43) LEFT VENTRICULAR FUNCTION OF SHR

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Left ventricular function in hypertensives is controversial, both in human and in experimental animals. Recently, there are reports concerning impaired left ventricular relaxation in patients with hypertension, but animal study of it is few. We studied left ventricular pumping ability and relaxation at rest and after volume loading in relatively young SHR and in sex- and age-matched WKY rats. We also evaluated left ventricular hypertrophy by measuring left ventricular free wall thickness(LVWT) and histologically.

Studies were performed on 25 male rats ranging from 25 to 35 weeks of age (average, 29 weeks), 8 SHR and 17 WKY rats. Under pentobarbital anesthesia, a catheter(PE 50) was advanced by way of the right carotid artery into the left ventricle(LV) for pressure measurements and first derivative of pressure (dP/dt). The left femoral vein was cannulated for IV infusions. The abdomen was opened, and a 1 mm electromagnetic flow probe was placed around the abdominal aorta for measurements of phasic aortic flow. All phasic pressures, dP/dt and phasic aortic blood flow were recorded at the paper speed of 100 mm/sec on a multichannel polygraph(San-ei). Time constant of the LV pressure fall(T) was calculated from the LV pressure and dP/dt. After baseline measurements, physiologic saline was infused for 1 minute into the femoral vein at the rate of 2cc/100g of body weight and peak increment of the aortic blood flow was recorded. After the completion of the hemodynamic study, the heart was excised, the right ventricle and LV plus septum wet weights were determined. Histological study was performed on HE stained preparation and LVWT was measured from the mid-ventricular transverse section of the LV.

Heart weight(HW) relative to body weight(BW) was significantly increased in SHR(1.05 ± 0.18 vs 1.63 ± 0.29 mg/g, $p < 0.001$). Resting aortic blood flow per BW and per HW in SHR was significantly decreased(26.4 ± 2.4 vs 18.4 ± 1.8 μ l/g, $p < 0.05$, 9.11 ± 0.83 vs 4.80 ± 0.66 μ l/mg, $p < 0.01$, respectively). After volume loading peak increment of aortic blood flow per HW was also significantly decreased in SHR(9.29 ± 1.08 vs 4.75 ± 1.49 ml/g, $p < 0.01$). On the other hand, aortic blood flow before and after the volume loading at the same value of LVEDP/LVWT was almost identical between SHR and WKY rats. Time constant T, was significantly prolonged in SHR(7.28 ± 2.48 vs 10.26 ± 3.35 msec, $p < 0.05$). LVWT was significantly increased in SHR(3.2 ± 0.4 vs 4.0 ± 0.5 mm, $p < 0.001$) and it was positively correlated to HW($r = 0.84$) and showed tendency to correlation to time constant T($r = 0.41$). Light microscopy revealed marked hypertrophy of muscle fibers in SHR. Mild hypertrophy of arterial wall, which was most marked in the media, and fibrosis surrounding the arteries were also noted in SHR.

LV hypertrophy in SHR is reported to occur from early stage. When LVWT increases as the compensatory mechanism of LV pressure overload, LV wall stress is smaller at the same level of filling pressure(Laplace's law). Therefore, we used LVEDP/LVWT as a more accurate index of preload than LVEDP alone. And we found that aortic blood flow was not significantly decreased in SHR. Therefore, we interpret that the left ventricular pumping ability of SHR is not depressed, or compensated at this age.

Prolonged time constant T, and normal peak negative dP/dt were found in this observation. Whereas peak negative dP/dt is dependent on systolic pressure, which was higher in SHR, prolonged time constant T, in SHR indicates the presence of LV relaxation abnormality at this stage.

We conclude that LV hypertrophy and fibrosis are present at the age of 30 weeks in SHR associated with impaired LV relaxation and compensated systolic function.