Journal of Cardiovascular Magnetic Resonance

BioMed Central

Meeting abstract

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2104 Differences in hemodynamics in the infra-renal aorta in mice and men: implications for the localization of Abdominal Aortic Aneurysms (AAA)

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from 11th Annual SCMR Scientific Sessions
Los Angeles, CA, USA. 1–3 February 2008

Published: 22 October 2008

Journal of Cardiovascular Magnetic Resonance 2008, **10**(Suppl 1):A373 doi:10.1186/1532-429X-10-S1-A373

This abstract is available from: http://jcmr-online.com/content/10/S1/A373

Introduction

In humans, abdominal aortic aneurysms (AAA) develop *inferior* to the renal arteries and end above the aortic bifurcation. The aorta superior to the renal artery is remarkably spared. Conversely, mouse models of AAA (including ApoE-/- or LDL Receptor-/- mice infused with AngII) exhibit AAA formation exclusively in the aorta *superior* to the renal arteries. Oscillatory wall shear stress (WSS) has been shown be important in the localization of atherosclerosis and has been implicated in AAA pathogenesis. Humans have a triphasic flow pattern (forward-reverse-forward) in the infra-renal aorta that results in oscillatory WSS in that vascular segment (Figure 1). Hemodynamics of the human aorta have been studied extensively but similar studies in mice have not been done.

Purpose

The purpose of the current work was to investigate the hemodynamic environment of the supra-renal and infra-renal abdominal aorta of normal mice using *in-vivo* magnetic resonance imaging (MRI). We hypothesized that there is *no* reversal of blood flow in the infra-renal aorta of mice due to the lack of AAA formation in this segment.

Methods

We have developed a phase contrast magnetic resonance (PCMR) sequence and processing software to acquire cine velocity maps of blood flow in the mouse aorta. *In-vivo* imaging was performed using a 4.7 Tesla Varian INOVA MRI scanner (Varian, Palo Alto, CA) with a 37-mm-diameter, 16-element birdcage quadrature coil. ECG-gating was used to acquire ten frames equally-spaced over the cardiac cycle with the R-wave as the trigger for image acquisition. In-plane resolution was 70 × 70 microns, slice thickness was 1 mm. Using the PCMR sequence, we obtained cine images which allowed measurement of both blood flow velocity and assessment of aortic wall motion. Images were obtained in a plane perpendicular to the aorta at the supra-renal and infra renal levels (Figure 1) of 18 normal C57BL/6J mice. Flow vs. time curves were created for all mice at both locations.

Results

Supra-renal and infra-renal velocity measurements were successfully obtained in 18 of 20 mice. Two out of the 20 mice died before the scan could be completed. Time averaged infra-renal blood flow was 7.4 ± 4.4 ml/min. Through the entire cardiac cycle, *flow was in the forward direction and there was no evidence of flow reversal at any time point.* This difference in flow pattern between mice and humans may suggest differences in renal vasculature resistance and/or lower limb vessel capacitance. Supra-renal flow in mice was 15.2 ± 7.9 ml/min and again, no reversal of flow was detected.

Conclusion

The mouse has become a commonly studied animal model for many cardiovascular diseases such as athero-

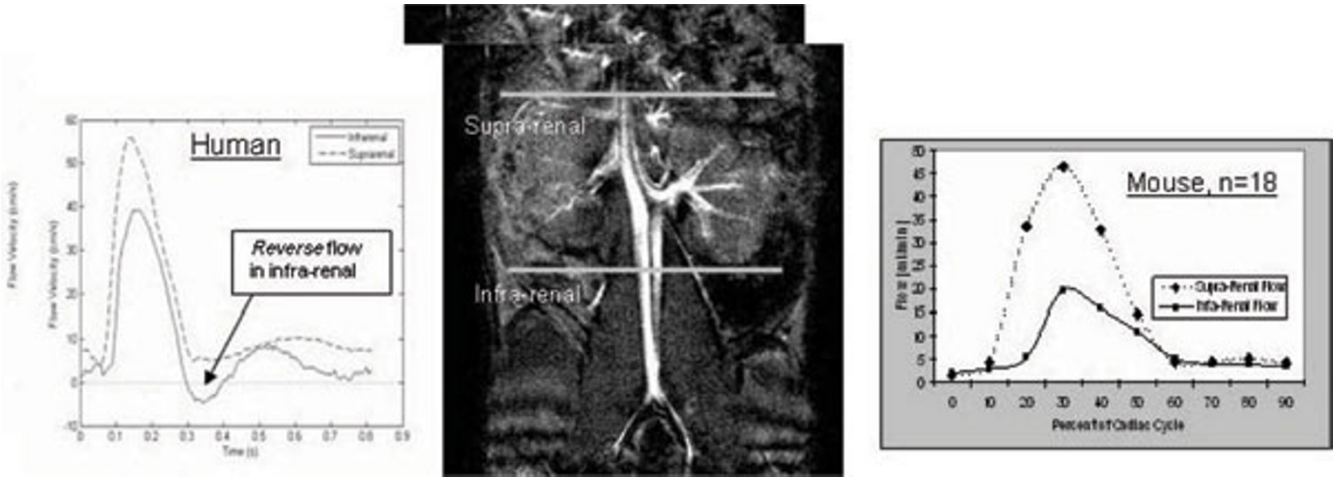

Figure 1
Left: Blood flow profiles from a healthy human volunteer taken at supra-renal and infra-renal axial locations. Note the triphasic flow pattern due to the reversal of flow in the infra-renal aorta. Center: A coronal scout image at the level of the kidneys indicating positions of supra-renal and infra-renal blood flow and velocity measurements. Right: Measured flow waveforms in the supra-renal and infra-renal aorta of 18 mice. Note the lack of triphasic flow in the infra-renal segment.

sclerosis and AAA development. However, there are differences that exist between many of these human diseases and their murine counterparts. The absence of blood flow reversal in the mouse infra-renal aorta is a major difference in aortic flow patterns between humans and mice. This difference in hemodynamic patterns between these two species may have important consequences for the etiology of AAA development.

Flow was measured in the supra-renal and infra-renal aorta of 18 C57BL6 mice using PCMR. No evidence or reverse flow was seen in the infra-renal aorta, contrary to what is seen in man.