MEASUREMENT OF DIASTOLIC BLOOD PRESSURE BY AUSCULTATORY RECORDING METHOD DURING DYNAMIC AND STATIC EXERCISE.

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INTRODUCTION

There are many reports about blood pressure during dynamic exercise which was determined by invasive method, however there are a few reports about diastolic blood pressure (DBF) during dynamic exercise by noninvasive method. The reasons are in the difficulties to make exact determination of DBF during dynamic exercise by noninvasive auscultatory method because of many noises and unclear sounds for determination of DBF.

Recently we reported that SBP determined by noninvasive auscultatory recording method showed a cubic regression equation as a function of heart rate (HR) and the rate of elevation of SBP was zero at HR 175 bpm as a mean of 32 male subjects during pedalling exercise (Obara, et al., 1997). It may be important information to take SBP and DBF by noninvasive method as a physiological response to exercise.

The purpose of this study is to examine DBF during dynamic and static exercise by noninvasive auscultatory recording method.

METHODS

Experiment I: Subjects were 11 healthy male volunteers. The subjects did light and moderate intensity pedalling exercise on an electrically braked cycle ergometer as a dynamic exercise. The exercise were done in two separate days. Work loads were 30 and 90 watts in one day, and were 60 and 120 watts in other day. The exercise duration is continuous 40 minutes, and the duration was separated two stages, i.e., 20 minutes in each work load. The reason of using 20 minutes exercise is to take four data of DBF in each work load. Because, DBF is affected a timing of measurement of BP, a DBF value may not be exact value at any exercise condition. We take a average of DBF from four DBF values which determined at every 5 minute during 20 minutes exercise at each work load.

We conducted simultaneous recordings of cuff pressure, vessel sound (Korotkov's sound), electrocardiogram (ECG), and artificial signal for marking height of sphygmomanometer every 10 mmHg during exercise. To improve the weak points of the traditional auscultatory method, we used a miniature pressure transducer (PS-2KB, Kyowa Electric Co., Ltd.) for recording cuff pressure, and a cardiophonometer (MA-250, Fukuda Denshi Co., Ltd.) for recording vessel sound. The microphone was placed on the left antecubital artery. All of the parameters mentioned above were recorded by an electromagnetic oscillograph (Visigraph, NEC San-ei Co., Ltd.) and by a data recorder (R-61,TeacCo., Ltd.).

Experiment II: Subjects were four volunteers. Subjects lift weight of 10 and 20% of maximum voluntary contraction (MVC) for 5 minutes by right hand. Blood pressure measurement was done at every one minute. The recording method is same to experiment I.

RESULTS

Experiment I: It is usually accepted that resting DBF is a point of disappearance of vessel sound, and exercise DBF is a point of rapid change of vessel sound. Although in many subjects two points of rapid change of vessel sound within four beats were shown on the charts, we determined exercise DBF at the point of first change of vessel sound. Heart rate, oxygen intake, SBP, and DBF as a mean of 11 subjects at rest were 693 (SD; 9.67) bpm, 4.8 (0.35) ml/kg/min, 113.1 (13.90) mmHg, and 73.5 (10.97) mmHg, and at 30 watts it were 88.2 (8.72) bpm, 12.0 (1.10) ml/kg/min, 129.2 (16.65) mmHg, and 79.7 (9.50) mmHg, respectively. It were 127.9 (12.75) bpm, 25.7 (2.48) ml/kg/min, 164.9 (17.13) mmHg, and 74.7 (13.81) mmHg at 120 watts, respectively. HR, Oxygen intake, and SBP showed significant differences among the values at each condition, there, however, were no significant differences among DBFs at rest, 30,60,90,120 watts.

Experiment II: DBF elevated about 10 mmHg from rest during 10%MVC static exercise for 5 minutes. At 20%MVC, SBP showed gradual elevation, but DBF elevated rapidly. It was about 25 mmHg from rest in both SBP and DBF at end of trial.
DISCUSSION

The marked difference between dynamic and static exercise was that DBF in dynamic exercise did not elevated at the work loads from 30 watts to 120 watts, but DBF in static exercise elevated rapidly immediately after exercise. These results agreed with preceding reports (Robinson, et al., 1988. MacDougall, et al., 1992). We would like to emphasize that auscultatory recording method will be appropriate method for measuring SBP and especially DBF during exercise.

REFERENCES