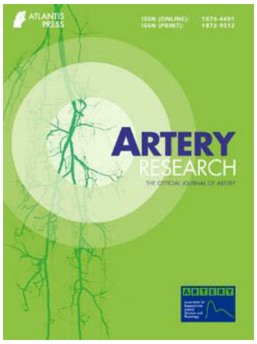

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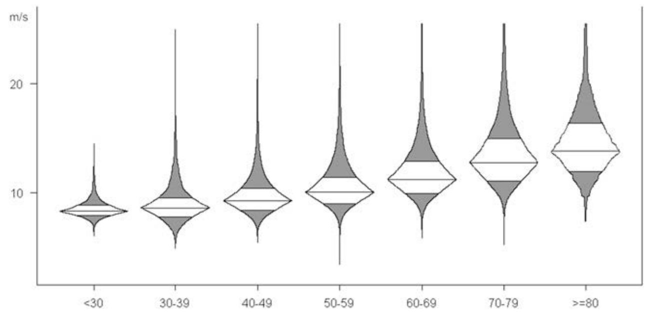

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03.01
ANALYSIS OF ARTERIAL WAVE REFLECTION PATTERNS IN A PATIENT-SPECIFIC HYDRAULIC BENCH MODEL OF THE HUMAN FOREARM

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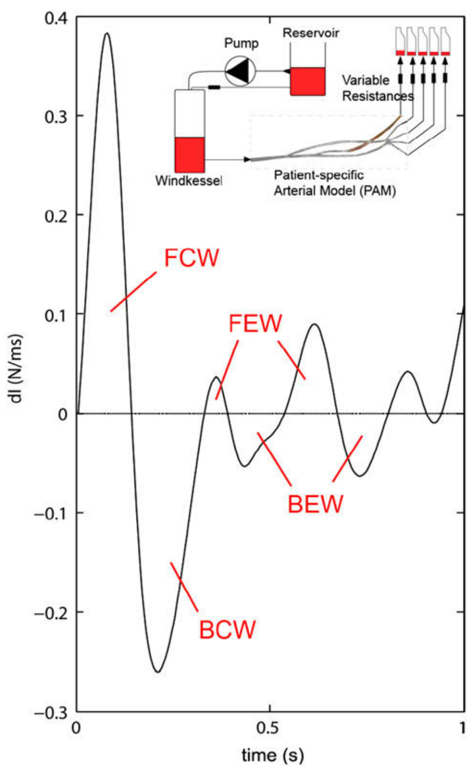

The complex branching topology of the local vascular bed contributes to the complex nature of the blood pressure and flow in the human forearm. The aim of this work is to develop a full scale hydraulic bench model within the framework of our research into arterio-venous fistula creation and the relationship between blood pressure in the upper arm and the wrist. A silicon 3D-model of the brachial, ulnar, radial and anterior interosseous artery completed with the palmar arch was constructed in full scale. The geometry was based on patient-specific functional measurements and MR-data. The Patient-specific Arterial Model (PAM) was built in a mock loop consisting of an upstream reservoir, a pulsatile pump, a windkessel and variable resistances downstream (Figure). 7.5% of the blood mimicking fluid (water-glycerine mixture) was flowing to the interosseous, while the remaining was split equally over the four outflow paths in the palmar arch. Wave Intensity Analysis (WIA) was performed to assess wave reflection patterns in the model. A typical WIA pattern at the brachial inlet is shown in the figure. The initial forward compression wave (FCW) generated by the heart is distally reflected and returns as a backward compression wave (BCW), whereas the subsequent forward expansion wave (FEW) can be interpreted as the open end-type reflection of this BCW. The FEW is on his turn reflected downstream in the backward expansion wave (BEW). The in-vitro PAM shows the complexity of the wave reflections and will be used to study more specific flow problems in the forearm.

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03.02
EVIDENCE OF A ''COMMON'' RESERVOIR PRESSURE TRANSMITTED ALONG THE LENGTH OF THE AORTA WHICH IS THE PREDOMINATE DETERMINATE OF ARTERIAL PRESSURE IN HUMANS

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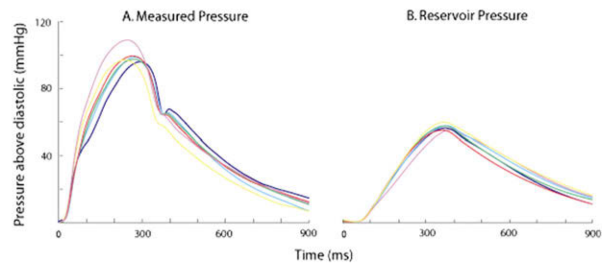

Background: Despite the large variation in pulse pressure waveform throughout the aorta, the diastolic decay of the pressure waveform is almost identical. We hypothesise that this is because there is a common reservoir pressure along the entire aorta, principally determined by the highly elastic proximal aortic root. We apply a new technique to calculate this reservoir pressure along the aorta to test this hypothesis.
Method and Results: Using intra-arterial wires, pressure and Doppler velocity were measured at 10cm intervals along the aorta in 16 patients (aged 55±11 years). Pressure was separated into reservoir and wave components using the new wave-reservoir technique. In all patients, the intra-subject reservoir pressure waveforms were almost identical (mean correlation coefficient 0.99±0.01) regardless of the marked changes in the measured pressure waveform (systolic pressure $p=0.020$ and pulse pressure $p=0.001$). Significant variation in reservoir pressure was seen between subjects (peak reservoir = 63.4 − 21.4 mmHg). The reservoir pressure was the predominate determinant of the pressure waveform and accounted for 67.0 ± 8.8% of the total integrated pulse pressure across all aortic sites.
Conclusions: The aortic pressure waveform is predominately determined by the reservoir pressure. This reservoir pressure is similar along the length of the aorta despite marked changes in the shape of the measured pressure waveform. Manipulation of the arterial reservoir, rather than wave-reflection sites may be more important in regulation of blood pressure control.

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03.03
VALIDATION OF A 1D MODEL OF THE SYSTEMIC ARTERIAL TREE INCLUDING THE CEREBRAL CIRCULATION

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The aim of this study is to develop and validate a distributed model of the systemic arterial tree, coupled to a heart model and including a detailed description of the cerebral arteries. No model has been developed so far that offers a physiologically relevant coupling to the heart and includes the entire cerebral arterial tree.
The 1D forms of the continuity and momentum equations are applied over tapered arterial segments. The intimal shear stress is modeled using the Womersley theory. A non-linear viscoelastic constitutive law for the arterial wall is considered. The arterial tree is coupled to the heart, which is modeled using the time varying elastance model. All distal vessels are terminated with three-element windkessel. Coronary arteries are modeled assuming a systolic flow impediment dependent on the varying elastance of the ventricles. The systemic