VALVULAR PULMONARY STENOSIS
PREOPERATIVE AND POSTOPERATIVE STUDIES

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Surgical therapy for congenital heart anomalies has improved as new identification procedures and new surgical methods have proved more fruitful and more certain than those previously used. The development of heart catheterization, for instance, has been advanced by hemodynamic studies, refinements in physical examination, and roentgenographic, eletrocardiographic and phonocardiographic observations. The subject has been only partially treated in the literature; there is as yet no unified study. We are presenting here observations of patients with valvular pulmonary stenosis treated by valvotomy at Hacettepe.

Materials and Methods

Valvotomy was perfomed in 20 cases of pulmonary stenosis, in which catheterization had shown that there was no intraventricular septal defect. The average age of the group of 20 patients was 13 years, with a range from 15 months to 30 years. Sixty–six per cent were males. After clinical, electrocardiographic, phonocardiographic and radiologic examinations patients suspected of or diagnosed as having pulmonary stenosis underwent cardiac catheterization. Angiograms were also made in some cases.

In half the cases, valvotomy was performed using the hypothermy technique. In the others, the heart–lung machine was used. Right ventricular pressures were measured throughout the operation by direct puncture. Continuous control was maintained with electrocardiographs, phonocardiographs, and radiographs. Periodic physical examinations were made following the operation and the patients continued to come in for check–ups.

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Discussion

Murmur : Murmurs heard in the pulmonary area are characteristically of the ejection type, and show a high frequency diagonal figure (Figures 1 and 2, upper row). When the right ventricular pressure was too high

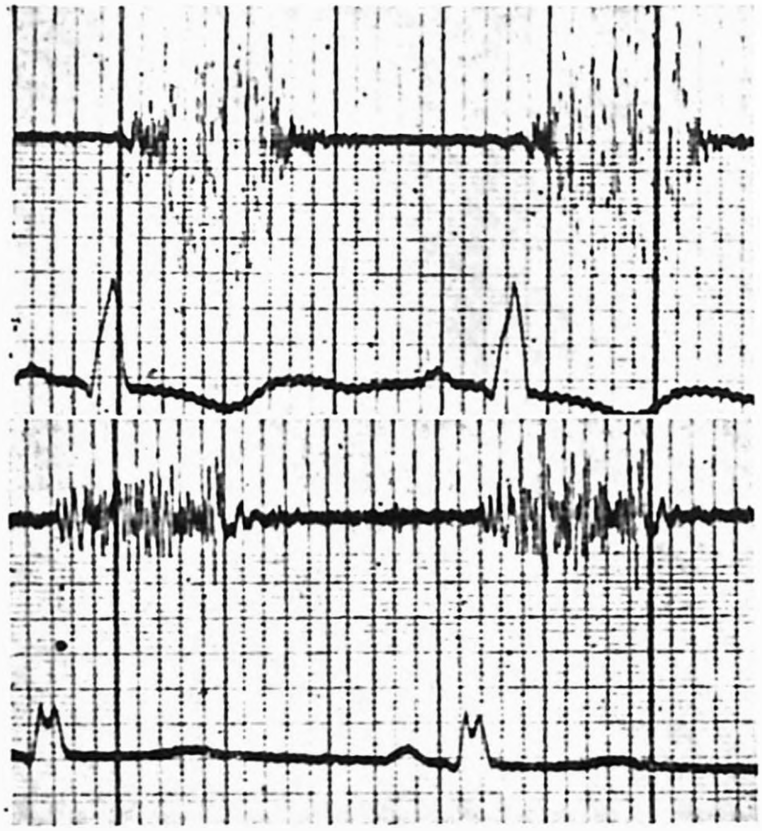

Figure 1. Phonocardiogram (case 5). Upper row before operation, lower after operation.

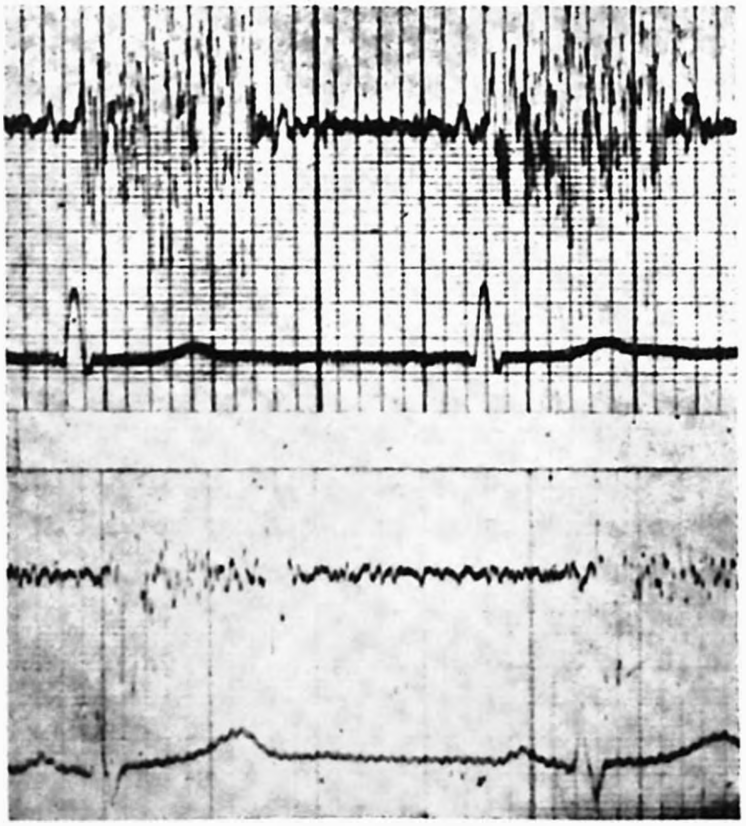

Figure 2. Phonocardiogram (case 3). Upper row before operation, lower after operation.

or the pulmonary valve too narrow, the intensity of the murmur was low (Figure 3, upper row). In five of our cases, murmur decreased markedly following valvotomy (Figures 1, 2 and 4). In two cases no changes were noted, and in three cases there was only a slight decrease in murmur.

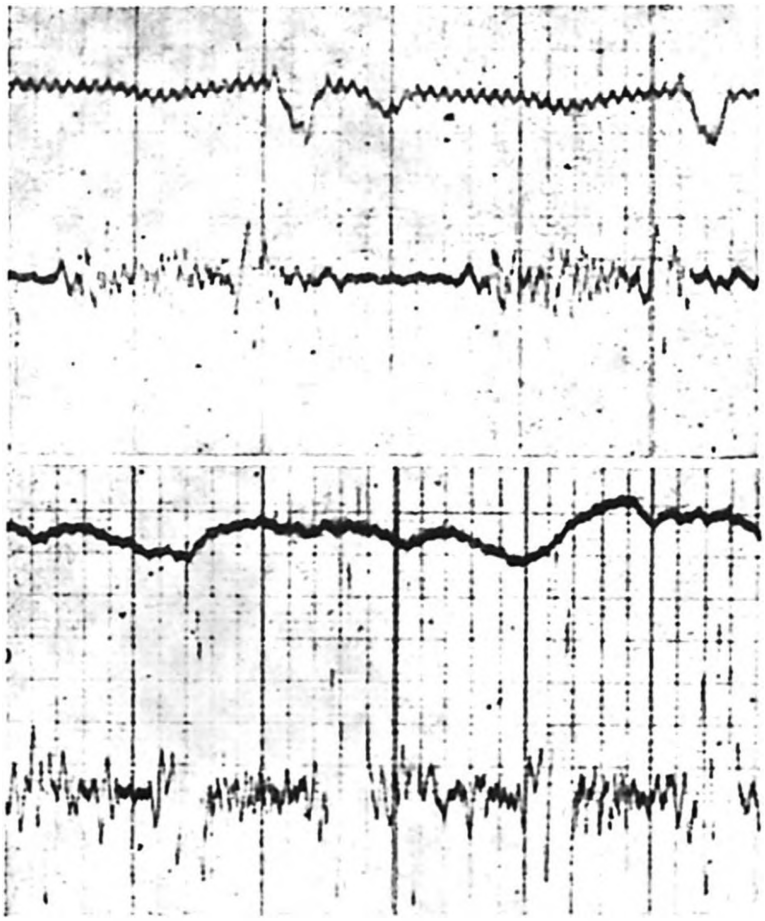

Figure 3. Phonocardiogram (case 9). Upper row before operation, lower after operation.

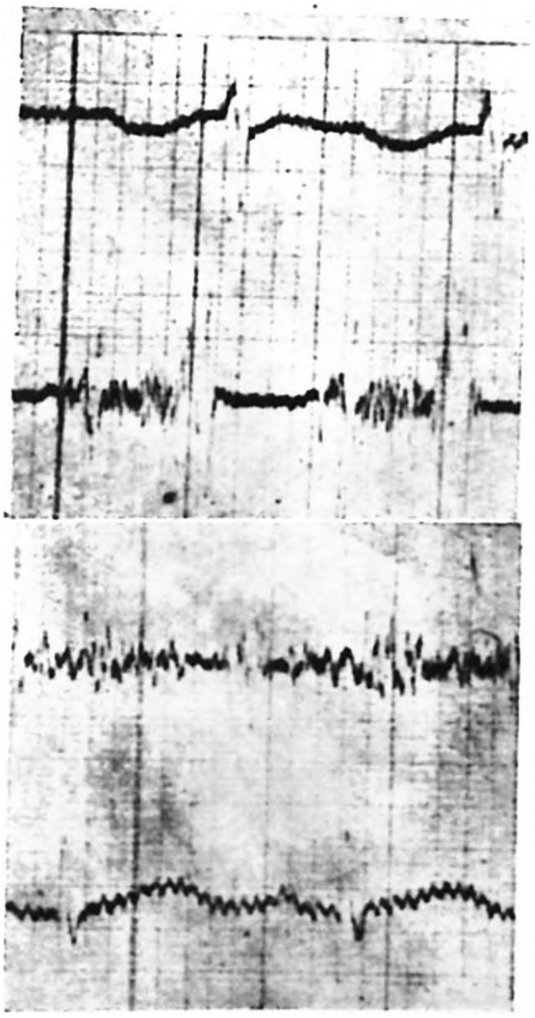

Figure 4. Phonocardiogram (case 1). Upper row before operation, lower after operation.

Thrill: No thrill was noted preoperatively in three of ten cases. These were the patients who had high right ventricular pressures and less severe murmurs. Thrill disappeared in all cases where it had been present, along with a lessening of the intensity of the murmur.

Poststenotic dilatation in teleradiography: Teleradiography showed prominent pulmonary artery in all but two cases (Figures 5 and 7). In these two, poststenotic dilatation disappeared in the months following the operation (Figures 6 and 8). In one other case, stenotic dilatation

Figure 5. Preoperative

Figure 6. Postoperative

Figure 7. Preoperative

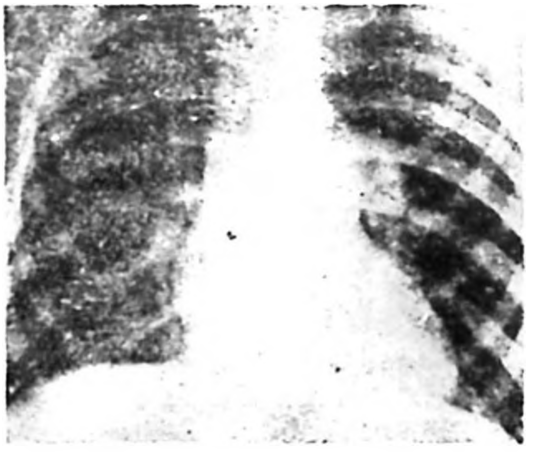

Figure 8. Postoperative

showed a marked decrease seven months after the operation. In the other cases, poststenotic dilatation did not change according to the tests performed during the first four months after the operation. The fact that poststenotic dilatation disappeared in two young patients (one 15 months old, the other 7 years old) suggests that if the operation is performed before the pulmonary artery loses its elasticity, poststenotic dilatation can be corrected more easily. A decrease in poststenotic dilatation in one case after seven months indicates that correction may occur naturally over a period of time. These patients may continue to improve in the future.

There seems to be no relation between the postoperative residual pressure on the right ventricle and the poststenotic dilatation. The relation between the changes in poststenotic dilatation and the murmur, may be an indication that this residual murmur is caused by the poststenotic dilatation.

Although Blount[1] reported that in 10 pulmonary stenosis cases which he followed preoperatively and postoperatively there was no change in poststenotic dilatation, no generalizations can be made because he does not state the ages of his patients.

Relation between electrocardiograms and right ventricular pressure: In all of the cases, electrocardiograms showed right axis deviation and right ventricular hypertrophy. In the patients with high right ventricular pressure, cyanosis, and right to left shunt at the atrial level, high and sharp P waves were seen due to right atrium enlargement accompanied by strain (Figure 9, upper row). In one case, right bundle branch block also occurred (Figure 10).

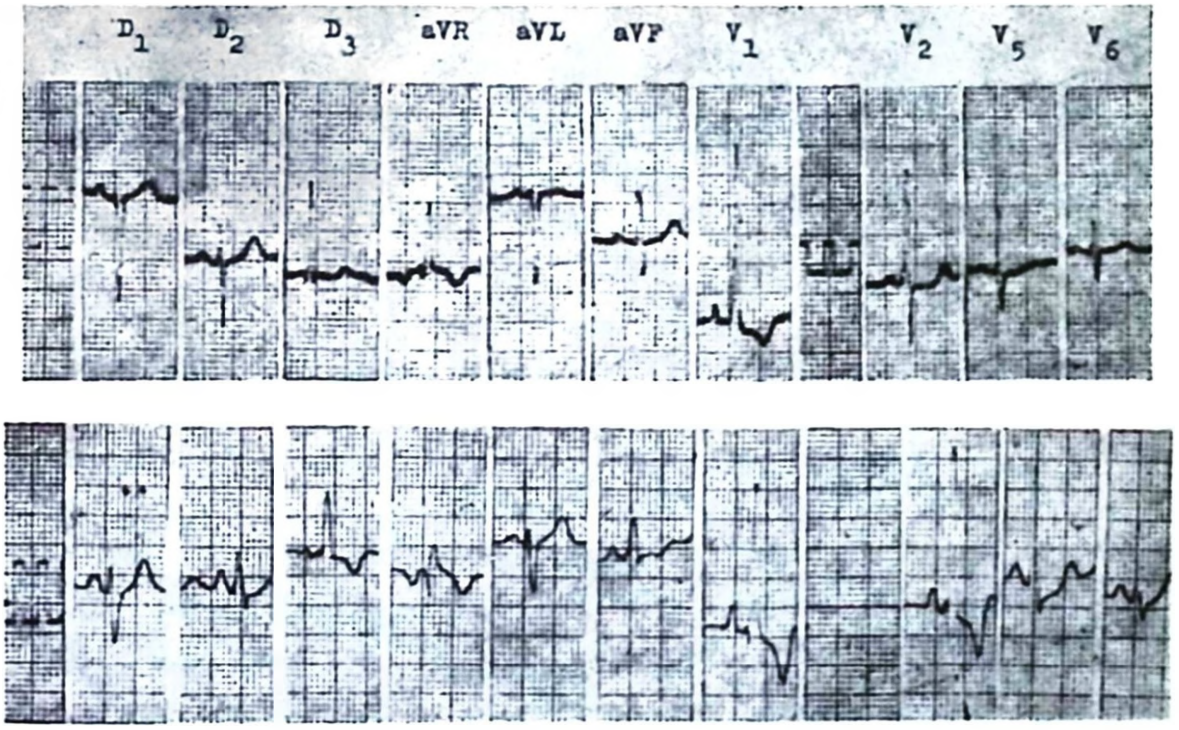

Figure 9. Electrocardiogram. Upper row before operation, lower after operation.

It has been suggested that there is a relationship between the right ventricular pressure and the length of the R wave in V_1, but opinion differs widely on this. Kahn,[2] after observing 12 patients prior to the operation reported that there was no relation between preoperative ventricular pressure and length of the R wave in V_1, although following the

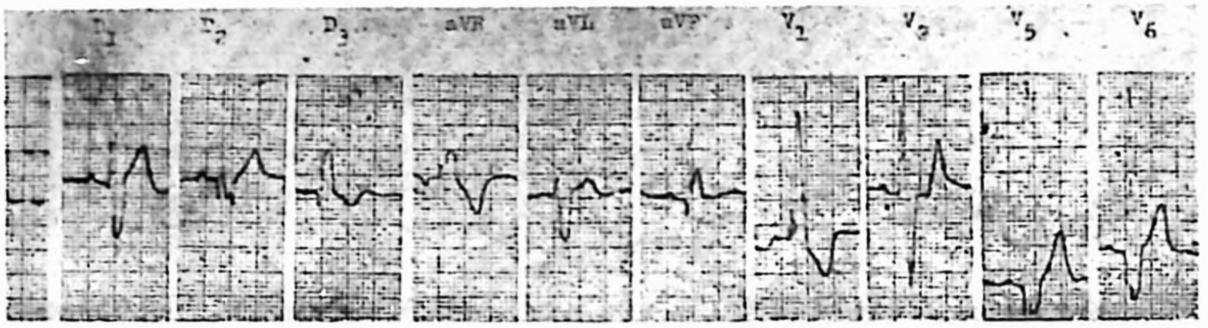

Figure 10. Electrocardiogram showing right bundle branch block.

operation he did note a return to more normal electrocardiograms. He concluded that this might be an important element in the evaluation of the patient's condition postoperatively.

DePasquale[3] in 41 patients between the ages of three and 38 years, observed a linear relation between the length of the R wave in V_1 and the right ventricular pressure preoperatively, and noted a marked decrease in the length of the R wave after the operation.

Scherlis[4] reported a relation between the R wave and right ventricular pressure but he did not elaborate on it.

Cayler and his colleagues,[5] after studying 105 cases, tried to establish a relation between right ventricular pressure and electrocardiographic changes. They developed a formula enabling them to calculate the right ventricular pressure from the electrocardiograph, as follows: RV_1 (in mm) x 3+47=right ventricular pressure (mm Hg).

In the 10 cases on which our study is based, we also tried to establish a relation between the R waves and ventricular pressure (preoperatively, with the catheterization method) and reached the following conclusions: 1. In our youngest patient (case 1, Figure 11) the ratio of the pressure to the RV_1 was 7. This may have been due to the fact that, although the pressure was high, hypertrophy had not yet developed. No definite conclusions could be drawn as only one instance of this was observed.

2. In the cases where strain was evident from the electrocardiogram, the ratio dropped to 2 to 3 (cases 5, 7 and 9, Figures 9 through 12). The explanation might be that the ventricular muscle has lost the power to exert pressure if strain is present, irrespective of the degree of hypertrophy.

3. In cases where strain is absent (Figure 13) the ratio between ventricular pressure and RV_1 is 4. This means that in children over 2 years of age, if the electrocardiogram shows no sign of strain, right ventricular pressure can be determined by multiplying the length of the R wave in V_1 measured with normal standardization methods by 4.

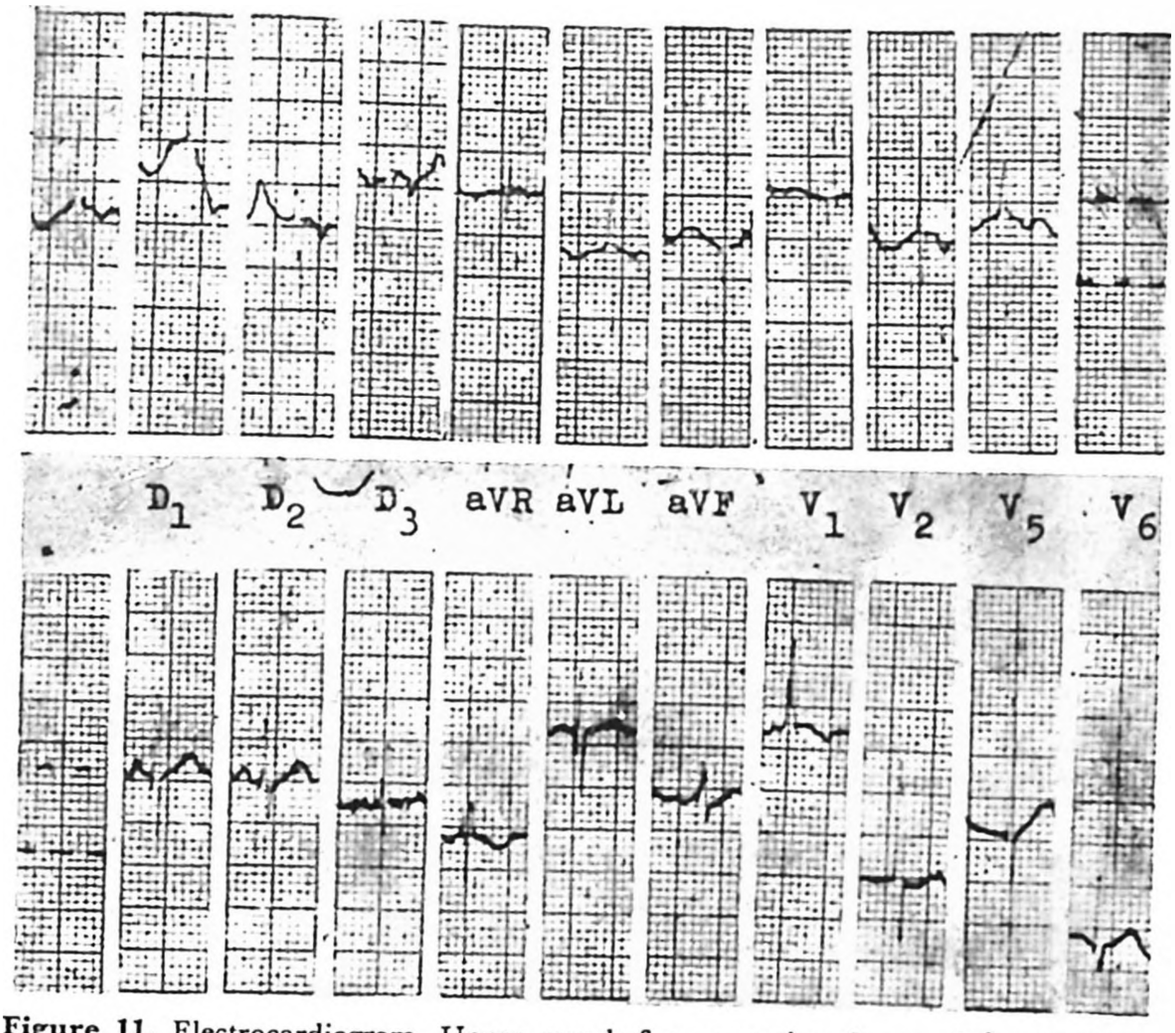

Figure 11. Electrocardiogram. Upper row before operation, lower after operation.

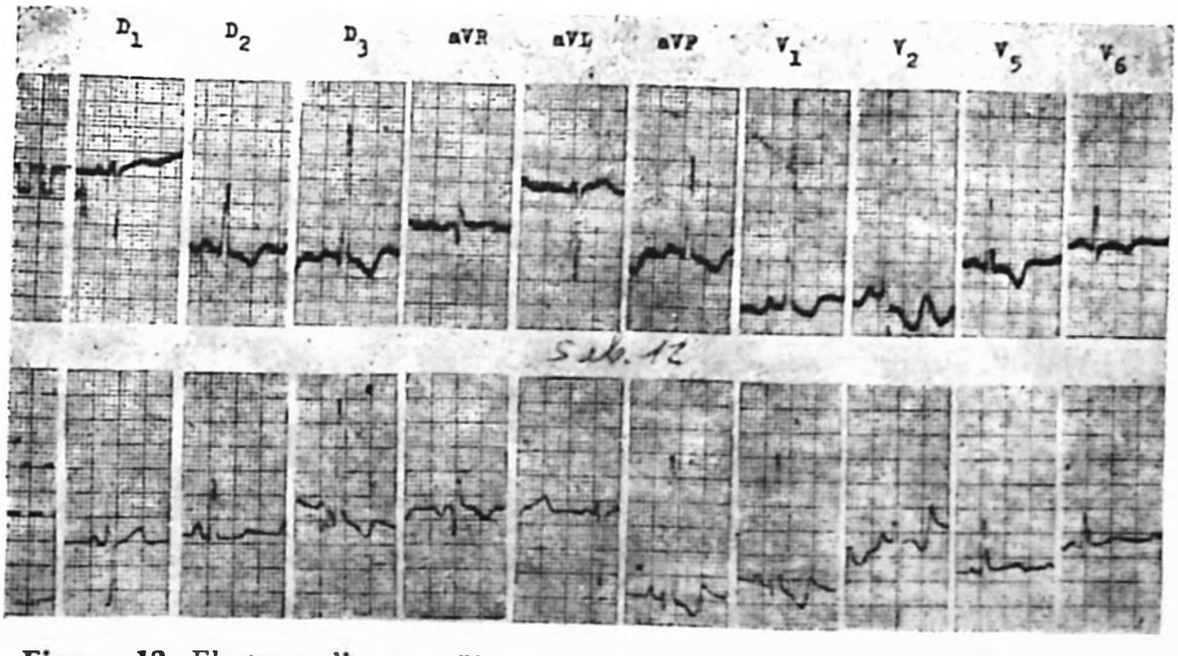

Figure 12. Electrocardiogram. Upper row before operation, lower after operation.

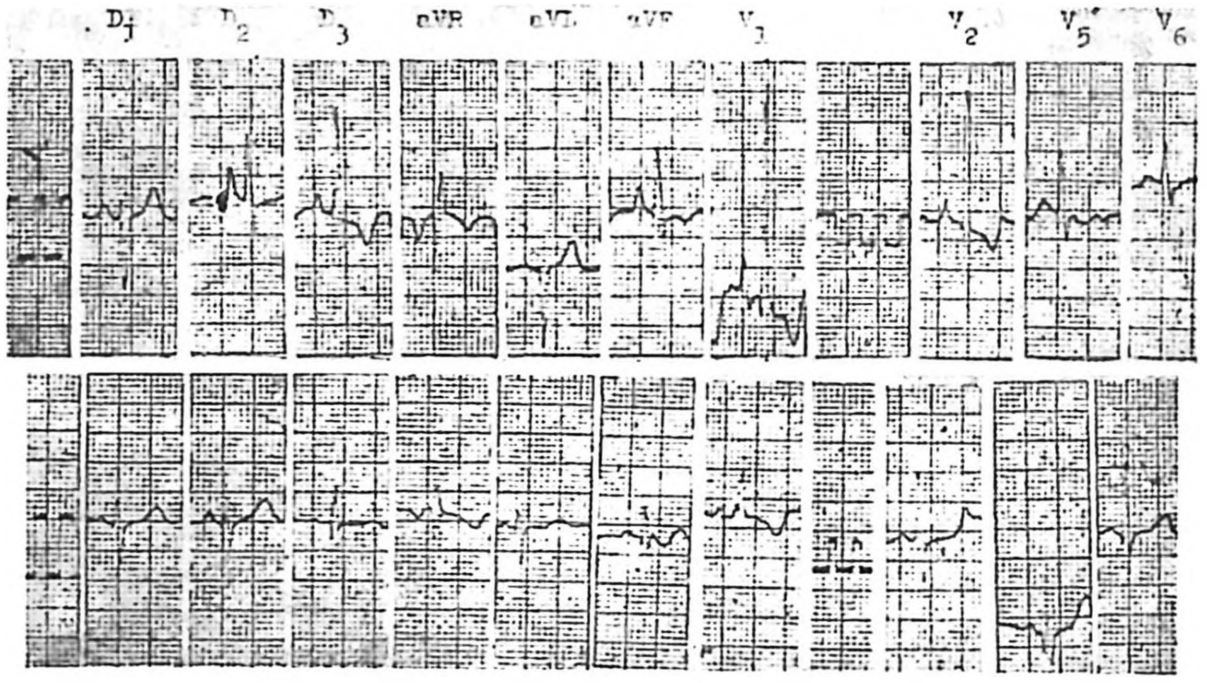

Figure 13. Electrocardiogram. Upper row before operation lower after operation.

Right ventricular pressure measured immediately following valvotomy showed a marked drop in all cases. Electrocardiograms made in the one to four months following the operation showed a parallel drop in RV_1 voltages. A comparison of the fall in pressure and in RV_1 length reveals a close relation between the two. For this reason electrocardiograms made during this period show a close relation with the residual right ventricular pressure. Whether this relation will continue in later years and can serve as a criterion, will have to be determined as the cases are followed in time. Catheterization performed two years after the operation may also help in this respect.

Summary

Preoperative and postoperative physical observations, electrocardiograms, phonocardiograms and x-rays of patients with pulmonary stenosis are discussed. The relationship between the R waves in V_1 and right ventricular pressure is examined. The following observations are presented:

1. After valvotomy, the intensity of the murmur decreased in all cases. In some, however, a low-frequency residual murmur remained, probably because of residual poststenotic dilatation.

2. Thrill disappeared in all cases.

3.. Poststenotic dilatation disappeared completely in two young patients, suggesting that the operation should be performed while the pulmonary artery is still elastic.

4. The ratio between the right ventricular pressure and the length of the R wave in V_1, where strain is absent, is 4.

5. There is a direct relation between the fall in right ventricular pressure and the decrease in RV_1, in the electrocardiogram during the first four months following valvotomy.

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