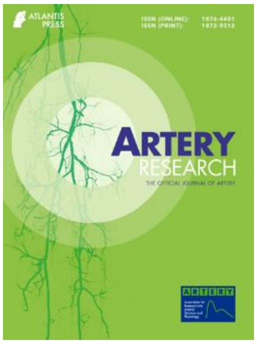

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P6.09: MULTIPLE REFLECTIONS, NOT A SINGLE DISTAL AORTIC REFLECTION DETERMINE PRESSURE WAVE SHAPE

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system and (2) a non-distensible zone, disturbing the buffer function of the aorta. As the many interfering factors and adaptive physiologic mechanisms present in vivo prohibit the study of the isolated impact of these individual factors, an advanced computer model was developed.

Material and methods: The geometry and flow boundary conditions are obtained from MRI data of a healthy subject (Figure 1). A segment with varying length and stiffness was included distal to the left subclavian artery (red zone in Figure 1). Recurrent coarctation was studied by altering the diameter (coarctation index of 0.5 for severe and 0.65 for mild coarctation).

Results: Figure 2 depicts the effect of a local non-distensibility on the pressure evolution proximal and distal to the rigid zone. Data shown represent the presence of a stent (length 5cm, 100 x stiffer than reference material) or scar tissue (length 5 mm, 5x stiffer). Although the overall impact is very limited, the presence of a stent increased the proximal systolic pressure with 4.5 mmHg compared to the pressure in a healthy subject.

Conclusion: The model allows to study the isolated effect of local non-distensibility and narrowing which is impossible to obtain in vivo.

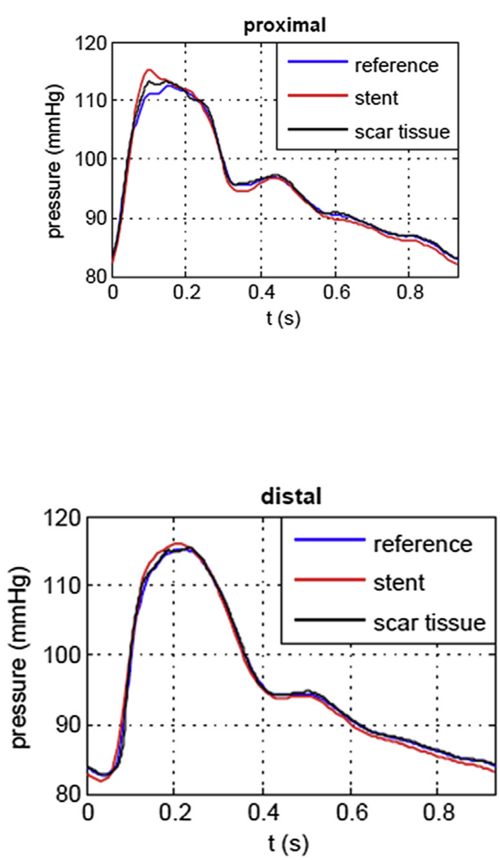

Figure 2 Proximal and distal pressure.

P6.09

MULTIPLE REFLECTIONS, NOT A SINGLE DISTAL AORTIC REFLECTION DETERMINE PRESSURE WAVE SHAPE

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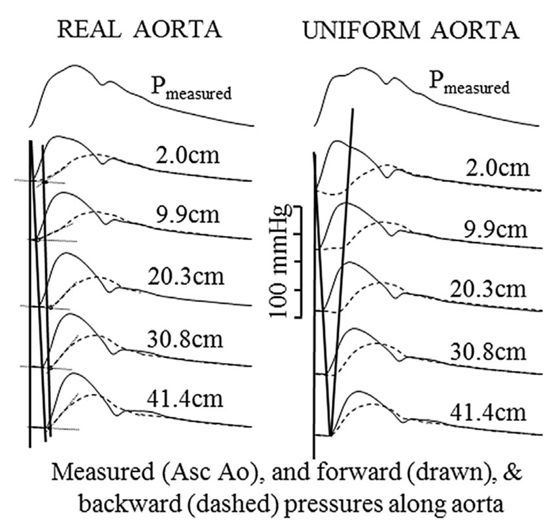
Arterial pressure and flow waves travel and are reflected. Waveform analysis and wave separation gave insight into these phenomena and parameters thus obtained are indicators of cardiovascular events. However, the interpretation of forward and reflected waves is still not generally agreed upon. We used an anatomically accurate (data from Hickson, 2010) model of the entire systemic arterial tree and also set all aortic diameters equal at mean aortic diameter ("uniform aorta"), leaving other arteries unchanged, and calculated forward and backward waves in the standard way (Murgo, 1981). In the anatomically accurate model, timing of the feet of backward and forward waves is location independent, as also recently reported by Tyberg, 2013. In the uniform aorta the delay between forward and backward waves is smallest in the distal aorta and largest in the ascending aorta. In both models pressure amplification over the aorta is ~1.35. Changes in microcirculatory resistance have little effect on wave shapes. We conclude that multiple local reflections in the aorta importantly contribute to pressure (and flow) wave shape. Thus pressure wave shapes depend on arterial geometry: aortic diameters and side branches. Distal aortic (bifurcation) and peripheral reflections are not the major contributors to overall reflection and wave shape. We suggest that studies of aortic dimensions and effect of side branches are needed to better understand aortic pressure wave shapes and wave travel.



Hickson et al., JACC Cardiovas Imaging 2010;2:1247.
Murgo JP et al., Circulation 1981; 63, 122.
Tyberg JV et al. J of Physiol 2013;591.5 p 1171.

P6.10

SENSITIVITY OF WAVE SEPARATION IN THE ARTERIES TO ERRORS IN ESTIMATING WAVE SPEED

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Objectives: Examine the effect of erroneous estimation of wave speed (C) on the magnitude and time of the separated pressure (P) and velocity (U) in arteries.

Methods: Pressure and flow were measured in the aorta of 11 dogs and C has been determined using the PU-loop technique. The waves were separated into the forward and backward directions using wave intensity analysis (WIA), with C varying from C-99C% to C+99C%. The following parameters were studied: **a)** Peak of forward (P+, U+) and backward (P-, U-) pressure and velocity waveforms, **b)** The onset and peak times of P+, U+ , P-, and U- all with respect to ventricular ejection time.

Results: Incorrect values of C resulted in an inaccurate estimation of the $P_{\pm}$ and $U_{\pm}$. An error of (+,-)50% in C results in an amplitude error of 7,7% in P_+, 6, 8% in P-, 20, 60% in U+ and 30, 116% in U-. Also, an error of (+,-) 50% in C results in an error in peak time of 7, 11% for P+, 15, 5% for P-, 7, 10% for U+ and 2, 20% for U-. Incorrect determination of C did not affect the onset of the forward waves while it resulted in error of 47,47% for P- and 38,38% for U- (Figure 1,2).

Conclusions: The separation of P and U waveforms using WIA is sensitive to changes of C, whose correct estimation is important for the accurate determination of the magnitude and peak time of the forward and backward waveforms.

P6.11

EVALUATION OF A NOVEL AND EXISTING TECHNIQUES FOR THE ESTIMATION OF PULSE TRANSIT TIME

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