THE USE OF RADIORHEOPNEUMOGRAPHY TO INVESTIGATE EXTERNAL RESPIRATION DURING OCCUPATIONAL WORK

L. I. Popov and Z. M. Kuznetsova

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Radiorheopneumography is a useful method for investigating the respiration rate of persons doing mental work in the course of their occupation and in certain types of physical activity.

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Of the existing methods of investigation of respiration during occupational activities those based on radiotelemetry are most promising, for they yield valuable physiological data actually during performance of their occupational work by the subjects, without removing them from their normal work operations.

In recent years a new method of investigation of external respiration – impedance pneumography – has undergone active development. Several articles have been published on different types of methods and the design of apparatus for impedance pneumography [3, 5, 7-11]. The method is based on the principle of rheography of the lungs [2, 4].

Analysis of schemes and instruments described by various authors for impedance pneumography has shown that they cannot be used for radiotelemetric recording of respiration under dynamic conditions. For these purposes the RPP-1* rheopneumographic converter was developed by Dombrovskii and Rozenblat [1]. It consists of a miniature semiconductor instrument, designed as an attachment to a type RÉK radio transmitter as used for radiotelemetry. The rheopneumographic converter makes it possible to record radiorheopneumograms (RRPG) with the same electrodes as radioelectrocardiograms (RECG). The variant of impedance pneumography using radio transmission is best described as radiorheopneumography.

The system used in the present investigations consisted of two types RÉK radio transmitters, a type RPP-1 rheopneumographic converter, two ARS-2 radio receivers, and an ÉKPSCh-3 two-channel electrocardiograph . By means of this system the RECG and RRPG can be recorded simultaneously and the pulse and respiration rates can be counted by ear using telephones. Stick-on electrodes were located to correspond to Nebb's 2nd thoracic lead (to obtain the best qualitative recording of the RECG) or in the mid-axillary lines at the level of the 6th-8th intercostal spaces.

Radiorheopneumography was used by the writers to study external respiration in persons performing mental work in the course of their occupation (teachers at the Institute), and at times of nervous and emotional stress (students during examination), and also in persons performing physical work. During mental work and work on a bicycle ergometer, adequate qualitative RRPGs were obtained. The RRPGs recorded under production conditions from die-press operators were unsuitable for analysis because of artefacts, or were doubtful because they reflected not merely respiratory movements but also work movements of the chest.

Experience of the use of radiorheopneumography has shown that this method has several advantages: 1) it does not require the use of a mask, producing subjective difficulties and objective changes in respiration; 2) the small size of the rheopneumographic converter and radiotransmitters reduce inconvenience to the subject to the minimum; 3) it is possible to use a common pair of electrodes to record the radio-

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TABLE 1. Pulse and Respiration Rates of Persons Performing Physical and Mental Work as Recorded by Radiopulsometry and Radiorheopneumography

Group	Conditions of investigation	Mean pulse rate (per min)	Mean respiration rate (per min)	Pulse rate/respiration rate
Manual workers	Resting	81.3	18.1	4.5
	Working on bicycle ergometer	109.0	25.8	4.2
Students at Institute	Before examination	99.8	17.4	5.7
	Taking ticket	109.0	16.4	6.8
	Preparing to answer	99.3	16.2	6.1
	Answering	104.0	15.9	6.7
	Summing up	94.7	14.0	6.7
Teachers at Institute	1st h of work	85.0	12.5	6.8
	2nd h of work	81.4	12.0	6.5
	3rd h of work	74.0	12.2	6.1
	4th h of work	75.6	11.8	6.4
	5th h of work	73.5	11.5	6.3

rheopneumogram and radioelectrocardiogram simultaneously; 4) the method is adequate for investigation of respiration in persons performing mental work in the course of their occupation and also during certain types of physical activity. Data for the pulse and respiration rates of various groups of subjects are given above in Table 1 as examples.

However, it must be admitted that the method of radiorheopneumography requires some refinement. Further work is necessary in connection with problems such as determination of the optimum parameters of high-frequency waves used for this method; limitation of interference connected with work movements of the trunk; methods of graphic, visual and audio recording of the respiration rate; the number of electrodes and their location; quantitative estimation of the pulmonary ventilation from the value of respiratory changes in impedance. Several investigators have found (admittedly, only in investigations carried out in hospitals) a linear relationship with a very high degree of correlation between the magnitude of the change in impedance of the chest wall and the change in lung volume [5, 6, 10, 11]. Solution of these technical and methodologic problems will considerably extend the scope of radiorheopneumography.

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