INTRODUCTION

Rapid injection of biologically compatible solutions produces a "cloud of echoes" in the blood which is otherwise echo free. The source of this echocardiographic contrast is microbubbles of air introduced during injection [1, 2].

Left ventricular catheter injections have been employed to identify left side structures from M-mode echocardiograms [3, 4] and to validate cardiac views imaged by two-dimensional echocardiography [5, 6]. The method has also been found to be accurate and sensitive for the demonstration of small, intracardiac, left-to-right shunts and of minimal degrees of aortic and mitral valve regurgitation [7, 8, 9].

Injection of echo contrast material into the left ventricle, however, requires cardiac catheterization, making it an invasive procedure. This probably explains why left ventricular contrast echocardiography has not gained widespread clinical application.

Recently the possibility of transmitting echo contrast material across the capillary bed of the lungs to the left heart with pulmonary wedge injections [10, 11, 12] or with peripheral venous injections using experimental contrast agents [13, 16] has been demonstrated. These possibilities show great promise and may stimulate an increasing interest in ultrasonic left heart opacification. This chapter aims to review some methodological and clinical aspects of left ventricular contrast echocardiography. Most of this area is still investigational.

METHODOLOGIC ASPECTS OF LEFT VENTRICULAR CONTRAST ECHOCARDIOGRAPHY

At present, echocardiographic contrast studies of the left ventricle are performed in the catheterization laboratory. M-mode or two-dimensional techniques can be employed, each having its specific advantages and limitations for clinical problem-solving and research.
Two-dimensional echocardiographic views employed

Our experience with left ventricular echo contrast has been mainly with two-dimensional echocardiography, using a dynamically focused linear-array instrument (Fociscan, Organon Teknika) or a phased-array sector-scanner (Toshiba SSH-10A). The long-axis and short-axis views from the parasternal transducer position as well as the four-chamber and long-axis views from apical transducer position are routinely recorded [6,14]. The apical views are especially useful for quantitative left ventricular studies, since the entire left ventricle from apex to base can often be recorded.

Left ventricular injection of echocardiographic contrast material

The rapid injection through a catheter of any biologically compatible fluid into the left ventricle causes echocardiographic contrast. We routinely use a manual flush of 5 to 10 ml of 5% dextrose in water.

Indocyanine green dye may yield a better contrast effect because of its surfactant properties, which keep the microbubbles of air, resulting from the vigorous shaking during preparation, stabilized in the solution [2]. One milliliter of indocyanine green solution (5 mg/ml for adults) is injected into the catheter and manually flushed with 5 to 10 ml of physiologic saline or 5% dextrose [7]. We have never observed any adverse patient reaction to direct left ventricular injections during echocardiographic contrast studies [15].

Pulmonary wedge injection of echocardiographic contrast material

Bommer et al. [10] reported in 1979 that catheter injections in the pulmonary wedge position in dogs cause echocardiographic contrast on the left side of the heart. Reale et al. [11] studied 43 patients with acquired or congenital heart disease and injected different echo-producing substances (indocyanine green dye, saline and carbon dioxide) via a balloon-tipped catheter in the pulmonary wedge position. Echocardiographic contrast was seen in the left ventricle in all patients studied. No complications or side effects were observed. We have studied 41 patients, using a Courand 7F catheter alone in 27, a Swan-Ganz 7F catheter alone in 3 and both catheters in 11, for pulmonary wedge injections. Left ventricular echocardiographic contrast was seen in 3 out of 14 patients with the Swan-Ganz catheter and in 30 out of 38 patients when the Courand catheter was used (Figure 1). We found that injection pressure proximal to the catheter had to be more than 40 kPa (300 mmHg) in order to obtain left side echocardiographic contrast.

Angiocardiographic studies with injections of Amipaque® further demon-