
Anschrift des Verfassers:

5.

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Pre- and postoperative exercise studies in patients with congenital and chronic rheumatic heart disease

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With 5 figures

An exercise tolerance test introduced by Sjöstrand (9) has during the past 25 years routinely been used at the Karolinska hospital in Stockholm for evaluation of the circulatory capacity in heart patients. Before heart surgery the hemodynamic alterations often are studied both at rest and during work in order to define the degree of functional impairment and the nature of the circulatory limitation. Determination of the circulatory response to exercise is of great value for the understanding of the effect of surgery. Therefore various surgical procedures have been checked in some series of patients. In the following this will be elucidated by some organic
heart lesions representing four types of abnormal load on the heart: 1) High pressure load of the right ventricle, in isolated pulmonary stenosis. 2) High volume load of the right ventricle, in atrial septal defect. 3) High pressure load of the left ventricle, in aortic stenosis. 4) High volume load of the left ventricle, in aortic incompetence.

**Material**

More than half of the number of patients operated at the Karolinska hospital are studied preoperatively in other hospitals but many of these might be examined by us postoperatively. On the other hand many of the patients studied preoperatively by us are not included in any postoperative follow up study. Only studies done in our hospital will be presented here. Therefore the same procedures and methods are used in all examinations pre- and postoperatively, but there are partly different patients included in the pre- and postoperative examinations. They are, however, similar types of patients as the only selection for the patients examined by us before surgery is geographical. The patients are referred to the cardiac department in his area and the population is homogenous over the contrys. The postoperative materials are also unselected. Patients operated with a special method over a given period of time are admitted to our hospital for a postoperative examination. This has been done as a special research projekt (2). Some results presented to represented identical materials pre- and postoperatively. The findings are related to a normal material studied with equal methods (1, 3). Reference level for zero-pressure equals the mid-thoracic. All studies during heart catheterization are done in recumbent position. Left atrial pressures were obtained by a transseptal catheterization.

**Pulmonary stenosis**

For maintaining a normal stroke volume in cases of pulmonary stenosis the right ventricular systolic pressure is elevated. For an equal stroke volume during exercise with a shorter ejection time, the pressure must rise even further. If the stenosis is very tight a normal output during exercise cannot be obtained (4). The hypertrophied right ventricle needs a high filling pressure which rises further during work. Only in mild stenosis it is normal both at rest and during exercise. After surgery patients with a tight stenosis still reveal a hypokinetic circulation during exercise (Fig. 1). The filling pressure of the right ventricle, however, is much lower (Fig. 2).

**Atrial septal defect**

If a large intra-atrial communication exists, both ventricles are exposed to equal filling pressures. When the thickness of the right ventricular wall decreases during the first months of life the right ventricle will become more distensible than the left and therefore will take a larger portion of the common pool available for filling. The right ventricular stroke volume gets larger and an abnormally large pulmonary flow will be established. The left ventricular stroke volume might be low but is normal in many cases. We do not have acceptable methods for determination of the systemic flow during exercise in atrial septal defects, but it ist probably rather normal as the physical working capacity is usually normal up to middle-age. We do sometimes see good athletes with large atrial septal defects. The relation between the filling of the two ventricles may change with increase in heart rate during exercise. In a study from 1957 (5) in a rather small number of patients we found that the right ventricular stroke volume decreased consi-