Poster #277

ELECTRICAL CARDIOMETRY COMPARES FAVORABLY WITH THERMODILUTION FOR POST-OPERATIVE HEMODYNAMIC MONITORING

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ABSTRACT

Introduction: Pulmonary artery catheters and thermodilution (PAC-TD) remain the gold standard for hemodynamic monitoring, particularly after cardiac surgery. However, the invasive nature of PAC-TD, combined with its lack of clinical efficacy, calls for increased use of non-invasive hemodynamic monitoring techniques. Electrical cardiometry (EC), a form of thoracic electrical bioimpedance, provides completely non-invasive hemodynamic monitoring. This study evaluated the reliability of EC compared to PAC-TD for continuous hemodynamic monitoring in post-operative patients.
Hypothesis: EC provides reliable continuous cardiac index (CI) monitoring compared to PAC-TD in post-operative patients.
Methods: Post-operative patients with indwelling PACs (Continuous Cardiac Output catheters, Vigilance monitor, Edwards) underwent simultaneous, continuous hemodynamic monitoring with EC (Aesculon monitor, Cardiotronic). Comparisons were made between hourly PAC-TD and EC determinations of CI. EC CI values were averaged from one minute readings ± 6 minutes centered on the hour. Bland-Altman analysis was performed for each individual patient's data. Bias (mean difference between PAC-TD- and EC-derived CI) and percentage error (2SD of bias/mean CI) for each patient were calculated. Variance (coefficient of variation) over the entire monitoring period for each patient was calculated. Data are mean ± SD.
Results: 30 patients (cardiac surgery 29, vascular surgery 1) were monitored for 33 ± 19 hours. Bias was -0.7 ± 1 L/min/m^2 and percentage error was 39 ± 12%. 23 (77%) of 30 patients had a percentage error < 40%. Coefficients of variation for PAC-TD and EC were 0.15 ± 0.04 and 0.14 ± 0.05, respectively (P = NS).
Conclusions: EC monitoring of CI demonstrated good correlation with PAC-TD in post-operative patients. While a percentage error ≤ 30% represents the ideal, clinically-acceptable limit of agreement between two hemodynamic monitoring techniques (Critchley and Critchley), many studies report values up to 40%. Our relatively small bias would generally be considered clinically acceptable and the low variance indicates reliable measurements. Our study supports EC as a reliable non-invasive method of continuous hemodynamic monitoring.

INTRODUCTION

Pulmonary artery catheters and thermodilution (PAC-TD) remain the gold standard for hemodynamic monitoring, particularly after cardiac surgery. However, the invasive nature of PAC-TD, combined with its lack of clinical efficacy and declining use, has fostered the development and increased use of less invasive hemodynamic monitoring techniques. Electrical cardiometry (EC), a form of thoracic electrical bioimpedance, provides completely non-invasive hemodynamic monitoring. EC requires cutaneous electrodes/sensors only which emit an electrical current and derives hemodynamic indices by detecting variations in thoracic impedance induced by beat to beat changes in aortic blood flow. This study evaluated the reliability of EC compared to PAC-TD for continuous hemodynamic monitoring in post-operative patients.

GOAL & HYPOTHESIS

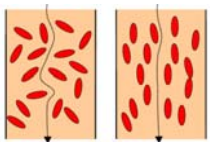
Goal – To compare EC to PAC-TD for continuous cardiac index (CI) monitoring in post-operative patients.

Hypothesis – EC provides reliable continuous cardiac index (CI) monitoring compared to PAC-TD in post-operative patients.

METHODS

- Eligible adult patients were in the Harper University Hospital ICU undergoing hemodynamic monitoring.
- Patients had indwelling PACs (Continuous Cardiac Output catheters, Vigilance monitor, Edwards).
- EC monitoring (Aesculon monitor, Cardiotronic) was instituted so that patients underwent simultaneous continuous hemodynamic monitoring with PAC-TD and EC for up to 72 hours.
- Comparisons were made between hourly PAC-TD and EC determinations of CI..
- EC CI values were averaged from one minute readings ± 6 minutes centered on the hour.
- Bland-Altman analysis was performed for each individual patient's data.
- Bias (mean difference between PAC-TD- and EC-derived CI) and percentage error (2SD of bias/mean CI) for each patient was calculated.
- Variance (coefficient of variation, SD/mean) over the entire monitoring period for each patient was calculated.
- Data are mean ± SD.
- Study approved by the Wayne State University School of Medicine Human Investigation Committee and patients provided informed consent.

Sensor Placement

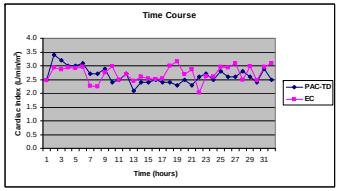


Diastole Systole

EC Stroke Volume Equation

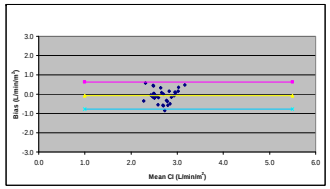
RESULTS

Figure 1. Time Course PAC-TD vs EC



Variance: PAC-TD - 0.11
EC - 0.10

Figure 2. Bland-Altman Analysis



Bias: - 0.1 L/min/m^2
% error: 26.3%

RESULTS

Table 1. PAC-TD vs EC Analysis

	Bias (L/min/m^2)	% error	Variance
PAC-TD vs EC	- 0.73 ± 1.1	39 ± 12	0.15 ± 0.04
EC	---	---	0.14 ± 0.05

P = NS

N = 30 patients: 29 cardiac surgery, 1 vascular surgery
Monitoring duration: 33 ± 19 hours

SUMMARY & CONCLUSIONS

- When compared simultaneously with PAC-TD, EC-derived CI showed a bias of - 0.73 ± 1.1 L/min/m^2 and a percentage error of 39 ± 12%.
- 23 (77%) of 30 patients had a percentage error < 40%.
- EC variance was equally low compared to PAC-TD.
- EC monitoring of CI demonstrated good correlation with PAC-TD in post-operative ICU patients.
- While a percentage error ≤ 30% represents the ideal, clinically-acceptable limit of agreement between two hemodynamic monitoring techniques, many studies report values up to 40%. The intrinsic error of PAC-TD is 15 - 20%.
- Our relatively small bias would generally be considered clinically acceptable and the low variance indicates reliable measurements.
- Our study supports EC as a reliable non-invasive method of continuous hemodynamic monitoring.

REFERENCES

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