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[Relationship between bioreactance and magnetic resonance imaging stroke volumes.](#)

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Title: Relationship between bioreactance and magnetic resonance imaging stroke volumes

Running head: Relationship between Bioreactance and MRI

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Summary The present study compared values of stroke volume estimated by bioreactance and magnetic resonance imaging, and assessed the relationship and agreement between the two methods. Twenty-five healthy subjects underwent non-invasive haemodynamic assessment by magnetic resonance imaging and bioreactance methods. Bioreactance produced 8% (6 ml/beat) higher stroke volume than magnetic resonance imaging (68 ± 11 vs. 74 ± 15 ml/beat $P < 0.01$), with lower and upper limits of agreement of -9 and 19 ml/beat between the two methods. There was a strong relationship between the two methods ($r = 0.82$, $P < 0.01$). Although the mean difference and relationship between the two methods are acceptable, the limits of agreement are wide suggesting the methods cannot be used interchangeably in clinical practice.

Key words: Stroke volume, Magnetic resonance imaging, Bioreactance

Introduction Monitoring of cardiac output has wide clinical application in surgery, anaesthesiology, emergency care, and cardiology.¹⁻⁸ The “gold standard” reference methods (i.e. Thermodilution and direct Fick remain) are invasive and are associated with inherent risks e.g. infections, arrhythmias and bleeding.⁹ Cardiac magnetic resonance imaging (MRI) has been suggested to be a non-invasive “gold standard” method,¹⁰ but its complexity and cost prevent its use in routine clinical practice. Bioreactance is a novel non-invasive, continuous monitoring method which estimates cardiac output by analysing the frequency of relative phase shift of electronic current applied across the thorax.^{11 12} Several studies demonstrated its clinical application and performance,¹¹⁻¹⁷ but its comparison with MRI has not been evaluated yet. The present study aimed to i) compare values of stroke volume estimated by bioreactance and MRI methods, and ii) to assess the relationship and agreement between the two methods.

Methods Twenty five healthy female individuals took part in the study (age 48 ± 18 years, range 25 – 78, height 1.63 ± 0.07 m, weight 62.7 ± 10.2 kg, body mass index 23.9 ± 4.4). In a cross-over design, each subject underwent measurements using cardiac MRI and bioreactance methods on consecutive days. All participants provided written informed consent. This study was approved by the Local Research Ethics Committee. Cardiac MRI was performed using a 3T Philips Achieva and a 6-channel cardiac coil (both Philips, Best, NL), as previously described.¹⁸ The bioreactance method (NICOM, Cheetah Medical, Delaware, USA) was used to assess haemodynamic variables continuously during a 10 minute while subjects rested in a semi-recumbent position.¹⁶⁻¹⁹ The difference between MRI and bioreactance was assessed using a t-test. Pearson's product moment coefficient of correlation was used to assess the relationship between MRI and bioreactance stroke volume values, Bland-Altman analysis performed to agreement. Statistical significance was indicated $P < 0.05$, and data presented as mean \pm SD.

Results and Discussion The mean difference between the MRI and bioreactance stroke volumes was 6 ml/beat (68 ± 11 vs. 74 ± 15 , $P < 0.01$), with bioreactance demonstrating on average 8% higher values than MRI. Pearson's correlation coefficient revealed a strong positive correlation between the two methods ($r = 0.84$, $P < 0.01$; Figure 1). In addition to the mean difference, Bland-Altman analysis also revealed lower and upper limits of agreement of -9 and 19 ml/beat respectively. This is the first study to compare the stroke volume obtained by bioreactance and cardiac MRI. A strong relationship between the stroke volume estimates of bioreactance and MRI, as well as a relatively small mean difference suggests that bioreactance could potentially be used in wider clinical practice where the use of gold standard, invasive- or non-invasive methods is not viable. This is particularly important in clinical settings where it is necessary to estimate haemodynamic response to a physiological or pharmacological challenges e.g. fluid responsiveness, passive leg raising,

surgery, drug titration and anaesthesia. The present findings suggest that bioactance cannot be used interchangeably with MRI. However, it should not preclude its use in clinical practice where its advantages over the gold-standard methods have been well documented, and its reliability in challenging hemodynamic scenarios confirmed.¹¹⁻¹⁷

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Figures

Figure 1. Relationship between magnetic resonance imaging and bioreactance stroke volume values.

Figure 1

