Ballistocardiography Simplified by Recording Microvibration of the Skin Surface of the Head

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OZAKI, T., SASAKI, S. and IGARASHI, K. *Ballistocardiography Simplified by Recording Microvibration of the Skin Surface of the Head.* Tohoku J. exp. Med., 1970, 102 (1), 99-100 — The microvibration was recorded from the skin surface of the parietal region of the head and compared with the ballistocardiogram simultaneously recorded with a conventional technique. The results suggest the possibility that the microvibration recording from this region may be used in place of a conventional ballistocardiography. — microvibration; head; ballistocardiography.

In the previous paper, Ozaki *et al.*¹ reported that there is a close relationship between the dominant waves of the microvibration (MV) of the skin surface above the thenar muscles and the I, J and K wave and L, M and N wave groups of the ballistocardiogram (BCG) in awaking relaxed subjects. It has been known that the head shows rhythmical movements associated with the heart beats, although they are invisible with the naked eye.

The aim of the present study is to determine whether the dominant waves of MV at the skin surface of the parietal region of the head are closely related to the ballistocardiogram recorded by conventional techniques, which have been proved to be useful in studying the cardiac output² and systemic and pulmonary hemodynamics.³

The BCG in the longitudinal direction was recorded during breathholding and during resting breathing by use of von Wittern's low frequency table modified by Nihon Kohden Kogyo Co., Tokyo. The sensitivity of the recording system was adjusted so that the load of 300 g gave a deflection of 30 mm. The MV was recorded simultaneously from the skin surface of the parietal region of the head by means of MV pick up (MT-3T, Nihon Kohden Kogyo Co., Tokyo), which was attached to the skin surface and fixed with a very thin cellophane tape, thereby a perfect contact of the pick up with the skin being ensured. Thus the skin surface of the parietal region was preferred for the reason that this region has little skeletal musculature beneath the skin. In addition, the electro-cardiogram (EKG, limb lead II) was recorded simultaneously to elucidate the relationship of the waves of MV to each phase of cardiac cycle.

Fig. 1 shows the BCG, MV and EKG tracings of a normal subject in a supine position during resting breathing (A) and during breath-holding in the inspiratory phase (B). The dominant waves of MV were found to be composed of two main vibrations corresponding to H, I, J and K wave and L, M, N and O wave groups of the BCG and to R and T waves of the EKG, though the correspondence of MV to the BCG was more distinct in H, I, J and K wave group than in the L, M, N and O wave one. In addition, the MV obtained from the parietal region was found to be of a slightly lower frequency than that from the regions of the thenar and eyelid. This may probably be due to the paucity of the musculature beneath the skin of the parietal region.

In conclusion, dominant waves of the MV showed a pattern very similar to I, J and K wave group of the BCG, associated with the systole of the cardiac cycle, as shown in Fig.

Fig. 1. Ballistocardiogram (BCG), microvibration (MV, head) and electrocardiogram (EKG, Lead II) during rest-breathing (A) and holding of breathing in the inspiratory phase (B). Each calibration in the right side indicates 1 mV in the MV and EKG, respectively. The calibration of the ballistocardiograph was, on the other hand, so accommodated that the load of 300 g gave a deflection of 30 mm. Note the appearance of the main components of the MV corresponding to the I, J and K complex of the BCG (H-F) and disappearance in the respiratory fluctuations in the BCG and MV during the holding of breathing in the inspiratory phase.

1. The correspondence and similarity between the main components of the MV and the I, J and K wave groups of the BCG were recognized well during the holding of breathing. The main components of the MV increased and decreased in amplitude in the inspiratory and expiratory phases of breathing respectively, where the cardiac output is known to fluctuate physiologically. The present results suggest the possibility that MV of the skin surface of the parietal region of the head may be used as a simple substitute for the conventional ballistocardiography.

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References

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