Ultrasound flow assessment in curved vessels: an in-vitro study
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Introduction
Ultrasonic perpendicular velocimetry (UPV) (Fig. 1) allows a simultaneous assessment of axial velocity profile and wall position in straight vessels, enabling an accurate flow estimation [1].

However, in-vivo, most arteries are curved, causing transversal velocity components, which can have an adverse effect on the performance of UPV. Additionally, the presently applied Poiseuille and Womersley approximations offer a poor estimate for the asymmetrical axial velocity distribution, resulting in inaccurate flow estimations.

Objective
Validate UPV for instationary non-Newtonian flow in a curved geometry. Estimate the volume flow from the assessed asymmetric velocity profiles and compare the results with the Poiseuille and Womersley approximations.

Methods
In the experimental setup, a physiologically relevant flow pulse is applied to a curved vessel phantom (Fig. 2). The employed fluid mimics the acoustic and viscoelastic properties of blood.

Results
Velocity profiles

Flow rates

Conclusions
The UPV method allows an accurate assessment of the axial velocity distribution in a curved vessel. For volume flow estimation it is found that the UPV based flow estimate is far more accurate than the existing Poiseuille and Womersley approximations.

References: