

# Free breathing MR flow measurements in infants and young children with ventricular septal defects: physiological aspects and comparison to invasive oximetry

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## Introduction

Since magnetic resonance based flow measurements (MRvenc) were introduced into clinical applicability, continuous improvements (1,2) led to several advanced techniques such as parallel data acquisition (3). Consequently, beside others, the diagnostic workup of ventricular septal defects (VSD) in young children shifted from invasive techniques to MRvenc assessments (4). A drawback, especially of faster MRvenc techniques is the need for breath holding to avoid motion artifacts. In small children, this requires narcosis and tracheal respiration, which is accompanied by a certain risk. It was shown, that the cardiac output is modified under breath holding conditions as compared to normal respiration (5).

## Aim

The aim of this study was to show, if MRvenc and angiographically guided invasive oxymetry (InvOx) as the standard of reference, produce comparable results in sedated, but not intubated small children. Both examinations were done without narcosis but in sedation and under free breathing conditions to guarantee minimal influences to cardiovascular physiology.

## Material and Methods

16 pediatric patients (age 14 days-8 years, median: 15 month, 9 female) suffering from different kinds of isolated VSDs (Fig. 1) received MRvenc of the main pulmonary artery and the ascending aorta. Retrospectively ECG-gated flow data were averaged over multiple respiratory cycles. The acquisition time for each MRvenc was 4 to 6 minutes. All children received InvOx as well and in 8 children both examinations were performed in the same sedation. Qp/Qs-ratios (pulmonary flow / systemic flow) and proportional shunt volumes were calculated and a comparative regression analysis was performed.

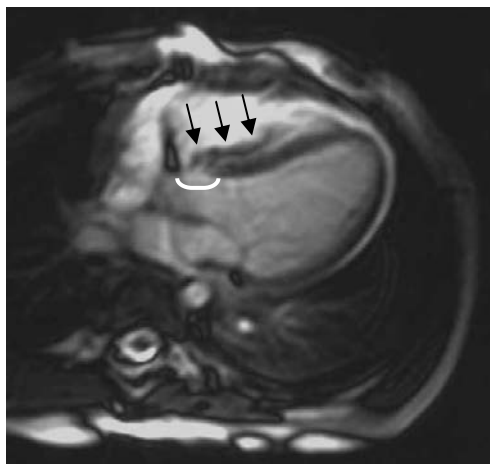


Figure 1: Muscular VSD (bracket) causing a systolic flow void artifact (arrows) in the right ventricle.

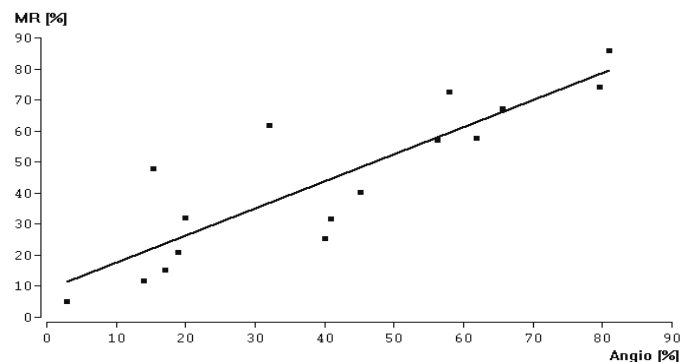


Figure 2: Regression analysis of the proportional shunt volumes as measured with MRvenc (MR) and InvOx (Angio).  $r=0.846$ ,  $p=0.004$ .

## Results

MRvenc was possible in all sedated children. No motion artefacts were detectable in any MR sequence. At InvOx the Qp/Qs varied between 1.03 and 3.8 (mean: 2.0) resulting in a proportional shunt volume of 2.9-73.7% (mean: 40%). The proportional shunt volume as measured with MRvenc under free breathing conditions varied between 5 and 81.5% (mean: 43.2%). The regression analysis revealed a correlation coefficient of  $r=0.846$  with  $p=0.004$  (Fig. 2).

## Conclusion

Determination of proportional shunt volumes using MRvenc without breath holding in infants and children suffering from VSDs is reliable as compared to invasive oximetry. These results should be transferable to older children and adults as well. Acquired data are measured under more physiologic conditions and are therefore more expressive and reliable. Consequently, the number of intubations with a certain risk for the children can be minimized. Invasive measurements are not needed any more and are therefore inadvisable.

## Literature

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