Comparing transthoracic echocardiography and impedance cardiography; systolic time intervals and stroke volume

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INTRODUCTION

Heart failure, rhythm disturbances and increased risk of sudden cardiac death are not uncommon in patients (late) after operation for their congenital heart disease. Impedance cardiography enables noninvasive measurement of cardiac performance in real life settings. Classically, three points are derived from the impedance cardiogram (ICG):

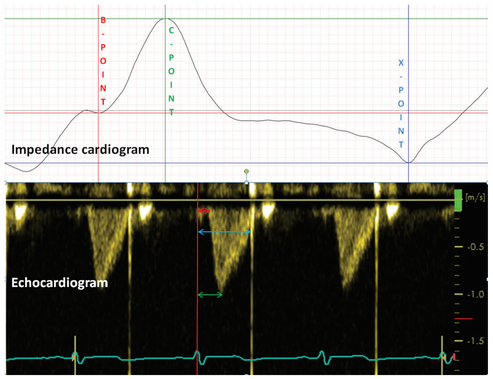
1. The 'B point' represents the moment of opening of the aortic valves
2. The 'C point' is the moment of maximal flow velocity of blood through the aorta and
3. The 'X point' depicts closing of the aortic valves.

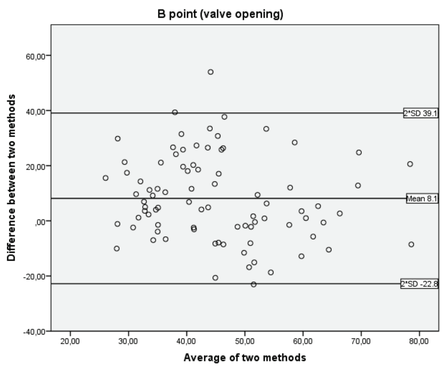
OBJECTIVES

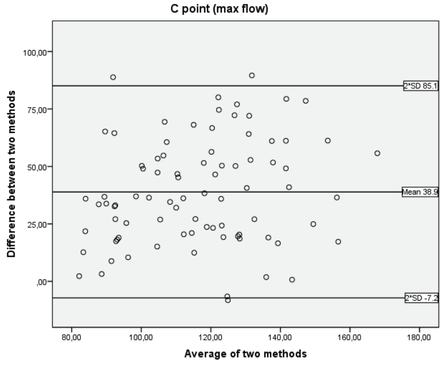
This study aims to validate systolic time intervals and stroke volume (SV) measured by impedance cardiography using simultaneously recorded transthoracic echocardiography (TTE).

METHODS

97 Healthy volunteers (50 girls, 47 boys) with an average age of 10,1 y (range 1-18), were recruited to undergo simultaneous recording of impedance with an ambulatory device during echocardiography in a standard clinical set-up. In the echocardiogram, 3 systolic time intervals were mapped using a pulsed wave Doppler flow signal over the left ventricular outflow tract in a parasternal 5 chamber view. SV was assessed using the velocity time integral. Systolic time intervals were measured from the R peak in the electrocardiogram to the three different points of interest (B-, C- and X-point). Bland-Altman plots and Intra Class Correlations (ICC) were used for analysis of the agreement between TTE and ICG. For Bland-Altman plots, the difference score was calculated as TTE – ICG.

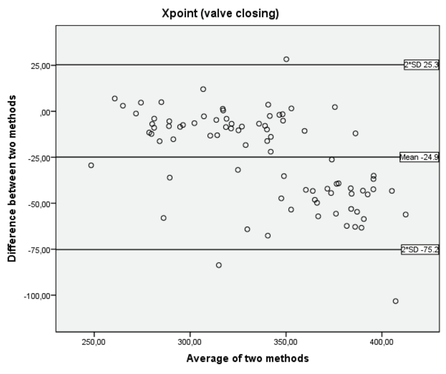


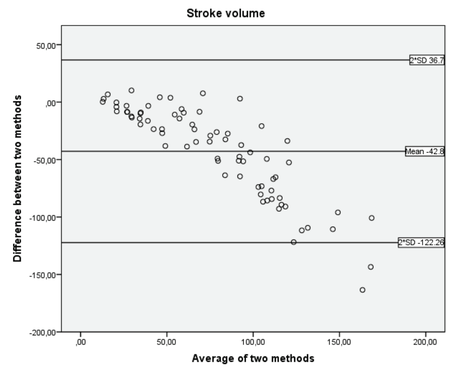




RESULTS

Agreement between systolic time intervals measured by the two different modalities was:
B point: ICC=.40 (95%CI: .21-.57)
C point: ICC=.51 (95%CI: .33-.65)
X point: ICC=.83 (95%CI: .75-.89)
SV: ICC=.61 (95%CI: .44-.73)
The X-point and SV are systematically overestimated by the ICG while the C-point seems to be systematically underestimated by ICG. Bland-Altman plots also show an increased deviation when left ventricular ejection time is longer (higher X-point) and when SV is higher.





CONCLUSION

The agreement between TTE and ICG from an ambulatory device is encouraging. A next step is to relate ambulatory recorded signals to clinical features in order to establish whether this might be of additional value in the clinical evaluation of (pediatric) cardiac patients.

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