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Introduction

Stroke volume (SV) is the amount pumped out by the heart per contraction. It is an important variable for assessing cardiac function and risk of cardiovascular disease as it provides diagnostic and prognostic information and is used to monitor patients during surgery and in the ICU. The current gold standard for measuring SV is highly invasive, expensive and painful for the patient. It also requires a highly trained technician to supervise the procedure. Recent focus has been on finding a cheap, non-invasive alternative which is efficient and requires little training. Magnetic resonance imaging (MRI) provides a good and reliable estimate of SV but is expensive, requires a skilled technician and can be claustrophobic for some patients. In comparison, the relatively new technology bioreactance is relatively inexpensive and is very easy to carry out. This uses sensors to measure the phase shifts which occur when an alternating electrical current is applied to the body. This study aimed to compare the two methods to evaluate whether bioreactance is a viable alternative to MRI as a non-invasive method of measuring SV.

Methods

Twenty five healthy female participants took part in the study (age 48 ± 17 years, range 25 – 78, height 1.63 ± 0.07 m, weight 62.7 ± 10.2 kg, body mass index 23.9 ± 4.4).

Participants attended the exercise laboratory on two consecutive days. On each day circulatory variables were measured at rest, using different methods on different days.

Results

A significant difference in SV values between the MRI and bioreactance methods (67.8 ± 11.4 vs. 73.5 ± 15.0 $P < 0.01$). The range of mean differences between the methods was -13 to +14.9 ml/beat. Pearson's correlation showed a strong positive correlation between the two methods ($r = 0.84$). MRI was seen to be consistently lower, being on average $5.66 \text{ ml}\cdot\text{min}^{-1}$ lower as shown in the Bland Altman plot.

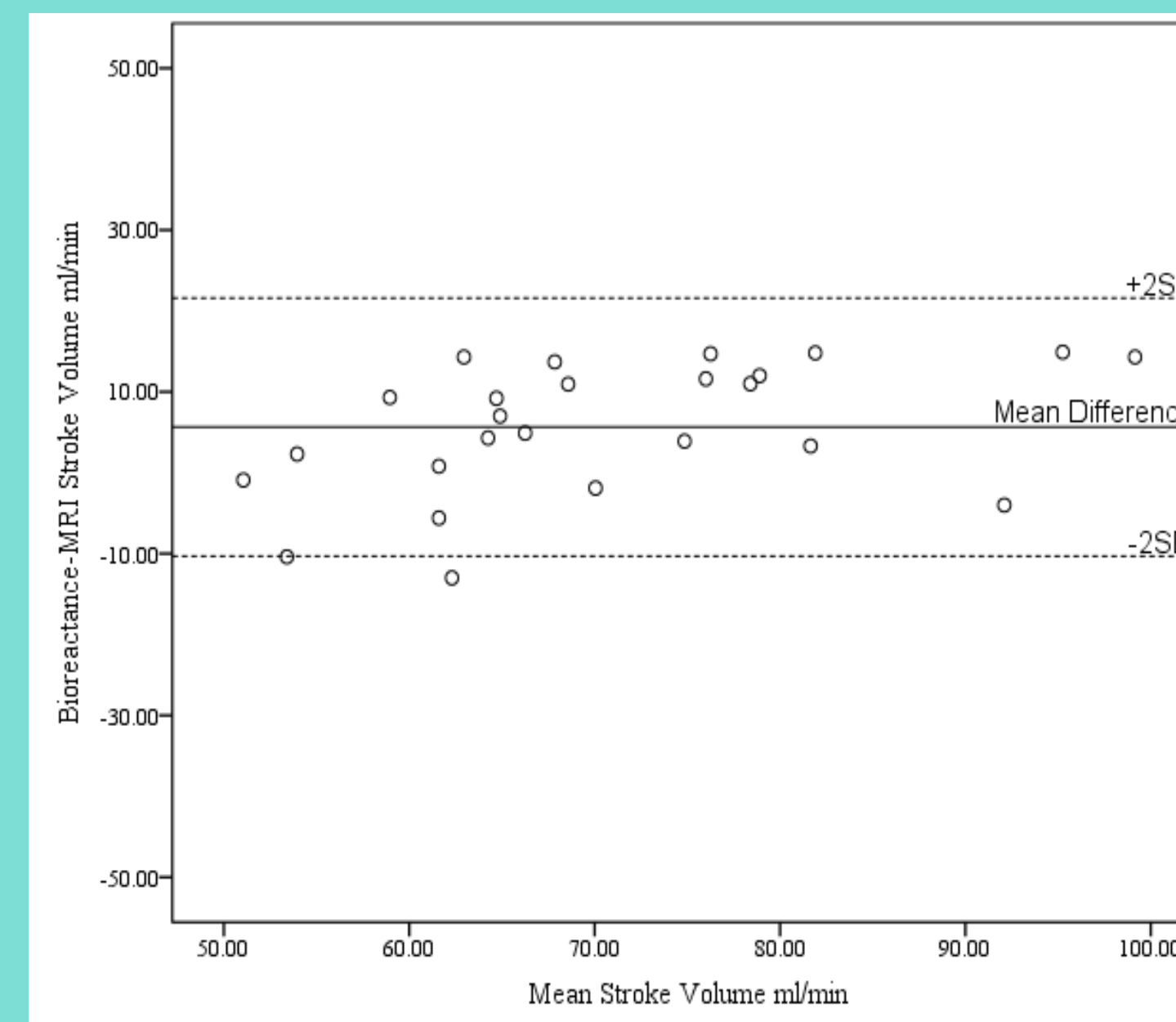


Figure 1. Bland-Altman plot to demonstrate the limits of agreement between bioreactance and MRI stroke volume values measured at rest.

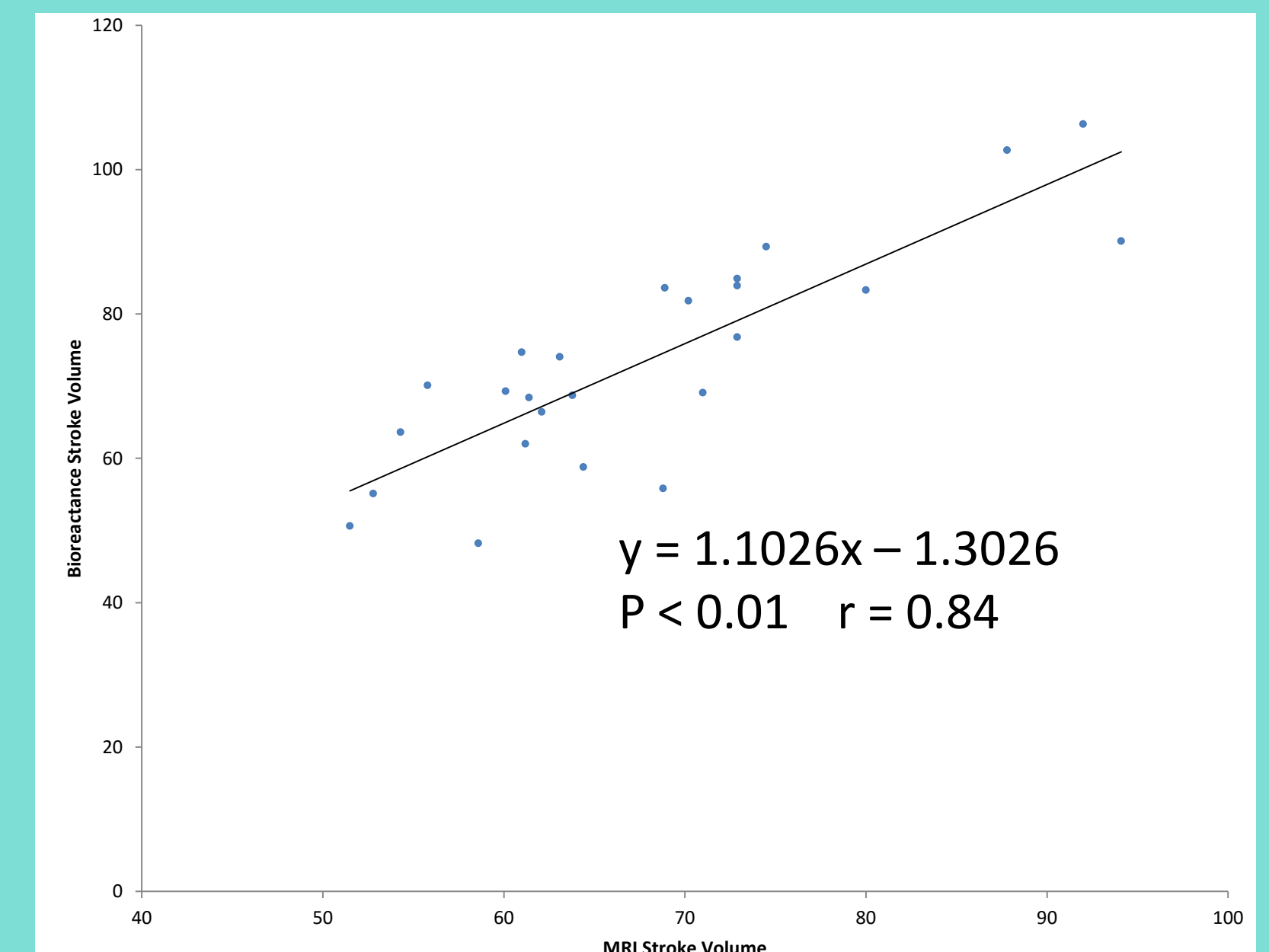


Figure 2. Relationship between magnetic resonance imaging and bioreactance stroke volume values. ($n = 25$)

Conclusion

In contrast with MRI, and indeed most other non-invasive methods, the bioreactance is cheap, easy to operate and patient friendly. Although its accuracy does need to be further investigated and confirmed against the gold standard in a larger population of patients with different pathophysiology, it is reasonable to suggest that bioreactance may have wider clinical application as its ability to track stroke volume changes is very consistent.