RADIOTELEMETRIC RECORDING OF THE PULSE WAVE VELOCITY IN MAN

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A radiotelemetric system has been used to investigate the pulse wave velocity (PWV) in healthy persons during work activity. Detector units were constructed from SF-2-2 photoresistors and 2.5-V endoscopic lamps. These photoelectric detectors are sensitive, small in size, and interference-free during the subject's movement. Depending on the points from which information is taken, detector units are either transmitting (finger, ear) or reflecting (over large superficial arteries). Under dynamic conditions the PWV is investigated in the segment shoulder–finger. The test system incorporates detectors, transmitters, receivers, and a two-channel electrocardiograph.

The most effective and reliable method of assessing the visco-elastic properties of blood vessels at the present time is determination of the pulse wave velocity (PWV). Under clinical conditions this index is studied at rest. However, in a few investigations dealing with this problem it has been shown that the greatest changes in visco-elastic properties of the blood vessels take place during physical work and nervous and emotional stress. Few dynamic studies have been made of the state of the blood vessels because of the complexity of the method and of technical difficulties. Under these conditions it is most convenient to use the radiotelemetric method of Stolbun and Forshtadt [4], in which ECG signals and signals of the digital photoplethysmogram are combined in one radio channel. The object of the investigation described below was to continue the development of this technique.

Recording by radiotelemetry under dynamic conditions presents increased demands on the detectors: they must be free from interference during the subject's movement, simple, and reliable to secure, convenient for the subject, they must not need regulating during work, and so on. The problem was to choose detectors and methods most suitable for use in dynamic radiophygmography.

As a result of technical trials, it was discovered that photoelectric detectors possess great advantages. These advantages are high sensitivity, relatively high freedom from interference (they react to displacement less than other types of detectors). Photoelectric detectors have been extensively used in plethysmography, oxyhemography, and so on [1, 5]. Despite difficulties associated with providing power for the lamps, photoelectric detectors are the most promising for dynamic investigations.

As photoreceivers, type SF-2-2 photoresistors were used, and the source of light was a 2.5-V endoscopic lamp. The maximum signal obtained from these detectors is 5-10 mV. Photodiodes and phototransistors can also be used as photoelectric cells. The detectors are suitable for work with standard electrocardiographs. Depending on the points of obtaining information, detectors working either with transmitted light when the area to be tested is placed between the lamp and the photoreceiver, or by reflected light, when the lamp and the photoreceiver are in the same plane, were used. Transmitting or plethysmographic detectors are convenient for the finger and ear. For large areas of the body, reflecting or true sphygmographic detectors are convenient. The light flux penetrating into the tissues in this case is reflected from the pulsating blood vessel and induces an intermittent photoelectric current. The lamps

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are supplied by two TsNK-0.45 storage batteries. The reflecting detectors are fixed to the skin above the blood vessel by adhesive plaster, or if necessary by an elastic bandage. Transmitting detectors are fixed to the finger by a rubber band.

The detectors are connected to the input of the radiotelemetric system intended for recording the ECG, and with input parameters of electrocardiograph in current production. Various models of electrocardiograph notably the models RÉK-10 and RÉK-11 built in the writer's Institute and described previously can be used as transmitters. The receivers are modified from ordinary 20 RTS commercial radio receivers.

The recording is made on an electrocardiograph with the paper winding speed 25-50 mm/sec. Calculation of the PWV indices is made much easier and more accurate, especially at low recording speeds, by means of the special ruler designed by the writer [3]. Both synchronized and superposed recordings can be made. Vessels of muscular type are investigated in the shoulder–finger segment, and vessels of elastic type in the segment from the beginning of the aorta to the femoral artery at the level of Poupart's ligament. The time of ejection of blood into the aorta is determined from the j wave of the kinetocardiogram [2].

The full set of equipment for investigating the PWV consists of two photoelectric detectors (or combined photoelectric and kineto-detectors), two transmitters, two receivers, and a two-channel electrocardiograph.

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