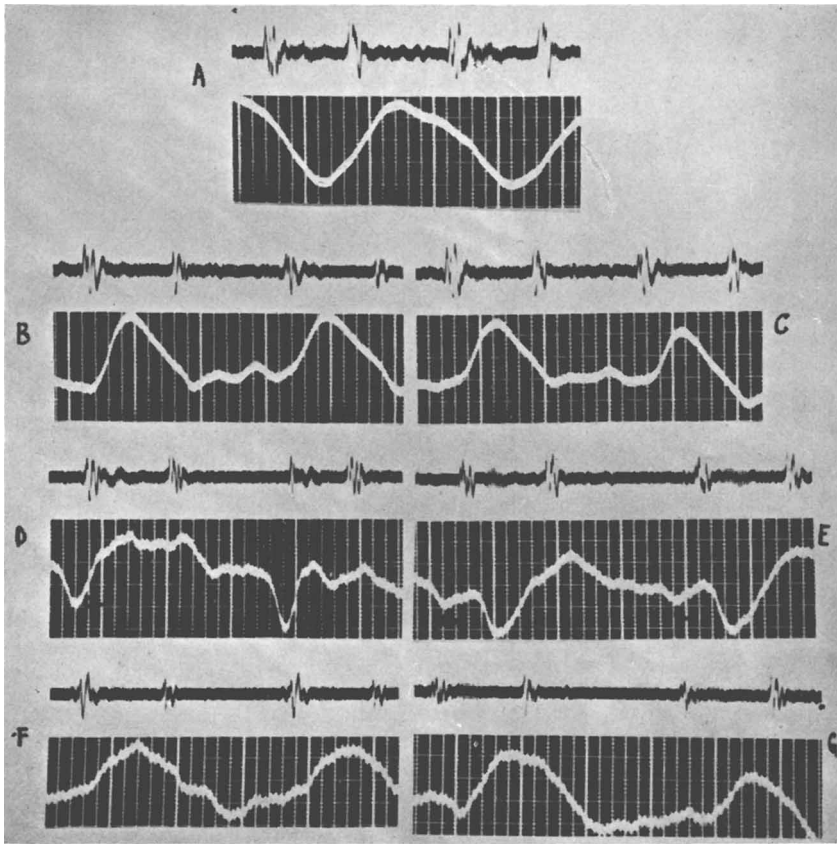


FIG. 2.

Tracings recorded on a 5-year-old normal boy during normal respiration with the use of the electrical filter.

A — Left ventricle; B = Pulmonary arch; C = Aortic arch; D = left auricle (right oblique); E = Right auricle; F = Right hilum; G = right lung; a—auricular wave of the auricular tracings.

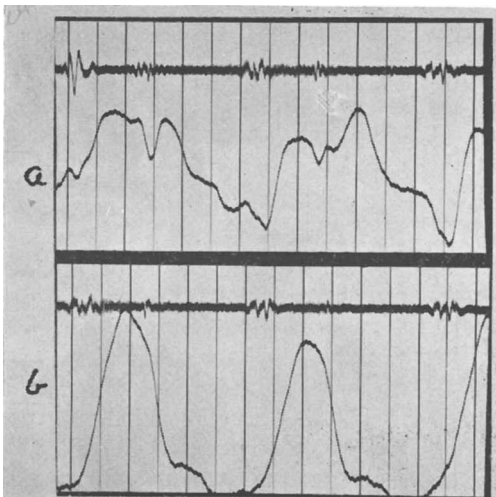


FIG. 3.

Tracings obtained during respiration by the use of the filter in a patient with severe pulmonary emphysema and dyspnea (border tracings).

(a) Pulmonary knob; (b) Aortic knob.

with mitral insufficiency and due to regurgitation of blood from the respective ventricle.<sup>5</sup> On the other hand, use of the filter permitted recognition of the rapid auricular rate of contraction (300 per minute) by eliminating part of the slow wave caused by the tricuspid insufficiency (Fig. 4).

*Summary.* (a) Fluorocardiography during normal respiration is possible by the use of an additional electrical filter, the physical

<sup>5</sup> Luisada, A. A., and Fleischner, F. G., *Am. J. Med.*, 1948, 4, 791.

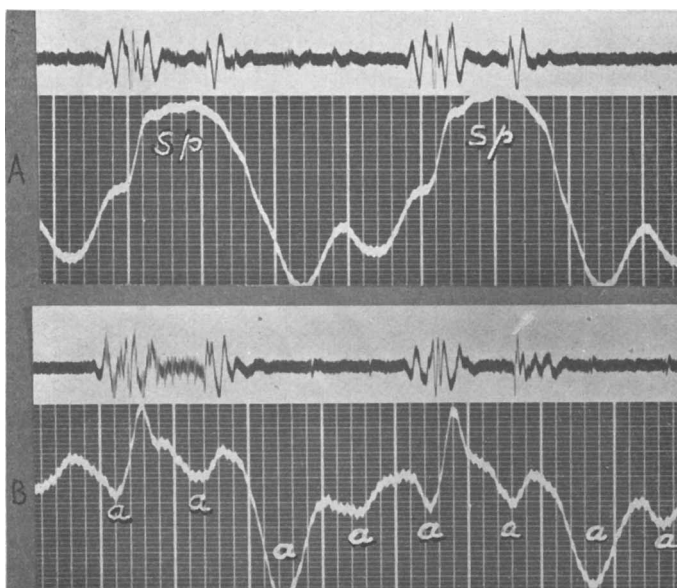


FIG. 4.

Tracings obtained during respiration in a patient with congestive failure, tricuspid insufficiency, and auricular flutter.

(A) Border tracing of right auricle (conventional tracing). A systolic plateau (SP) due to valvular insufficiency is apparent.

(B) Border tracing of right auricle (use of the filter). The rapid succession of auricular contractions (rate of 300) becomes apparent (a,a,a).

basis and principle of which are given.

(b) By using the filter, it is possible to record the fluorocardiogram of the child. This is of particular importance in congenital heart diseases.

(c) By using the filter, it is possible to study dyspneic cases of emphysema, pul-

monary fibrosis, or congestive failure.

(d) The use of the filter eliminates those slow waves of cardiac origin which may interfere with other rapid cardiac waves whose study is more important in particular cases.

Received August 29, 1949. P.S.E.B.M., 1949, 72.

### Determination of Iodine-131 in Urine.\* (17361)

R. R. EDWARDS, W. A. REILLY, AND R. G. HOLMES (Introduced by B. B. Wells.)

*From Department of Pediatrics, University of Arkansas School of Medicine, Little Rock, Ark.*

In conjunction with research on the diagnostic and therapeutic value of radioactive iodine (8.0 day I-131) in thyroid disorders, a simple and accurate procedure for determining the amount of radioiodine excreted

\* The iodine 131 used in this investigation was supplied and obtained on allocation from the Atomic Energy Commission.

Journal Series No. 888, University of Arkansas.

is needed. Preparation of counting samples by evaporation of urine samples to dryness is a tedious and unpleasant procedure, and has also proved inaccurate, perhaps due partly to loss of some iodine by volatilization (possibly as volatile organic iodine compounds) and partly to variations in the geometrical character of the resulting solid samples.