Systematic Increases in the Aortic Ejection Velocity with Decreasing Deuterium Content in Food

Edwin C. Jones 1*, Gwendolyn Maddox 2
1 Department of Veterans Affairs, Knoxville Outpatient Clinic, 8033 Ray Mears Blvd., Knoxville, TN 37919
2 Electrophysiology Consultant, 1468 Towee Pike, Reliance, TN 37369
*Correspondence Author: Edwin C. Jones, Department of Veterans Affairs, Knoxville Outpatient Clinic, 8033 Ray Mears Blvd., Knoxville, TN 37919.

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Abstract
The deuterium concentration in the fatty acids of food consumed was recently shown to impact the maximal rate of ATP production effecting the resting heart rates in six volunteers. One of these volunteers had three echocardiograms to evaluate an intermittent systolic ejection murmur that first appeared after adopting a ketogenic diet and this murmur became more pronounced following a low deuterium cold water sea food diet. The echocardiograms revealed that the aortic ejection velocity and aortic pressure gradients systematically increase with decreasing deuterium levels in the diet. These findings reveal that the meals consumed do have a significant impact on the parameters determined from echocardiography likely due to changes in the ventricular contractility. The aortic pressure gradients extrapolate to zero as the deuterium content approaches 155.9 ppm.

Key words: aortic ejection velocity; aortic pressure gradient; atp production; deuterium; deuterium-protium ratio (d/h); echocardiography; ejection fraction; heart failure; murmur

Introduction
Deuterium is well known to be toxic at high levels from laboratory animal studies so researchers routinely take precautions to minimize exposure to deuterium during isotope studies. One field dealing with the use of high levels of deuterium is fusion energy [1]. It was also known in the 1980’s that high levels of heavy water D2O exposure would shut down the ATP production in living organisms [2-4], but the mechanism remained elusive until the discovery of the ATP nanomotor and different binding energies for the protium and deuterium nuclei acting on these nanomotors [5-6]. A detailed summary of the effect of deuterium on the mitochondria energy production is published in open-source literature elsewhere [7-8].

More recently, the deuterium content in food was shown to impact the cardiac stroke volume leading to inotropic changes in the heart rate [7-8]. The deuterium in the fatty acids which is known to disrupt the ATP nanomotors located in the mitochondria was found to decrease the cardiac stroke volume leading to increased heart rates [7]. When the heart rate reaches the point that further compensation cannot occur, heart failure with preserved ejection fraction (HFpEF) occurs [8]. Such findings raise an important question such as what is a safe limit for deuterium exposure?

The case presented here shows a correlation between the aortic ejection velocity and the aortic pressure gradients with the deuterium level in the food consumed prior to each procedure. The echocardiograms were obtained from a very athletic man who hikes between 800 and 1200 km yearly [9-10]. This man does have well controlled type-II diabetes and also maintains detailed food logs which made this case possible [9].

The data presented in this case show that the aortic pressure gradients from the echocardiograms extrapolate to zero at a deuterium level of 155.9 ppm suggesting that this might be a possible limit to the safe exposure level of deuterium. However, in living organisms’ deuterium from food gets buffered with the stored skeletal fat which tends to be lower in deuterium suggesting a time delay in the appearance of this toxicity [8]. Further studies are clearly needed to confirm this potential level of cardiotoxicity from deuterium.

Case Presentation
A 57yo man with a 16-year history of well controlled type-II diabetes mellitus was referred to a cardiac clinic for evaluation and treatment of symptomatic paroxysmal atrial fibrillation and atrial flutter. During the initial evaluation a grade 1 systolic ejection murmur was auscultated. An echocardiogram was conducted which revealed an aortic ejection velocity of 1.9 m/s and ejection fraction of 65% by the biplane disc-summation method [11]. He was also started on Eliquis anticoagulation due to a CHA2DS2-VASc score of 2 (DM-I and HTN) [12]. During the next two years, the focus of treatment was the symptomatic arrhythmia. He was started on Floecainide [13] following a negative stress test to rule out coronary artery disease. At the age of 57.7 years, he received a cavotricuspid isthmus ablation. The cavotricuspid isthmus ablation was chosen [14] because the atrial fibrillation patterns were frequently preceded by atrial flutter rhythms suggesting that these atrial flutter rhythms were disintegrating into atrial fibrillation. Furthermore, Fourier spectral analysis of the atrial fibrillation patterns revealed 150bpm and 300bpm spectral components suggesting atrial flutter as the trigger. Following the radiofrequency catheter ablation, Floecainide was
discontinued and only Eliquis anticoagulation therapy was continued [12-13]. Episodes of lone atrial flutter and atrial fibrillation, which had been occurring on a weekly basis, were now nonexistent with the exception of one episode documented over the next four years.

During a post-ablation routine cardiac clinic follow-up visit, the systolic ejection murmur was found to have increased to grade 2 in intensity by age 61. A second echocardiogram was ordered that revealed an aortic ejection velocity of 2.48 m/s and ejection fraction of 68.0% using the biplane disc-summation method [11]. The man was asymptomatic and also remained very active physically. The echocardiogram was suggestive of possible asymptomatic aortic sclerosis; therefore, the plan was to repeat an echocardiogram after one year while maintaining the Eliquis anticoagulation therapy.

At the age of 61.9 years, a third echocardiogram showed that the aortic ejection velocity had decreased to 2.08 m/s and ejection fraction increased to 68.4%. The aortic valve was observed to be normal and there was a trace systolic ejection murmur over the aortic area that started in his 50’s. Figure 1 shows a recent electrocardiogram that indicates a normal sinus rhythm.

**Discussion**

In this case study, the changes in the echocardiographic parameters, i.e. aortic velocity and aortic pressure gradients, are shown to systematically vary with the deuterium content of the foods consumed prior to each echocardiogram. These echocardiograms were ordered to assess a systolic ejection murmur over the aortic area that started in his 50’s. Figure 1 shows the changes in resting heart rates vs deuterium levels reported elsewhere [7-8].

The results of these three echocardiograms were analyzed with the parameters compared to the known food deuterium levels. The first echocardiogram was obtained on a morning following a diet of clams and eggs whose brands were later tested with mass spectroscopy to yield a deuterium level of 137 ppm. The second and third echocardiograms were taken following diets of 123 ppm and 132 ppm deuterium, respectively. The peak aortic valve velocities are shown in Figure 2. The aortic velocities clearly decrease with rising food deuterium levels consistent with the changes in resting heart rates vs deuterium levels reported elsewhere [7-8].
Figure 2: Peak velocity of blood ejected from the aortic valve plotted as a function of the level of deuterium in the fatty acids consumed prior to the echocardiograms. The peak velocity of the blood in m/s was fit by a linear regression fit with the best linear fit equation shown. Points 1, 2 and 3 were obtained at ages 57.02 years, 60.79 years and 61.90 years.

Figure 3 shows the aortic pressure gradients for the three echocardiograms plotted against the food deuterium levels. The data were fit with the best linear fit regression curves with the peak and mean pressure gradients constrained at the same point on the x-axis, e.g. 155.9 ppm D/H. The linear fit coefficients of determination were $r^2_{\text{peak}} = 0.9577$ for the peak pressure gradient and $r^2_{\text{mean}} = 0.9983$ for the mean pressure gradient.

Figure 3: Peak and mean aortic pressure gradients as determined by the Doppler velocity derived from the three echocardiograms at (1) age 57.02 years, (2) age 60.79 years and (3) age 61.90 years. These were fit with linear regressions with both curves extrapolated to the same point on the x-axis at 155.9 ppm D/H. This is the point that death would be predicted to occur if the fatty acid deuterium level reached that level of deuterium. This is very close to the Vienna Standard of Mean Ocean Water (VSMOW) or 155.76 ppm [15].

Figure 4 shows the left ventricular ejection fractions determined by the biplane disc-summation method [11] from each of the three echocardiograms.
Conclusion

A man received three echocardiograms between the ages of 57 and 62 years to evaluate an asymptomatic systolic ejection murmur. These echocardiograms revealed systematic increases in the aortic ejection velocities and aortic pressure gradients with decreasing deuterium levels in the food consumed prior each procedure. The ejection fractions during this time period gradually increased from 65% at age 57 years to 68.4% at age 62 years indicating a gradual improvement to overall cardiac functioning. As of this time, no further echocardiograms are planned since this individual appears to have efficient cardiac functioning and a non-pathologic athletic heart murmur [16-17].

This case shows the strong impact of food on echocardiograms. The authors recommend a low deuterium diet with regular physical activity. Low deuterium foods include cold water seafoods, grass-fed meats, cheese, olive oil, almonds and leafy vegetables [8]. It is also recommended to avoid highly processed foods since these often have high deuterium levels [8]. Deuterium depleted water is also helpful but still remains relatively expensive [10].

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Conflicts of Interest

The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of the Veterans Health Administration, Department of Veterans Affairs, or the US Government.

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References


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