

# Does wave reflection protect the microvasculature from high pulse pressure?



#### Wave Reflection and Ageing



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• Mitchell et al. J Appl Physiol 105: 1652–1660, 2008

- The foundation of our understanding of wave reflection/transmission
- Based on the principle of pressure continuity at junctions
- This implies that
  - In youth, reflection is not protective.
  - With ageing, reduced reflection would reduce (not increase) transmission.
- Microvascular pulse pressure (mPP) does increase with ageing<sup>1,2</sup>.
- Aim: Investigate whether reduced R increases mPP using a computational model



<sup>• &</sup>lt;sup>1</sup>Kearney-Schwartz et al. Stroke, 2009. 40(4): p. 1229-36. <sup>2</sup> Waldstein et al. Hypertension, 2008. 51(1): p. 99-104.

## Arterial Compliance and Ageing



Hypothesis: Reduced arterial compliance, rather than reduced wave reflection per se, leads to increased mPP with ageing due to an increase in forward pressure

<sup>•</sup> Briet et al. Kidney Int. 2012 Aug;82(4):388-400.

#### Fractal Tree

- Represents an arterial network from large conduit arteries to the microvasculature
- Details
  - # generations: 14
  - # vessels: 5008
  - Fractal exponent:  $r_0^x = r_1^x + r_2^x$  (x = 2.76)
  - Asymmetry ratio:  $\frac{r_1}{r_2} = 0.8$
  - Length-to-radius ratio: 8



- Vessel wave speeds (c) were set to attain the same reflection coefficient (R) at every junction
- Values of R tested:
  - R = -0.025
  - R = 0
  - R = 0.025
  - R = 0.05



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## Proximal Stiffening

- Multiply wave speed by a scaling factor for each of the 'distal stiffening' cases
- Results in the same set of R values
- Similar to changes with ageing



#### Results



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## Results (Constant Proximal Pulse Pressure)





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#### Conclusions

- Reduced wave reflection may accompany (but does not cause) increased mPP with ageing
- Reduced arterial compliance, leading to increased forward pressure, underlies increased mPP with ageing





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# **Contact Information**



In

avinash.kondiboyina@mcri.edu.au



@ Murdoch Children's Research Institute, 2017