

METHODS

RECORDING THE KINETOCARDIOGRAM IN A FREELY MOVING SUBJECT

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UDC 612.171.1:621.398

The radiokinetocardiogram (RKCG) can be reliably recorded in an unrestrained subject by means of a telemetric system and kinetoelectromagnetic transducer. The form of the RKCG is sufficiently differentiated and enables phase analysis of the cardiac cycle to be carried out.

KEY WORDS: radiokinetocardiography; freely moving subject; acceleration kinetoelectromagnetic transducer; phase analysis of the cardiac cycle.

Many methods nowadays used in clinical practice to investigate the chromocardiogram (cardiac catheterization, polycardiography, electrokymography) are unsuitable for use on the working individual under dynamic conditions. The method of acceleration kinetocardiography appears particularly promising from this point of view. Oranskii [1-3] has published information showing the high accuracy of the method for phase analysis of the cardiac cycle. No details could be found of the radio recording of the kinetocardiogram (KCG) during measured effort and in the course of work activity.

To record the radiokinetocardiogram (RKCG) a bioradiotelemetric system (BRTS) and kinetic transducer were used. The BRTS, various types of which have been described previously [4], included a biopotentials amplifier, a functional transducer, and a transmitter (the patient's apparatus), a receiver, decoder, and recorder (the investigator's apparatus).

In the present investigation kinetoelectromagnetic transducers with parameters similar to the standard fixed kinetic transducers, but smaller in size and weight, were used. The electromagnetic transducer was assembled from the parts of the TM-2M small head telephone. The kinetic transducer was fixed to the part of the body chosen by the investigator by means of adhesive tape.

Comparison of the KCG of the left ventricle recorded by cable and by radio from the same subject (in 20 subjects)* showed no distortion of the shape of the curve in the case of radiotransmission (Fig. 1). The

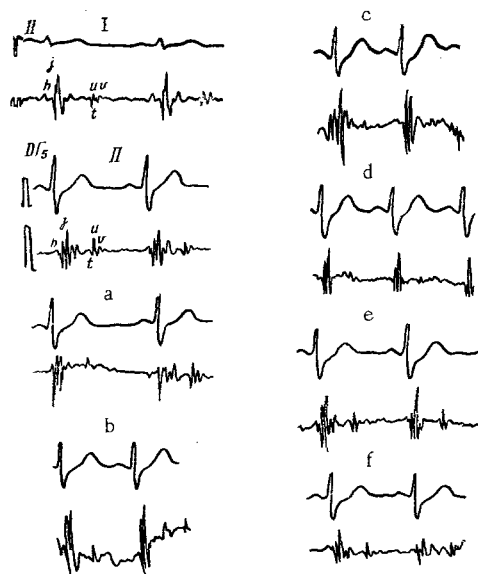


Fig. 1. RKCG of patient S., a man aged 37 years, climbing up and down a pair of steps. I) KCG transmitted by cable at rest, recumbency; II) RKCG before beginning of test, standing, a) 15th second of test, b) first minute of test, c) third minute of test, d) 30 sec after beginning of restitution, e) first minute of restitution, f) fifth minute of restitution.

*These investigations were carried out jointly with Candidate of Medical Sciences E.I. Likhacheva.

Institute of Work Hygiene and Occupational Diseases and Medical Institute, Sverdlovsk. (Presented by Academician of the Academy of Medical Sciences of the USSR A. A. Letavet.) Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 80, No. 9, pp. 115-117, September, 1975. Original article submitted June 17, 1974.

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basic waves of the systolic complex h and j, as well as the u and v waves, were clearly detectable on the RKCG. The other waves of the diastolic complex were inadequately differentiated. In most cases it was difficult to identify the atrial complex of the KCG. If the radioelectrocardiogram (RECG) is recorded simultaneously it is possible to determine the duration of the cardiac cycle, of electromechanical and mechanical ventricular systole, including the duration of the phases of asynchronous and isometric contraction, and of rapid and reduced expulsion, as well as the duration of ventricular diastole, including the protodiastolic interval and the phase of isometric relaxation. Consequently, the RKCG enables the phase structure of the cardiac cycle to be characterized sufficiently completely.

The RKCG can be reliably recorded during work activity during micropauses of rest lasting 2-3 sec.

The opportunities for radiokinetocardiography were studied under laboratory and production conditions. The RKCG was recorded during measured effort (6 descents and ascents of a pair of steps in 3 min) in 10 patients with a suspected diagnosis of fluorosis and 10 patients with a known initial stage of fluorosis. The RKCG was recorded 6 times during exertion and in the course of restitution for 5 min (Fig. 1). Analysis of the RKCG revealed some distinguishing features in the dynamics of the phase shifts of the patients with fluorosis during physical exertion and in the period of restitution.

The possibility of reliable recording of the RKCG in a freely moving subject (in micropauses in the course of movement) was thus demonstrated. As a result of experience with the method it can be concluded that radiokinetocardiography is a promising technique for use in practical work physiology and functional diagnosis.

LITERATURE CITED

1. I. E. Oranskii, "The accelerometric precordial ballistocardiogram (kinetocardiogram) in healthy persons (on the possibility of determining the phase structure of cardiac contraction)," *Ter. Arkh.*, No. 9, 65 (1961).
2. I. E. Oranskii, "The kinetocardiogram and its importance in the clinical management of cardiovascular diseases," *Kardiologiya*, No. 5, 69 (1964).
3. I. E. Oranskii, *Acceleration Kinetocardiography* [in Russian], Moscow (1973).
4. V. V. Rozenblat et al., "Improvements in single-channel systems for dynamic radiotelemetry of cardiac and brain potentials," in: *Biological and Medical Electronics (Proceedings of the 4th All-Union Conference)* [in Russian], Part 3, Sverdlovsk (1972), pp. 16-20.