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Case Report

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

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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 echocardiocardiograms 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 CHA_2DS_2-VASc score of 2 (DM-II and HTN) [12]. During the next two years, the focus of treatment was the symptomatic arrhythmia. He was started on Flecainide [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, Flecainide 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 to minimal regurgitation documented for both the mitral and tricuspid valves. The pulmonic valve could not be visualized well with the standard transthoracic echocardiographic approach. The man again remained asymptomatic from any cardiac valvular problems and he continued to remain physically active. The echocardiogram was determined to be normal and no further echocardiograms are planned barring any changes to his physical condition.

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 a recent electrocardiogram that indicates a normal sinus rhythm.

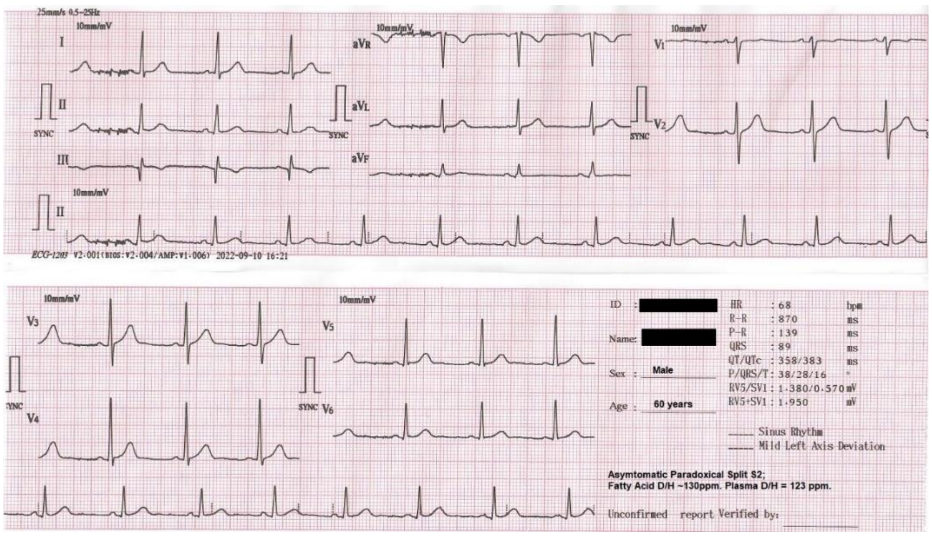

Figure 1: 12-lead ECG recorded from the male at age 60 shows normal sinus rhythm. The rhythm is free of any pathologic Q-waves, ST or T-wave abnormalities. A mild left axis deviation of 28 degrees is noted but this angle did not occur in other ECG's.

The first echocardiogram was obtained at age 57 years after he developed paroxysmal atrial fibrillation and atrial flutter episodes in addition to the systolic ejection murmur. As part of a workup for a referral to cardiology an echocardiogram was obtained which suggested aortic sclerosis without any outflow obstruction. His ejection fraction was 65% as determined by the biplane disc-summation method [11].

He was referred to cardiology services where he was started on Eliquis anticoagulant therapy [12]. He also received a radioisotope stress test to rule out any coronary artery disease. The stress test was negative for any coronary artery disease and therefore, Flecainide therapy was subsequently initiated [13].

The first echocardiogram, labelled 1 in the final three figures, was performed after the appearance of paroxysmal atrial fibrillation and atrial flutter episodes at the age of 57 years. Following a cavotricuspid isthmus ablation [14] at age 57.7 years which nearly eliminated the arrhythmias with only one atrial fibrillation episode recorded over a four-year post-ablation period, the focus of cardiac visits shifted to the monitoring of the heart valves.

The systolic ejection murmur was noted to be more pronounced at grade 2 by age 60.79 years therefore a second echocardiogram was obtained. The echocardiogram parameters labelled a 2 in the final three figures includes a 2.48 m/s aortic ejection velocity and a 68% ejection fraction determined by the biplane disc-summation method [11]. During this time period the man had changed his diet to predominately cold water seafoods known to induce very low heart rates while maintaining a high level of physical activity [8]. His resting heart rate now ranged between 46 bpm and 55 bpm. The morning of the second echocardiogram his food deuterium level was measured at 123 ppm deuterium level from mass spectroscopy. The parameters from the second echocardiogram were suspect for aortic sclerosis which could evolve into stenosis so a plan to monitor his valves was initiated.

At the age of 61.90 years, a third echocardiogram was obtained. Prior to the procedure, the man had temporarily switched to a higher deuterium, grain-fed animal diet including grain-fed chicken. [7-8] The deuterium level in the food on the morning of the echocardiogram measured at 132 ppm deuterium level from mass spectroscopy. The idea was to be closer to a typical diet so that the echocardiogram parameters would more accurately predict a future need for a valvular intervention if aortic stenosis were to develop. Ironically, the echocardiogram results returned as normal with the aortic ejection velocity dropping to 2.08 m/s and ejection fraction further increasing to 68.4% by the biplane disc-summation method [11]. At this time, no further echocardiograms are planned.

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].

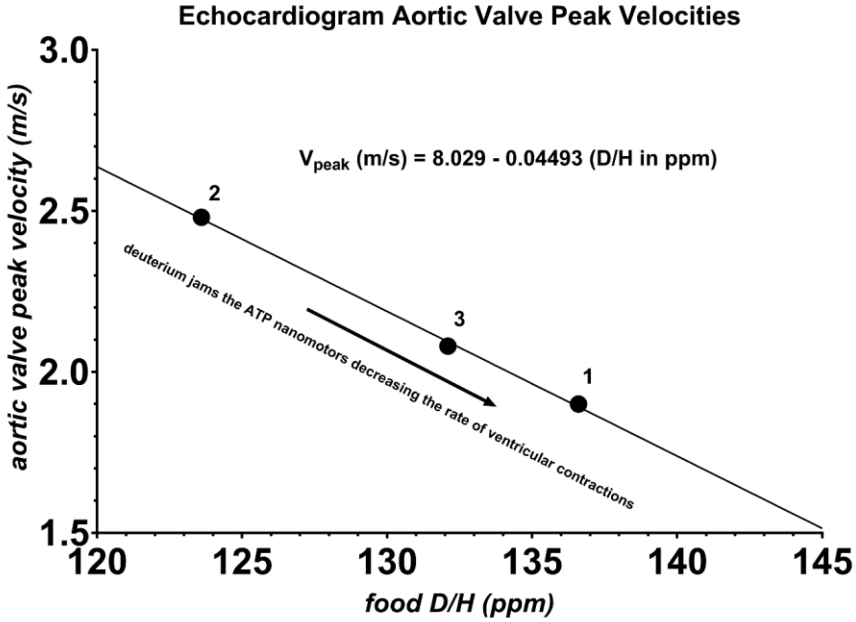

Figure 2: Peak velocity of blood ejected from the aortic valve plotted as a function of the level of deuterium in the fatty acids consumed prior to the echocardiograms. The peak velocity of the blood in m/s was fit by a linear regression fit with the best linear fit equation shown. Points 1, 2 and 3 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_{peak} = 0.9577 for the peak pressure gradient and r^2_{mean}=0.9983 for the mean pressure gradient.

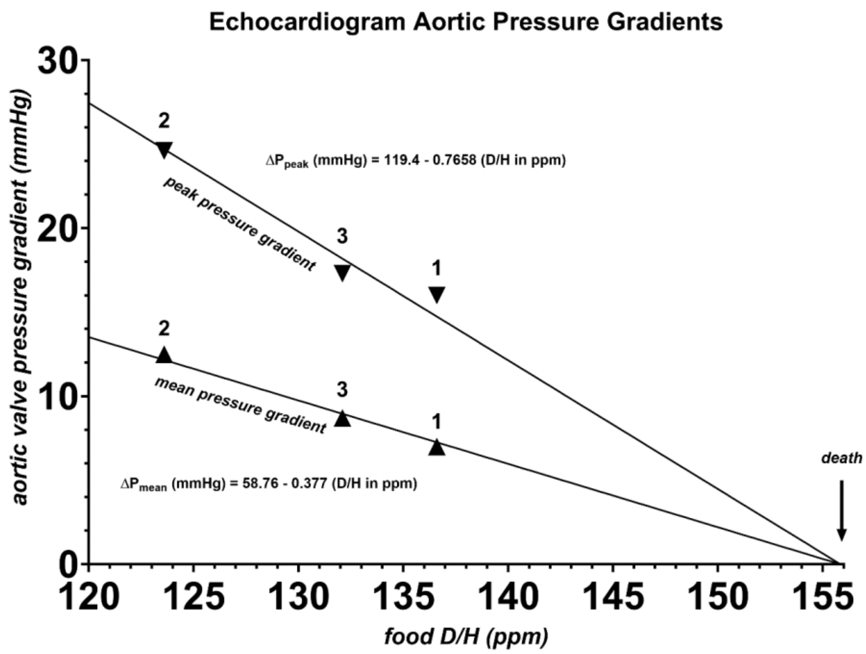

Figure 3: Peak and mean aortic pressure gradients as determined by the Doppler velocity derived from the three echocardiograms at (1) age 57.02 years, (2) age 60.79 years and (3) age 61.90 years. These were fit with linear regressions with both curves extrapolated to the same point on the x-axis at 155.9 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.

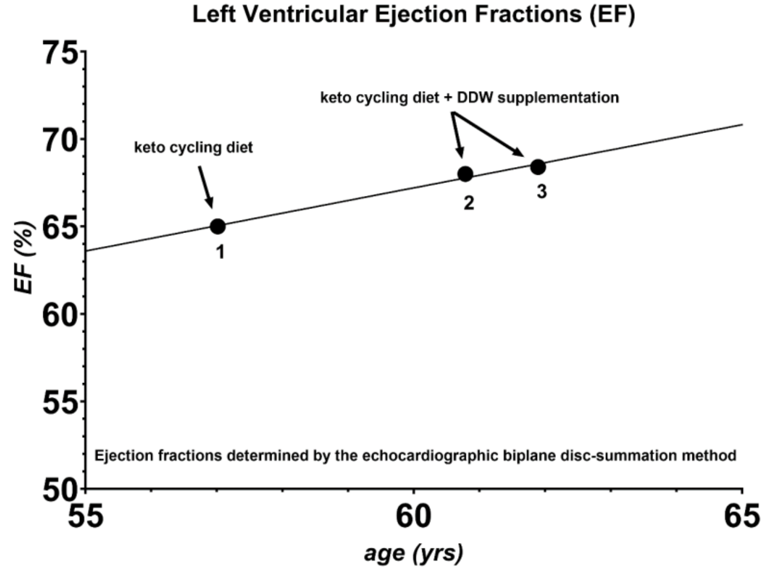

Figure 4: Left ventricular ejection fractions determined by the echocardiographic biplane disc-summation method [11]. for ages (1) 57.02 years, (2) 60.79 years, and (3) 61.90 years. The individual was utilizing the keto cyclical diet during this entire time period and further supplementing with deuterium depleted water after the age of 57.4 years. The ejection fraction is in the range seen in many athletes and gradually trending upward during this time period.

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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