Short Report

Echocardiographic Evaluation of Pulmonary Hypertension by Oxygen Inhalation Method

YOSHIRO YOSHIDA, ASAO TOMOE, MORIKUNI FUKUDA and SHIGEO YAMAKI*

Department of Pediatrics and *Department of Thoracic and Cardiovascular Surgery, Tohoku University School of Medicine, Sendai 980

YOSHIDA, Y., TOMOE, A., FUKUDA, M. and YAMAKI, S. Echocardiographic Evaluation of Pulmonary Hypertension by Oxygen Inhalation Method. Tohoku J. exp. Med., 1979, 127 (2), 199-200 - The ratio of the right ventricular pre-ejection period to the right ventricular ejection time was calculated from the echocardiogram of the pulmonic valve before and after inhalation of a high concentration of oxygen in pulmonary hypertensive patients. The results showed that this non-invasive method could differentiate pulmonary vascular disease from non-pulmonary vascular disease and hence useful for evaluating the change of the pulmonary vascular bed in the pulmonary hypertensive patients.

RPEP/RVET; pulmonary vascular disease; oxygen inhalation method

In the evaluation of the organic change of the pulmonary vascular bed in patients with pulmonary hypertension, catheterization data before and after inhalation of a high concentration of oxygen or injection of tolazoline are compared. Those with pulmonary vascular disease show no remarkable decrease in pulmonary vascular resistance, whereas those without pulmonary vascular disease show decreases in the value. Recently it has been shown that the ratio of the right ventricular pre-ejection period to the right ventricular ejection time (RPEP/RVET) has a good correlation with the pulmonary vascular resistance (Hirschfeld 1975; Riggs 1977; Gutgesell 1978). In the present study we calculated RPEP/RVET from the echocardiogram of the pulmonic valve (Fig. 1) before and after inhalation of a high concentration (60-70%) of oxygen for a period of more than 10 min in the following four groups of patients: Group I, 3 patients with pulmonary hypertension and pulmonary vascular disease; Group II, 13 patients with pulmonary hypertension but without pulmonary vascular disease; Group III, 9 patients with congenital heart disease but without pulmonary hypertension; Group IV, 11 patients with normal heart. Echocardiograms were recorded on oscillopaper at the paper speed of 100 mm/sec utilizing a Toshiba Sonocardiograph SSL-51U, and 2.25 or 5 megaHz non-focused transducers were alternately used depending on the body size. In all the cases but those in the Group IV cardiac catheterization was performed and evaluations in pulmonary hypertension was made. Fig. 2 shows the results of the oxygen inhalation, the left column showing the pulmonary hypertensive groups and the right one showing the non-hypertensive groups. Before oxygen inhalation all the patients but 3 in the Groups I and II showed RPEP/RVET ratios of 0.3 or higher whereas all the patients in the Groups III and IV showed the ratio 0.26 or lower. After oxygen inhalation the ratios in the Group I remained at great values (0.38 or higher), but all patients except for one in the Group II showed decreases in the ratio. Groups III and IV remained at low levels (between 0.17 and 0.25), although 3 patients showed slight increases. In 2 cases of the Group I and 3 cases of the Group II
lung biopsy was performed. The former cases showed severe pulmonary vascular damage (Heith-Edwards IV) and the latter cases showed minimum change in the pulmonary vascular bed (Heith-Edwards I).

Our data showed that an RPEP/RVET of 0.30 or greater was highly suggestive of the presence of pulmonary hypertension and that no decrease of the great ratio after inhalation of oxygen indicated a lack of the response of the pulmonary vascular bed to it and hence the organic change of the tissue had already progressed. There are some patients e.g. those with Down's syndrome whose pulmonary hypertension rapidly progresses to pulmonary vascular disease. So the patients who present RPEP/RVET of 0.3 or greater should require close observation. Repeated echocardiographic studies using the oxygen inhalation method could detect ominous signs early, i.e. the RPEP/RVET getting greater and/or less response to oxygen inhalation. These findings should be followed by cardiac catheterization and evaluations of the pulmonary hypertension without delay and then the patients could be safely operated on before the development of pulmonary vascular disease.

Thus the oxygen inhalation method applied to the echocardiography is very useful for evaluation of the pulmonary hypertension and also useful for determining the time to perform cardiac catheterization in a pulmonary hypertensive patient.

Fig. 1. Right ventricular pro-ejection period (RPEP) is measured from the beginning of the QRS complex of the electrocardiogram to the opening point of the pulmonic valve, and the right ventricular ejection time (RVET) from that point to the pulmonic component of the second sound of the phonocardiogram.

Fig. 2. RPEP/RVET before and after oxygen inhalation. o--o, Group I; o--o, Group II; o--o, Group III; o--o, Group IV. For details, see text.

References