Left Atrial and Left Ventricular Pressures in Subjects without Cardiovascular Disease
Observations in Eighteen Patients Studied by Transseptal Left Heart Catheterization

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The measurement of pressures in the left side of the heart now constitutes one of the basic technics in the clinical study of the circulation. Left heart catheterization is of importance not only in cardiovascular diagnosis but also as a tool in the physiologic investigation of the central circulation in normal and abnormal states. In spite of the widespread applications of left heart catheterization, the level of pressures in the left side of the heart in subjects without cardiovascular disease in a basal physiologic state has not been known. The lack of this information is understandable when the risk, patient discomfort, and technical complexity associated with the older methods of left heart catheterization are considered.1 These procedures were in general reserved for those patients in whom the establishment of a specific diagnosis or of a therapeutic plan required specific knowledge of the pressures in the left side of the heart.

With the development of left heart catheterization by the transseptal route 2-5 it has become possible to study the dynamics of the left side of the heart with relative safety and little discomfort to the patient. We have had the opportunity to measure left atrial and left ventricular pressures in 18 subjects without any apparent abnormalities of the cardiovascular system; the data obtained in these patients form the basis of this report.

Methods
The subjects studied ranged in age from 5 to 49 years, with an average age of 21 years; 11 of them were male and 7 were female. All were studied because of the presence of heart murmurs. On clinical examination these murmurs were considered to be functional in origin by several examining physicians, and the chest roentgenograms and electrocardiograms showed no abnormalities. Right heart catheterization was carried out through the right saphenous vein, and in each instance the pressures in the pulmonary artery, right ventricle, and right atrium were found to be within normal limits.6 There was no evidence of a circulatory shunt by application of indicator-dilution curves7 and of foreign gas technics.8 Following right heart catheterization transseptal left catheterization was carried out in a manner detailed previously.4, 6

Left atrial pressures were measured through a no. 17-gage thin-walled needle in 16 patients and through a no. 19-gage needle in the other patients. Left ventricular pressures were measured through a polyethylene catheter (PE no. 50), 100 cm. in length in 16 patients, and through a radiopaque polyethylene catheter, 70 cm. in length with an internal diameter of 1.15 mm. in the other two patients. Pressures were measured with P23D Statham pressure transducers and were recorded on a multi-channel photographic recorder. The baseline for all pressure measurements was 5 cm. below the sternal angle.

All patients were studied in the basal, post-absorptive state. Thirteen of them were given 100 mg. of pentobarbital orally while the five children, aged 5 to 14 years, received a mixture of meperidine, phenergan, and promazine intramuscularly prior to study.

Results
The results are presented in detail in figure 1. The mean left atrial pressures ranged between 2 and 12 mm. Hg, and the average value was 7.9 mm. Hg. The mean left atrial pressure exceeded the mean right atrial pressure in every subject; the difference between these mean pressures ranged from 1 to 7 mm. Hg, and the average difference was 3.9 mm.
Hg. The left atrial pressure at the onset of the atrial contraction (a) wave was, in general, almost identical to the mean left atrial pressure, ranging from 1 to 12 mm. Hg, with an average value of 7.1 mm. Hg. The left atrial a wave peak ranged from 4 to 16 mm. Hg and averaged 10.4 mm. Hg. Thus, the left atrial a wave pulse pressure, i.e., the difference between the pressure at the onset and at the peak of the a wave ranged from 1 to 7 mm. Hg and averaged 3.4 mm. Hg. The left atrial z point pressure,9 i.e., the atrial pressure at the onset of left ventricular contraction, ranged from 1 to 13 mm. Hg and averaged 7.6 mm. Hg. The tallest wave in the left atrial pressure pulse was generally the v peak, i.e., the pressure at the time of the opening of the mitral valve. This ranged from 6 to 21 mm. Hg and averaged 12.8 mm. Hg. The left ventricular end-diastolic pressure differed little from the mean left atrial and the left atrial z point pressures; it ranged from 5 to 12 mm. Hg, with an average value of 8.7 mm. Hg.

A typical left atrial pressure pulse in one of the subjects is reproduced in figure 2.

**Discussion**

It is well established, on the basis of experimental observations in the dog, that the mean pressure in the left atrium normally exceeds that in the right atrium.10 Although pressures from the left atrium have been recorded in patients with atrial septal defects at the time of cardiac catheterization for many years,11, 12 the presence of the interatrial communication in such patients lowers the left atrial pressure and reduces the normal interatrial pressure gradient. Thus, the left atrial pressure in these patients cannot be considered to be representative of that existing in normal subjects. Left heart pressure measurements in patients without cardiovascular disease have, up to now, been limited to observations carried out at the time of thoracotomy.13-17 In patients with an open chest the mean left atrial pressure averaged 7.5 mm. Hg in one series15 and 9.0 mm. Hg in another;16 the left ventricular end-diastolic pressures ranged from 5 to 14 mm. Hg in one group15 and 5 to 17 mm. Hg (mean 9 mm. Hg) in the others.16 The mean left atrial pressure exceeded the mean right atrial pressure by an average of 2 mm. Hg, whereas the left ventricular end-diastolic pressure exceeded the right ventricular end-diastolic pressure by an average of 3 mm. Hg.16 The close correspondence between these values, obtained at the time of operation, and the pressure values obtained at catheterization and reported herein is of interest.

**Summary**

Transeptal left heart catheterizations were carried out in 18 patients without apparent evidence of organic cardiovascular disease.
These studies have permitted delineation of
the pressures that exist in the left side of the
heart in normal subjects studied in a basal
physiologic state.

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