



Continuous Non-Invasive Cardiac Output Measurements in the Neonate by Electrical Cardiometry: A Comparison with Echocardiography



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Abstract

Background: The ability to non-invasively and continuously monitor cardiac output in absolute numbers would be invaluable in the care of critically ill neonates. Electrical cardiometry (EC) is a non-invasive method of continuous left cardiac output monitoring based on measurement of thoracic electrical bioimpedance.

Objective: To investigate the agreement between cardiac output measurements performed by echocardiography and the non-invasive continuous cardiac output monitor (Aesculon®).

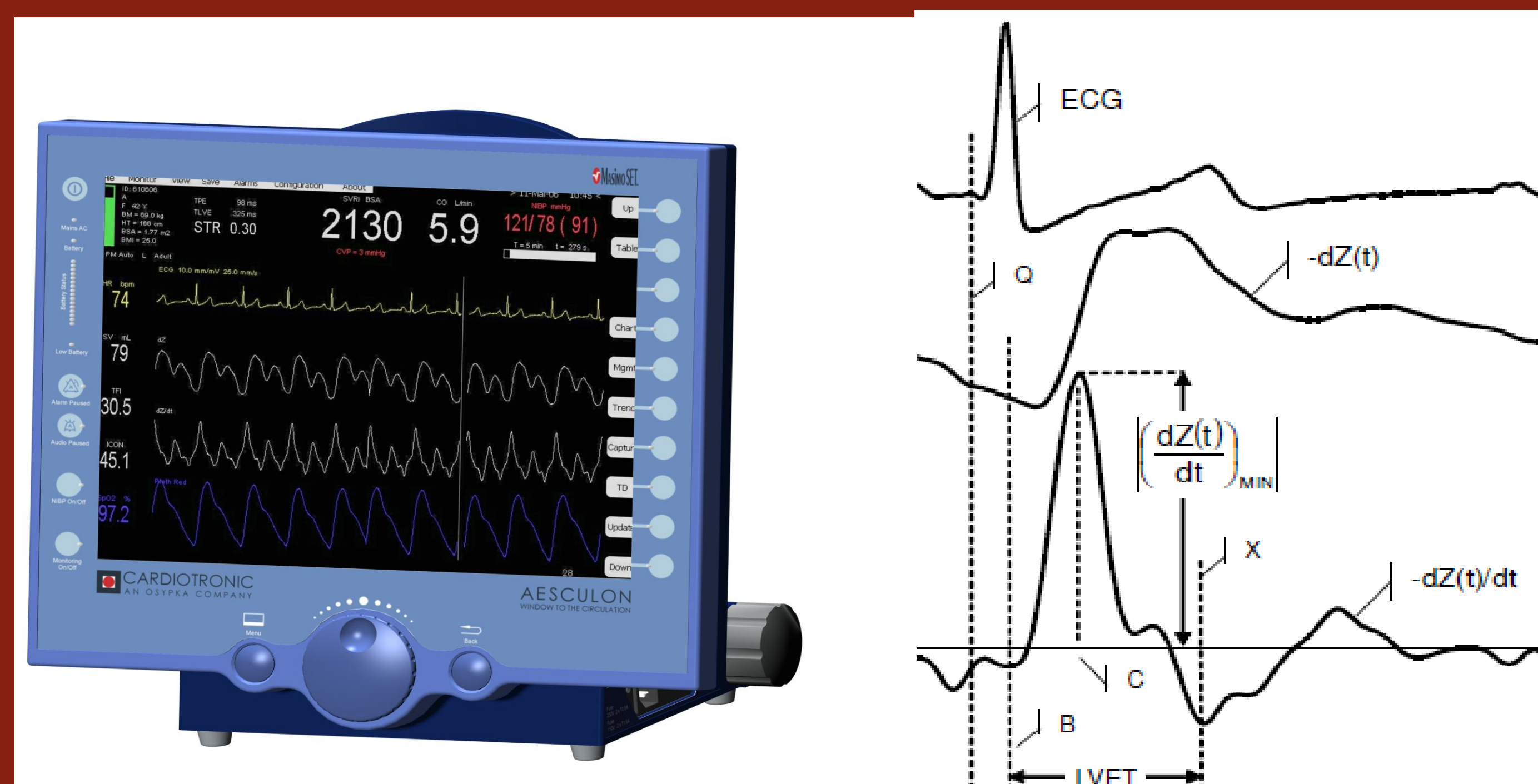
Design/Methods: This was a prospective observational study. Left ventricular output (LVO) was measured by echocardiography (LVO-echo) and EC (LVO-ec) simultaneously. Measurements were performed in healthy term neonates on postnatal days 1 and 2. As EC estimates LVO by assessing blood flow primarily in the ascending aorta, we included subjects with a patent ductus arteriosus irrespective of the potential hemodynamic significance of ductal shunting. The echocardiographer was blinded to the results of EC monitoring. To determine the agreement between the two methods, the bias and precision in measuring left ventricular output were calculated.

Results: We performed 115 paired measurements in 20 healthy term neonates (birth weight = 3094 ± 338 g; gestational age = 39.2 ± 1.1 weeks). LVO-echo and LVO-ec were similar (538 ± 105 vs. 534 ± 105 ml/min, p=0.7). The bias and precision between the two methods were 4.4 and 118 ml/min, respectively.

Conclusions: There is a very good agreement between the average left ventricular output measured by echocardiography and EC. However, we found a wide variation in the agreement among the individual subjects studied. This variation may be attributed to several factors including the limitation of each method in estimating LVO and the narrow range of small cardiac output values in the neonates studied. Further studies in preterm neonates and neonates with hemodynamic instability are needed to define the validity and potential utility of the non-invasive cardiac output monitor.

Background

- The ability to non-invasively and continuously monitor cardiac output in absolute numbers would be invaluable in the care of critically ill neonates
- Electrical cardiometry (EC) is a non-invasive method of continuous left cardiac output monitoring based on measurement of thoracic electrical bioimpedance



Objective

- To investigate the agreement between cardiac output measurements performed by echocardiography and the non-invasive continuous cardiac output monitor (Aesculon®)

Materials and Methods

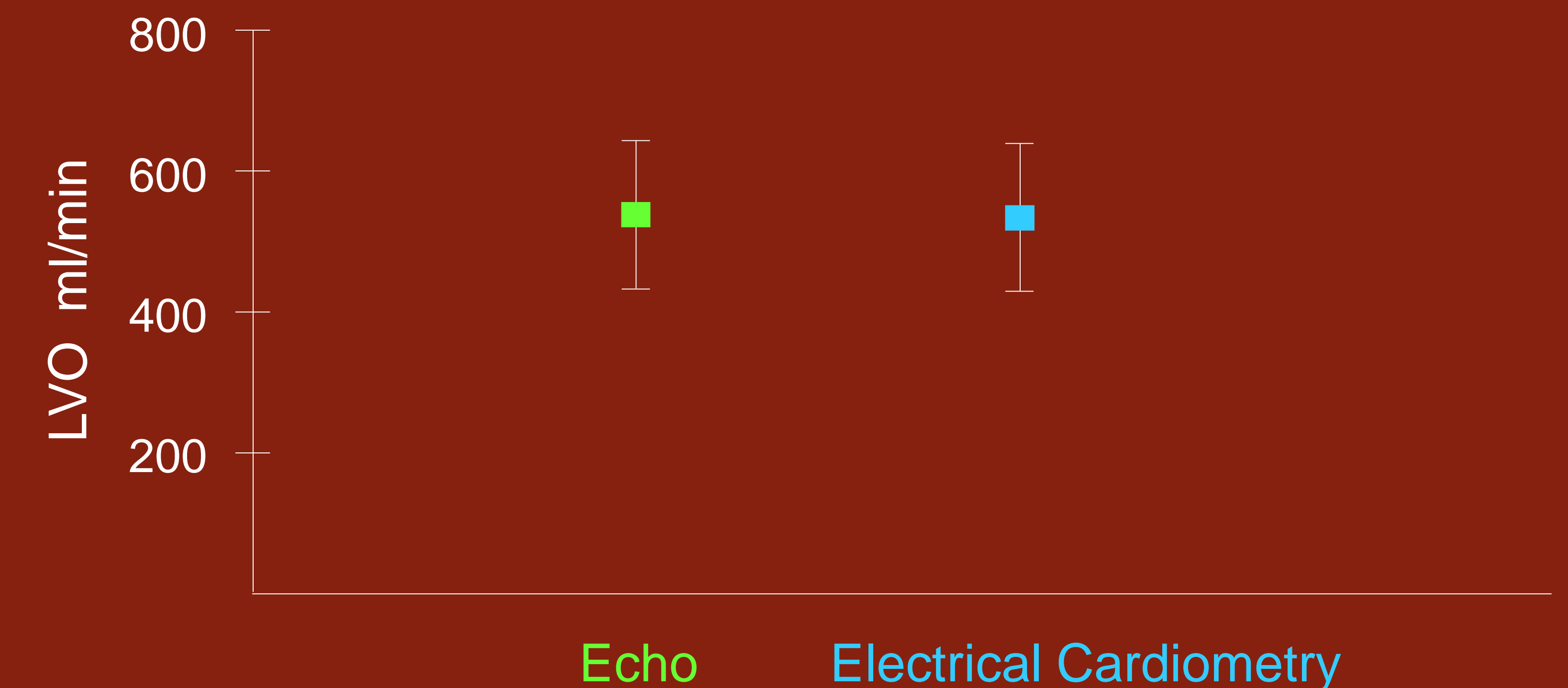
- This was a prospective observational study
- In 20 healthy term infants, the following measurements were performed on Day 1 and repeated on Day 2:
 - Left ventricular output (LVO) was measured by echocardiography (LVO-echo) and EC (LVO-ec) simultaneously.
 - Measurements were performed in healthy term neonates on postnatal days 1 and 2.
 - As EC estimates LVO by assessing blood flow primarily in the ascending aorta, we included subjects with a patent ductus arteriosus irrespective of the potential hemodynamic significance of ductal shunting.
 - The echocardiographer was blinded to the results of EC monitoring.
 - To determine the agreement between the two methods, the bias and precision in measuring left ventricular output were calculated

Results

Characteristics of the Study Population

| | |
|----------------|------------|
| n | 20 |
| GA (wk) | 39.2 ± 1.1 |
| BW (g) | 3094 ± 338 |
| Apgar at 1 min | 8 (5-9) |
| Apgar at 5 min | 9 (8-10) |
| C-sec | 15% |
| Male gender | 50% |
| SGA | 10% |

- We performed 115 paired measurements in 20 healthy term neonates



- The bias and precision between the two methods were 4.4 and 118 ml/min, respectively.

Conclusions

- There is a very good agreement between the average left ventricular output measured by echocardiography and EC
- However, we found a wide variation in the agreement among the individual subjects studied
- This variation may be attributed to several factors including:
 - the limitation of each method in estimating LVO
 - the narrow range of small cardiac output values in the neonates studied.
- Further studies in preterm neonates and neonates with hemodynamic instability are needed to define the validity and potential utility of the non-invasive cardiac output monitor