1. Why is this clinically important?

Cardiac output (CO) monitoring is used to assess the haemodynamics of critically ill patients. It is used to guide fluid administration and vasoactive drug use. Monitors estimate CO from the arterial blood pressure (ABP) wave using the Windkessel model of the circulation. Aim: To assess the accuracy of existing methods for CO monitoring using the Windkessel model during a change in vascular tone.

2. The Windkessel Model

This model expresses stroke volume, \( V \), as the sum of distending flow and outflow terms. Each term contains an unknown physical variable: compliance, \( C(P) \), or resistance, \( R \).

Aim: To assess the accuracy of existing methods for CO monitoring using the Windkessel model during a change in vascular tone.

3. Clinical Evaluation

Methods

ABP signals were acquired from 15 critically ill patients, alongside reference CO measurements, \( CO_{\text{ref}} \). The dosage of norepinephrine infusion, a vasoactive drug, was doubled during the recording giving a step-change in vascular tone. Continuous CO, \( CO_{\text{est}} \), was estimated using each simplification method. \( CO_{\text{est}} \) values were calibrated with \( CO_{\text{ref}} \) prior to dosage increase. The precision of each method was assessed by comparing \( CO_{\text{ref}} \) during double dosage with the mean \( CO_{\text{est}} \) during that \( CO_{\text{ref}} \) measurement.

Results

See table. The most accurate methods maintained both compliance and outflow terms. The remaining methods, which eliminated one of the terms, tracked CO less well during changes in vascular tone.

References


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