Phonocardiographic Characteristics of the St. Jude Prosthesis in the Aortic Position*


The St. Jude valvular prosthesis is a bileaflet pyrolytic carbon device which is being implanted with increasing frequency. Knowledge of the auscultatory and phonocardiographic characteristics of artificial cardiac valves has proven to be useful in detecting their malfunction.2,4

We describe here our observations on the phonocardiographic features of the St. Jude prosthesis in the aortic position. Figure 1 shows the simultaneously recorded carotid arterial pulse tracing, phonocardiogram from the tricuspid area and lead 2 of the electrocardiogram from such a patient. The major component (M1) of the first heart sound complex is normal. An early systolic sound (ES) is present at the lower left sternal border. This sound is usually heard over the entire precordium, but is best recorded at the left parasternal location. The interval from the first heart sound to the opening or ejection sound ranges from 60 to 80 msec. Note that the ejection sound coincides in timing with the onset of the external carotid pulse upstroke. The aortic component (AC) of the second heart sound consists of a major high amplitude high frequency component followed by multiple lower amplitude medium to low frequency vibrations. This aortic closing sound is recorded in conjunction with the dicrotic notch of the external carotid pulse tracing. In all cases, the aortic closure sound was greater in amplitude than the opening ejection sound with an AC:ES amplitude ratio ranging from 5:1 to 8:1. Phonoechographic study indicates that the early systolic sound follows the opening point of the prosthetic leaflets by approximately 40 msec. The aortic component of the second heart sound is inscribed at the time of ultrasonic valve closure or immediately after it (Fig 2).

It can be surmised that the early systolic sound observed in these patients may be related to maximum excursion of the opening motion of the carbon leaflets or turbulence created by transvalvular flow during left ventricular systole. The high frequency aortic closure sound is probably produced by coaptation of the leaflets and vibrations from the resonant prosthesis secondary to rapid deceleration of blood at end-systole. Other findings noted

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Early prosthesis, the phonocardiogram at the root.

Possible mechanisms for the systolic murmur are:
1) the presence of a resonant structure in the aortic root, 2) turbulence of blood around the prosthesis during left ventricular ejection, and 3) a transvalvular pressure gradient. A cautionary note relevant to the early systolic sound requires emphasis. This transient is not necessarily heard or recorded in all patients with a St. Jude valve in the aortic position. Two to four of ten subjects may not display this finding and they appear to have no evidence of short-term prosthetic dysfunction. Serial phonocardiographic study will be required in order to ascertain whether or not the absence of this sound has clinical significance.

It is concluded that the phonocardiogram is a simple noninvasive graphic technique for evaluating sonic qualities of the St. Jude valve.

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