Vessel Diameter and Systolic Blood Velocity in Swine Peripheral Blood Vessels: Data For In-Silico Model Development and Quantitative Comparisons with Human Blood Vessels

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Introduction: Swine are frequently used as models for medical device and procedure testing due to their comparability to humans in size and vascularization. Qualitative comparisons illustrate the similarity between swine and human cardiovascular systems, but quantitative comparisons between swine and human blood flow are not readily documented in a single source. The purpose of the study was to measure blood velocity and vessel diameter in commonly accessed swine peripheral vessels and make quantitative comparisons with previously published data on blood flow in human blood vessels. The current study also seeks to provide in silico model development with blood flow data from frequently accessed peripheral vessels in live swine subjects.

Materials and Methods: Thirteen (n = 13) Yorkshire swine, weighing at least 60kg, were used in this study. The swine were anesthetized and ultrasonography (Visualsonics Vevo 2100) was used to visualize peripheral vessels. Vessel diameter and systolic velocity measurements using pulsed wave (PW) Doppler were taken for multiple vessels on each swine subject. Ten vessels were visualized and measured for each animal; the right saphenous artery (RSA), right cephalic artery (RCA), right femoral artery (RFA), right saphenous vein (RSV), right cephalic vein (RCV), left saphenous artery (LSA), left cephalic artery (LCA), left femoral artery (LFA), left saphenous vein (LSV) and the left cephalic vein (LCV). Vessel diameter and maximum flow rate velocity were averaged across all animals. Comparisons were made to published scientific studies on blood flow in human blood vessels within the forearm, abdomen, chest, and leg anatomical regions of the body.

Results and Discussion: Mean values of the peak systolic velocities in the left and right swine saphenous and femoral artery (s-SA and s-FA) had overlapping standard deviations with the systolic velocity in the human radial and ulnar arteries (h-RA and h-UA) from Özcan et al., 2011. However, diameter measurements from the swine femoral artery showed a much larger value than the mean diameter of the radial and ulnar artery reported by Özcan et al., 2011. Additional vessels have shown similarities and differences between swine and human data.

Figure 1. Comparisons of velocity and diameter between swine and human arteries and veins. Swine vessels are labeled beginning with an “s-” and human vessels are labeled beginning with a “h-“.

Translational Impact: Our findings detail blood flow velocity and vessel diameter data for commonly used peripheral vessels in swine vascular testing. The recorded values in swine have been shown to be relevant for specific human vessels and provide an adequate scientific basis for in-silico model development.

Disclosure Statement: No conflicts of interest.

Acknowledgements: The authors would like to acknowledge our Research Animal Facility staff, as well as Barry Bellamy and Kate Szymczyk for their support of this project.