Dye Dilution Curves after the Artificial Atrial Septostomy in Three Infants with the Transposition of the Great Vessels

Hiroshi Onoki, Tetsuo Sato, Ichiki Kano and Keiko Mochizuki

Department of Pediatrics (Prof. Ts. Arakawa), Faculty of Medicine, Tohoku University, Sendai

Hemodynamic consequences after the Rashkind and Miller balloon atrial septostomy were successfully evaluated by means of the dye dilution technic in three infants with the complete transposition of the great vessels.

The complete transposition of the great vessels has been the most common cause of death in infants born with congenital malformations of the heart; according to Boesen\(^1\) forty-two per cent of the patients with this anomaly succumbed within one month of life and seventy-three per cent within the first three months of life.

In 1964 Mustard\(^2\) reported a case of the transposition of the great vessels in which the successful result of the radical operation was obtained by adopting a two-stage correction technic; that is, creation of an atrial septal defect was done by Blalock-Hanlon's procedure with thoracotomy when 20 days of life, then successful radical operation was carried out at the age of 18 months.

In 1966 Rashkind and Miller\(^3\) devised a method for the creation of an atrial septal defect without thoracotomy as a palliative approach to the complete transposition of the great vessels.

Then in 1968, Rashkind and Miller\(^4\) reported thirty-one infants with the transposition of the great vessels who were subjected to the balloon atrial septostomy of theirs with a marked improvement in the interatrial blood communication.

When the successful balloon atrial septostomy was done, a marked improvement in clinical conditions, i.e., a decrease in cyanosis, etc., was observed. The abolition of the pressure gradient between the atria and the sampling of highly oxygenated blood from the right atrium were further evidences for the presence of an adequate interatrial blood communication after the balloon atrial septostomy.\(^5,6\)

Our present study was an attempt to use the dye dilution technics\(^7,8\) after the artificial balloon atrial septostomy as a method for estimating the interatrial blood communication induced by the procedure.
CASES EXAMINED

Case 1. M.A., a female was born on October 9, 1968, weighing 2,800 g. The child was cyanosed at rest which became more remarkable when she was crying or taking feedings.

Physical examination, when 4 months old, revealed a cyanotic and thin girl, there were moist rales all over the lungs. X-ray films of the chest showed cardiac enlargement and increased pulmonary vascularity (cf. Fig. 1). Electrocardiograms revealed bilateral hypertrophy of both the ventricles and atria (cf. Fig. 2). Phonocardiograms showed the presence of faint systolic murmurs at the pulmonic area (cf. Fig. 3).

![Fig. 1. A chest roentgenogram of Case 1.](image)

The result of angiocardiography established a diagnosis of the complete transposition of the great vessels with no evidence of either interventricular or interauricular blood communication.

When 4 months old, the balloon atrial septostomy was carried out according to Rashkind and Miller's method by using the catheter 4F. The amount of the contrast material infused into the balloon was one ml.

After the procedure, dye dilution curves were recorded with a result showing a marked improvement in the interatrial blood communication (cf. Fig. 4).

Case 2. Y.K., a 12-day-old male was admitted to the University Hospital because of deep cyanosis soon after birth. His delivery was uneventful, with a birth weight of 3,960 g. Physical examination revealed a boy with cyanosis and tachypnea. The liver was palpable 5 cm below the costal margin. There were
rales all over the lungs. No cardiac murmurs were recorded in phonocardiograms (cf. Fig. 7). Chest X-ray films revealed the cardiac enlargement and pulmonary congestion (cf. Fig. 5). Electrocardiograms showed a remarkable right ventricular hypertrophy (cf. Fig. 6).

A diagnosis of the transposition of the great vessels without interatrial or interventricular septal defect was established by angiocardiographic findings.
Fig. 5. The chest roentgenogram of Case 2.

Fig. 6. An electrocardiogram of Case 2, showing remarkable right ventricular hypertrophy.

Fig. 7. A phonocardiogram of Case 2.
When 13 days old, the balloon atrial septostomy was done with use of Rashkind's single lumen catheter 4F. The balloon was inflated with 1.5 ml of the contrast medium.

The dye dilution curves were recorded before and after the balloon atrial septostomy, showing that a marked improvement in the interatrial blood communication was achieved by the Rashkind's procedure (cf. Figs. 8A and 8B).

Case 3. T.O., an 11-day-old male was admitted to the University Hospital because of cyanosis and tachypnea soon after birth. The birth weight was 3,100 g. The liver was palpable 3 cm below the costal margin. There was suprasternal retraction on inspiration. X-ray films of the chest demonstrated cardiac enlargement and pulmonary overvascularity (cf. Fig. 9). On phonocardiograms apical systolic cardiac murmurs were recorded (cf. Fig. 11). Electrocardiograms showed a remarkable hypertrophy of the right ventricle (cf. Fig. 10).

An angiocardiography taken on the 12 days of life gave definite evidences for the complete transposition of the great vessels without interauricular or interventricular septal defect.

The balloon atrial septostomy was performed, where the balloon was inflated with 1.5 ml of the contrast medium.
Fig. 9. A chest roentgenogram of Case 3 on admission.

Fig. 10. An electrocardiogram of Case 3.

Fig. 11. A phonocardiogram of Case 3.
Dye dilution curves were recorded before and immediately after the Rashkind septostomy, showing a striking increase in the interatrial blood mixing after the balloon atrial septostomy (cf. Figs. 12A and 12B). A marked decrease in the cardiothoracic ratio was observed 10 days after the balloon atrial septostomy (cf. Fig. 13).

Fig. 12A. A dye dilution curve before the balloon atrial septostomy.

Fig. 12B. A dye dilution curve after the balloon atrial septostomy.

Fig. 13. A chest roentgenogram of Case 3, taken 10 days after the balloon atrial septostomy.
DISCUSSION

The result of our present study revealed that the effective balloon atrial septostomy could be evaluated on the basis of the dye dilution curves recorded before and after the procedure. The evidences for the presence of artificial interatrial blood communication were consisting of the following findings in the dye dilution curves obtained after the procedure: 1) An occurrence of an abnormal hump in the down slope, 2) the prolongation of the disappearance time, 3) loss or diminution of the recirculation curve, 4) a decrease in the peak concentration, and 5) a decrease in the gradient of the down slope.

References