Scintica INSTRUMENTATION

Questions & Answers

WEBINAR:

Aortic acceleration as a noninvasive index of left ventricular contractility in the mouse.

Questions and answers from the March 4, 2021 webinar titled "Aortic acceleration as a noninvasive index of left ventricular contractility in the mouse."

This document includes questions we received and answered during the webinar, as well as those that we did not have time to address.

1. **Thank you everyone for this interesting webinar. I would like to ask the following. If the accelerations in the aorta are deduced from blood flow velocities, does that suffice bearing in mind that the aorta itself is an accelerating medium with the chest space?**

   [Dr. Anilkumar K. Reddy] By saying "…aorta itself is an accelerating medium." I am assuming that you mean that the aorta pushes the blood forward. The aorta moves (accelerates) slightly during ejection but that is very small compared to blood flow velocity. However, the aorta does not actively accelerate blood, but it passively stores energy during systole and releases it during diastole (compliant/capacitor).
   The ejection phase, specifically the time from the beginning of ejection to the peak aortic flow velocity is reflective/representative of the initial rapid increase in LV +dP/dt. It is during the initial ejection period the LV ventricle & ascending aorta behave like a single chamber with blood being transferred from one side to the other side of the valve. During this phase, the ascending aorta acts as a capacitor absorbing the energy. After the valves are closed the aorta releases/recoils resulting in pushing the blood forward.

2. **Have you measured descending AO velocity?**

   [Dr. Anilkumar K. Reddy] We have measured it but not for any specific purpose. We measured it once in a mouse that had undergone TAC to find out if we can detect vortex shedding frequencies (Figure 9 of Reddy, et al. IEEE Transactions on

Biomedical Engineering, 52(10):1771-1783, 2005). Most of the time we are measuring signals from aortic arch.

3. **Do you have any experience with the right ventricular function using this methodology?**

   [Dr. Anilkumar K. Reddy] The anatomical position of the pulmonary artery (PA) with respect to ascending aorta makes it difficult to measure PA velocity without image guidance. Peak velocity in the PA can be up to 50-60% of the peak aortic velocity.
   The uncertainty of where the sample volume is placed combined with Doppler angle may make operators believe that they are measuring from PA while they may be measuring from ascending aorta at a higher angle. It is possible to measure tricuspid flow velocity as long as the operator is well aware of the anatomy and the shape of the waveform (typically E-wave is smaller than A-wave).

4. **For mouse, if HR goes above 500, can you still get E/A measurement with your doppler system?**

   [Dr. Anilkumar K. Reddy] It is hard to get E/A separation at higher heart rates. So, we end up using just the E-peak to determine the diastolic performance. In such cases however, we sometimes use Echocardiography to measure Tissue Doppler of mitral annulus to get E' & A'.

5. **Thank you for your interesting presentation. We use Indus system for coronary artery blood flow velocity mapping in mice at rest and after adenosine (regadeneson) injection, we found that the H/B ration (hyperemic to baseline ratio) is increased in older mice, mainly due to a decrease in the baseline velocity. This is usually not the case in the clinic where the stress (hyperemic) flow in decreased. Is the blood flow velocity directly proportional to the blood flow perfusion?**

   [Dr. Anilkumar K. Reddy] I am not sure what anesthesia was used in your mice. With isoflurane as anesthesia the coronary vessels are partially dilated at MAC50 Isoflurane. For, humans the MAC50 isoflurane is depends on age (1.6-1.8% in O2 for

children; 1.28% in O2 for young adults; and 1.05% in O2 for people over 60). In mice a standard dose of 1.5% in O2 is used on mice at all ages. If the mechanism of action in mice is similar to that in humans than younger mice would be getting relatively lower dose compared to older mice, which would mean that younger mice may wake up faster and keeping baseline velocities higher compared to older mice (which is what we observed in our study using isoflurane as anesthesia as well as coronary vasodilating agent). Using adenosine under these conditions may reflect some of the isoflurane effects. If you are not using isoflurane, then we may have to look at that combination as well. You can contact me directly if you wish to further discuss this topic.

6. **How is the angle correction done in echocardiography?**

   [Dr. Anilkumar K. Reddy] In the 2D (B-mode) image of the ascending aorta the blue dotted line can be adjusted to change the angle. The angle value will be seen under the Sample Volume menu on the left side of the screen in VEVO770 system.

7. **Hi Anil - nice presentation.... interesting stuff for our comparative stuff ..... will be in touch. Thanks! Darwin at Roanoke**

   [Dr. Anilkumar K. Reddy] Thanks Darwin. Glad you could attend.

8. **Did you compare with cardiac MR?**

   [Dr. Anilkumar K. Reddy] No, we did not. In our study it was possible for us to measure the Doppler signals from both systems simultaneous (as shown in Fig 3 of the paper). This keeps the conditions same for both measurements and the comparisons more equitable. We are not sure if we can do this with Cardiac MR.

9. **I used that methodology lastly, and the signal from the probe appeared up and down the line (at the same time). How can I change it to obtain the signal only at the one side?**
   [Dr. Anilkumar K. Reddy] I am assuming that you are referring to simultaneous mode of pulse wave velocity measurement using two probes on the two sites. If that is the case, there is setting on the Doppler set up window where you should check

the “Use F/R not I/Q” box below the “Use Interpolation” check box in the “Processing” part of the window. This will make the program to parse signal from one arterial site to the upper side and the signal from the second site to the lower side.
If you are not referring to pulse wave velocity method, then one of the connectors (I or Q) may not be properly connected to the digitizer box.
Please contact us with more details if this is not what you are referring to.

10. **Have you evaluated PWV or other peripheral flow targets with 2.5% iso, as a way to assess flow reserve/dynamic dilation in sites other than coronary?**

    [Dr. Anilkumar K. Reddy] We have not done that, but we are aware that isoflurane also vasodilates systemic vessels to a milder extent. We may do this in the future.

11. **In serial measurements where no changes in aortic diameter are expected, it isn't a direct measure, but aortic outflow and CO should trend together, right?**

    [Dr. Anilkumar K. Reddy] Yes, that is correct if you assume that the diameter does not change. Most of the time peak aortic outflow and CO trend in the same direction.

12. **Would an acute change in systemic vascular resistance affect the acceleration? This could limit conclusions on cardiac contractility.**

    [Dr. Anilkumar K. Reddy] If the acute changes in systemic vascular resistance (afterload) are within physiological limits then the control mechanisms (neural and/or hormonal) act to compensate to keep the systemic arterial blood pressure more-or- less constant thus resulting in almost constant aortic flow with little effects on acceleration. As we mentioned in our paper that experimentally induced changes to preload and afterload are less physiological. Conditions such as rapid blood loss (hypotensive shock) or rapid volume overloads are abnormal and less physiological.