15) Diagnosis of Congenital Cardiac Malformations in WKY/NCrj Rats Using Echocardiography with a Pulse Doppler Ultrasound. Kazutoshi Shimoo, Takashi Nakamura*, Masami Shima*, Kin-ya Matsubara*, Akiyoshi Matsumuro*, Rika Narihara*, Hiroshi Katsume*, Masao Nakagawa*, Toshiro Kuribayashi**. Department of Medicine, Meiji Collage of Oriental Medicine, Kyoto-fu 629-03. *Second Department of Medicine, **Second Department of Anatomy, Kyoto Prefectural University of Medicine, Kyoto-fu 602.

We have previously noted that tetralogy of Fallot(TOF), ventricular septal defect(VSD), pulmonary valve dysplasia(PVD), and hypertrophic cardiomyopathy(HCM) like myocardial lesion occur spontaneously in WKY/NCrj rats (Pediatr Res 27:483, 1990). In this study, to diagnose various cardiac abnormalities and to study their functional aspects, we employed echocardiography with Doppler ultrasound.

We compared the anatomic findings of the hearts of 97 WKY/NCrj rats, which are weighed 300-400g, with those of 20 weight-matched WKY/Ta rats, which is an inbred strain originating the same source as the WKY/NCrj strain and which is maintained in the Central Research Division, Takeda Chemical Industries, and 30 weight-matched normal Wistar rats. Under pentobarbital anesthesia (3mg/100g body wt, i.p.), rats were placed on a bed in the prone or right lateral decubitus position. Echocardiography was performed with a Sonos 100 mechanical sector scanner (Hewlett Packard) with a 7.5MHz transducer. We obtained M-mode echocardiography at the level of the great arteries and the ventricles to measure the dimension of the heart and the thickness of its wall. The velocity of intracardiac blood flow was recorded by a pulse Doppler method within the right ventricular(RV) inflow and outflow, across the pulmonary ostium and within the main pulmonary trunk. Contrast echocardiography with hand-agitated iopamidol(50% solution) was performed when a high-velocity signal was detected within the RV. Following echocardiographic examination, the right jugular vein and the right carotid artery were each cannulated with a polyethylene tube to record the aortic pressure and the peak RV and left ventricular(LV) pressure by a pressure transducer(Millar MPC 500). After hemodynamic measurement, we arrested the heart by injecting saturated EDTA solution into the right atrium, and fixed it by perfusing the coronary artery with 10% formalin via the cannula into the carotid artery, and then examined the heart anatomically.

The WKY/NCrj rats showed a VSD in 20 and PVD in 41, in which both VSD and PVD were identified in 18. The mean transverse cardiac dimension was significantly larger in the rats with VSD as compared to the normal Wistar rats, as were the aortic root diameter, the RV free wall thickness, and ventricular septal thickness. VSD was readily diagnosed in vivo by the jet flow signal derived from the left-to-right shunt near the membranous portion, with sensitivity of 85% and a speciality of 99%. Ultrasound imaging revealed an overriding of the aorta and RV hypertrophy in 18 of 20 rats with VSD. Of the 20 rats with VSD, 10 had a systolic high-velocity jet across the RV outflow indicating an infundibular stenosis. PVD was commonly accompanied by a pulmonary regurgitation signal with severe cases. The regurgitation signal showed a good diagnostic value for PVD with a sensitivity of 82% and specificity of 85%. The peak RV pressure was abnormally high only in WKY/NCrj rats with VSD. There was a good correlation between peak RV pressure and RV wall thickness($r=0.67$, $p<0.001$), and peak pulmonary flow velocity($r=0.48$, $p<0.001$) in the WKY/NCrj rats. In the remaining 54 WKY/NCrj rats without VSD or PVD, the ratio of mean LV wall thickness to cavity dimension, the fractional shortening of the LV dimension, and the septal to LV free wall thickness ratio were abnormally high, and the motion of the ventricular septum was reduced in most of the cases compared with that of the other two strain. In contrast to the WKY/NCrj rats, the WKY/Ta rats showed no anatomic, sonographic or functional abnormalities. The noninvasive diagnosis of these abnormalities in rats will enhance the utility of these animal for studying congenital heart diseases.