

Evaluation of Noninvasive Cardiac Output Monitor with Transthoracic Doppler Method in the ICU

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Introduction:

Conclusive evaluation of cardiovascular status is one of the important tasks in the ICU. Although cardiac output determination with pulmonary artery catheter (PAC) has been commonly used in the current practice, several randomized control trial failed to establish the usefulness of PAC (1). USCOM device (USCOM, Sydney, Australia) is one of the less-invasive cardiac output monitors and measures blood flow transthoracically with continuous flow Doppler method either at ascending aorta or main pulmonary artery. Previous studies demonstrated the remarkable accuracy of USCOM monitor against thermodilution in cardiac post-operative patients (2,3). However, only limited informations are available about the measurement site and the success rate and accuracy of this method. Also, the continuous measurement of cardiac output (CCO) has been widely used in the ICU and the information about the bias and precision of USCOM against CCO may be clinically important. The purpose of this prospective, observational study was to evaluate the accuracy of USCOM device compared with CCO in various situations in the ICU.

Methods:

With IRB approval, patients with CCO monitoring (Edwards Lifescience, Irvine, CA) in the ICU were screened for this study. When eligible, non-invasive determination of CO with USCOM (Ver. 1.5) performed at either main pulmonary artery (PA) or ascending aorta (Ao) twice a day during the ICU stay. The same investigator performed all the measurements. Semi-automatic calculation was applied if possible and may be switched to manual mode if the automatic calculation yielded unsatisfactory results. At least 5 stroke volumes were recorded and the CO was calculated by multiplying maximal stroke volume and heart rate. The bias and precision of cardiac output measurement was statistically analyzed with Bland-Altman method. The success rate was defined as the number of measurements that the relative error was less than 20% against CCO divided by the number of possible measurements.

Results:

During the study period, 126 measurements at Ao and 103 measurements at PA was performed in 40 patients. The mean \pm SD of the CCO in these subjects were 5.3 \pm 0.57 L/min. Measurable Doppler signals could not be obtained in 3 occasions at Ao and 17 occasions at PA. The bias \pm precision of USCOM against CCO was -0.80 \pm 1.30 L/min. The comparison between Ao and PA measurement were summarized in the table.

Conclusion:

The result indicates that the accuracy of USCOM was modest against CCO. However, taking into account that CCO overestimates cardiac output in most instances, the actual systemic bias may be less and clinically acceptable. Although the measurable Doppler signals were not obtainable more frequently, PA measurement was more accurate than Ao measurement. Several advantages of USCOM device, such as real-time, beat-to-beat assessment and cost-effectiveness prompt further clinical application.

[References] (1) Lancet 2005;366:472-7 (2) Br J Anaesth 2005;94: 287-91 (3) Ann Thorac Surg 2005;80:1479-8.[table1]

Table				
Bias±precision	relative error(%)	measurement mode(semiautomatic/manual)	success rate(satisfactory/possible)	
Ao (n=123)	-1.04±1.29	-18±22	85/38	62/126
PA (n=86)	-0.37±1.21	-3±21	51/35	59/103

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