

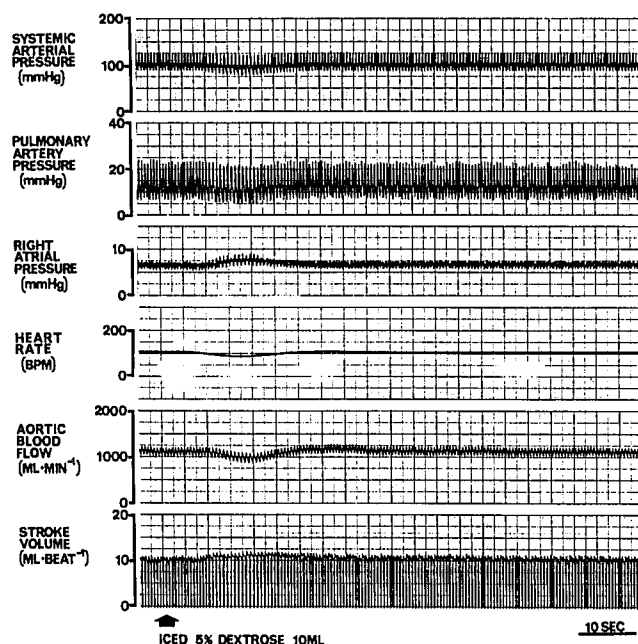
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## Alterations in Stroke Volume during Cardiac Output Determination by Thermodilution

*To the Editor:*—Recently, Groban *et al.*<sup>1</sup> showed a significant increase in stroke volume when iced injectate was used for cardiac output determination in patients in the intensive care unit. I would like to make a few comments regarding the interpretation derived from their investigation. Although I agree with the assumption that prolonged cardiac filling due to slowing of heart rate may contribute to the increase in stroke volume, the data could not be explained solely by this mechanism; in their study, stroke volume increased by an average of 30%, while heart rate decreased only by an average of 6%. As one of the underlying mechanisms, acute volume loading with 10 ml injectate also could account for the significant increment in stroke volume in their study. Furthermore, impedance cardiog-

raphy may be associated with some limitations in measuring stroke volume.<sup>2</sup>

In my previous clinical reports and animal experiments,<sup>3-5</sup> several episodes of reductions in systemic and pulmonary arterial pressures were noted following administration of iced injectate. Although I did not present the stroke volume data in my previous animal study,<sup>5</sup> I had observed significant reductions in systemic and pulmonary pressures and blood flow along with small increments in stroke volume (fig. 1). If an increase in stroke volume compensates adequately for a transient reduction in blood flow when heart rate slows, pressure changes are not likely to take place unless arterial vasodilation occurs concomitantly. Because alterations in blood flow seem to account for pressure changes in most instances, according to my experimental data,<sup>5</sup> cardiac output values estimated by the thermodilution technique should be accurate and reliable when pressures remain stable during measurement. However, if an alteration in pressure does occur, the accuracy of cardiac output measurement by the thermodilution method may be reduced because of the possible occurrence of a significant perturbation in blood flow associated with the measurement.



**Fig. 1.** Polygraph tracings of systemic arterial pressure, pulmonary artery pressure, right atrial pressure, heart rate, aortic blood flow, and stroke volume after the injection of 10 ml iced injectate in an anesthetized dog. Aortic blood flow and stroke volume were measured continuously with a square-wave electromagnetic flowmeter (MFV-1200, Nihon-Kohden). Note transient simultaneous changes in pressures and flow along with small changes in stroke volume when heart rate decreased.

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