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ORIGINAL ARTICLE

Evaluation of concordance among three cardiac output measurement techniques in adult patients during cardiovascular surgery postoperative care

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KEYWORDS
Transesophageal echocardiography;
Cardiac output;
Thermodilution;
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Abstract
Introduction: The standard method for cardiac output measuring is thermodilution although it is an invasive technique. Transesophageal Echocardiography (TEE) offers a dynamic and functional alternative to thermodilution.
Objective: Analyze concordance between two TEE methods and thermodilution for cardiac output assessment.
Methods: Observational concordance study in cardiovascular surgery patients that required pulmonary artery catheter. TEE cardiac output measurement at both mitral annulus (MA) and left ventricle outflow tract (LVOT) were performed. Results were compared with thermodilution. Correlation was evaluated by Lin's concordance correlation coefficient and Bland–Altman analysis. Statistical analysis was undertaken in STATA 13.0.

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Results: Twenty-five patients were enrolled. Fifty two percent of patients were male, median age and ejection fraction was 63 years and 35% respectively. Median thermodilution, LVOT and MA -measured cardiac output was 3.25 L/min, 3.46 L/min and 8.4 L/min respectively. Different values between thermodilution and MA measurements were found (Lin concordance = 0.071; Confidence Interval 95% = −0.009 to 0.151; Spearman's correlation = 0.22) as values between thermodilution and LVOT (Lin concordance = 0.232; Confidence Interval 95% = −0.12 a 0.537; Spearman's correlation 0.28). Bland−Altman analysis showed greater difference between MA measurements and thermodilution (DM = −0.408; Bland−Altman Limits = −0.809 to −0.007), than the other echocardiographic findings (DM = 0.007; Bland−Altman Limits = −0.441 to 0.428).
Conclusion: Results from cardiac output measurement by doppler and 2D-TEE on both MA and LVOT do not correlate with those obtained by thermodilution.

PALABRAS CLAVE
Ecocardiografía transesofágica;
Gasto cardiaco;
Termodilución;
Cirugía cardiaca

Evaluación de la concordancia de tres técnicas de medición del gasto cardiaco en pacientes adultos durante el postoperatorio de cirugía cardiaca

Resumen
Introducción: El cálculo del gasto cardiaco se realiza por termodilución, y su principal desventaja es el carácter invasivo. La ecocardiografía transesofágica (ETE) representa una alternativa dinámica y funcional a la termodilución.
Objetivo: Analizar la concordancia entre dos métodos de ETE y termodilución para la evaluación del gasto cardiaco.
Métodos: Estudio observacional de concordancia en pacientes de cirugía cardiovascular con requerimiento de catéter de arteria pulmonar. Se realizó medición de gasto cardiaco por ETE en anillo mitral (AM) y en el tracto de salida del ventrículo izquierdo (TSVI). Los resultados se compararon con la termodilución. La concordancia fue evaluada por el coeficiente de correlación concordancia de Lin y analizada por el método de Bland-Altman. Los análisis estadísticos se realizaron en STATA 13.0.
Resultados: Se incluyeron 25 pacientes. El 52% fueron hombres, con mediana de edad de 63 años y fracción de eyección del 35%. La mediana de gasto cardiaco por termodilución, AM y TSVI fue de 3,25, de 3,46 y de 8,4 L/min, respectivamente. Se encontraron diferentes valores entre termodilución y AM (concordancia de Lin = 0,071; IC 95%: −0,009 a 0,151), así como entre termodilución y TSVI (concordancia de Lin = 0,232; IC 95%: −0,12 a 0,537). El análisis de Bland-Altman muestra una diferencia entre la medición por AM y termodilución importante (DM = −0,408; Bland-Altman Limits = −0,809 a −0,007), así como entre las dos medidas por ETE (DM = 0,007; Bland-Altman Limits = −0,441 a 0,428).
Conclusión: Los resultados en la medición del gasto cardiaco por doppler y ETE bidimensional tanto a nivel del anillo mitral como del TSVI no son concordantes con la termodilución.

Introduction

Historically, cardiac output calculation for adults has been measured through thermodilution using a pulmonary artery catheter. This became the standard measurement method around 1970, and so it remained for more than ten years, until a high frequency of complications and/or misinterpreted data were associated to high mortality rates related to this technique.[1,2]

The first alternative to replace thermodilution was suggested by Dr. Parisi, who measured ventricle volume and ejection fraction using a two-dimensional transesophageal echocardiography (TEE).[1,3] Other methods have been proposed (e.g. arterial wave contour analysis, PiCCO, transpulmonar thermodilution, transpulmonary lithium dilution),[4] although they have shown questionable benefit during open-heart cardiovascular surgery.

A recent promising possibility is TEE, which allows both cardiac structure and function evaluation during perioperative open-heart surgery. However, it requires training and certain skills to be learned by the operator in order to allow him or her to interpret different results adequately, and using them to guide management and improve care for a critically ill patient.[5–7]

Currently, TEE cardiac output monitoring is most commonly performed through a deep transgastric long axis view and aortic ring measurement (LVOT),[1] procedure that requires skills, and could be associated with gastroin-

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