

**RAPID EVALUATION OF HAEMODYNAMICS IN THE CRITICALLY ILL
PATIENT BY CONTINUOUS WAVE DOPPLER ULTRASOUND
MEASUREMENT OF AORTIC MINUTE DISTANCE**

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One of the most important physiological variables to assess in the critically ill patient is the cardiac output (CO). Measurement of CO has always involved a high degree of invasiveness, as in the pulmonary artery catheter, or relatively poor accuracy with low invasiveness devices such as transoesophageal Doppler. The advent of a highly accurate yet entirely non-invasive monitor for cardiac output determination by using continuous wave transcutaneous Doppler ultrasound (Ultra Sonic Cardiac Output Monitor, (USCOM) USCOM Ltd., Sydney, Australia) allowed for the possibility of rapid (less than 10 minutes) determination of CO in emergency department patients. The derived data could then be used for optimising early goal directed therapy and normalising haemodynamics.

The first part of the study involved the determination of the normal haemodynamic variables and cardiac output in 250 volunteers with no known history of cardiovascular disease nor any recent medication history. Preliminary medical screening of the volunteers resulted in the elimination of 13 subjects (5.2%) with unexpected findings of significant pathology on ultrasound imaging or non-diagnostic quality images on USCOM evaluation, from further study. The remaining 237 study subjects had ages ranging from 2.5 years to 71 years with a weight range of 15 to 135 kilograms. The sex ratio was 124 females to 112 males (52.7% vs 47.3%). During this part of the study it was observed that the aortic minute distance (AMD), derived from the product of the velocity-time integral and the heart rate, showed a very strong correlation with the cardiac index. (Cardiac index is the cardiac output divided by the body surface area, which provides a comparative index between individuals independent of age, height, weight, sex or adiposity.) The AMD could be measured in less than 30 seconds in 98% of study subjects (232/237). Only seven otherwise normal study subjects were subsequently found to have significant cardiovascular pathology, leaving only two subjects (0.84%) with no evidence of pathology yet an AMD below 14 m/min.

In the second part of the study, 50 patients known to have a low cardiac output as defined by cardiac index of less than 2.3 L/min/m^2 were reviewed to assess the relationship between cardiac index and AMD. In all 50 patients the AMD was found to be below 14 m/min. The ease and speed at which AMD can be measured using the USCOM, typically within 15 seconds, allows for the rapid evaluation of haemodynamics with a high degree of certainty as to the critical value of cardiac index of 2.3 L/min/m^2 . Early goal directed therapy can then be initiated when indicated, and optimised by either repeated measurements of AMD at clinically appropriate intervals, or by formal cardiac output determination using the full features of the USCOM.