



How fatty acids are transported through cardiac Mitochondria.

Targeted audience:

This scientific inquiry is for instructors and students who are part of Biochemistry and Human physiology courses and are planning to pursue their field of studies in Medicine, Molecular genetics, and Biochemistry.

Estimated time: 20 -25 mins.

Inquiry Question:

Why the fatty acids are oxidised to be transported through mitochondrial membrane and what genetic sequence can disrupt the normal cardiac functioning?

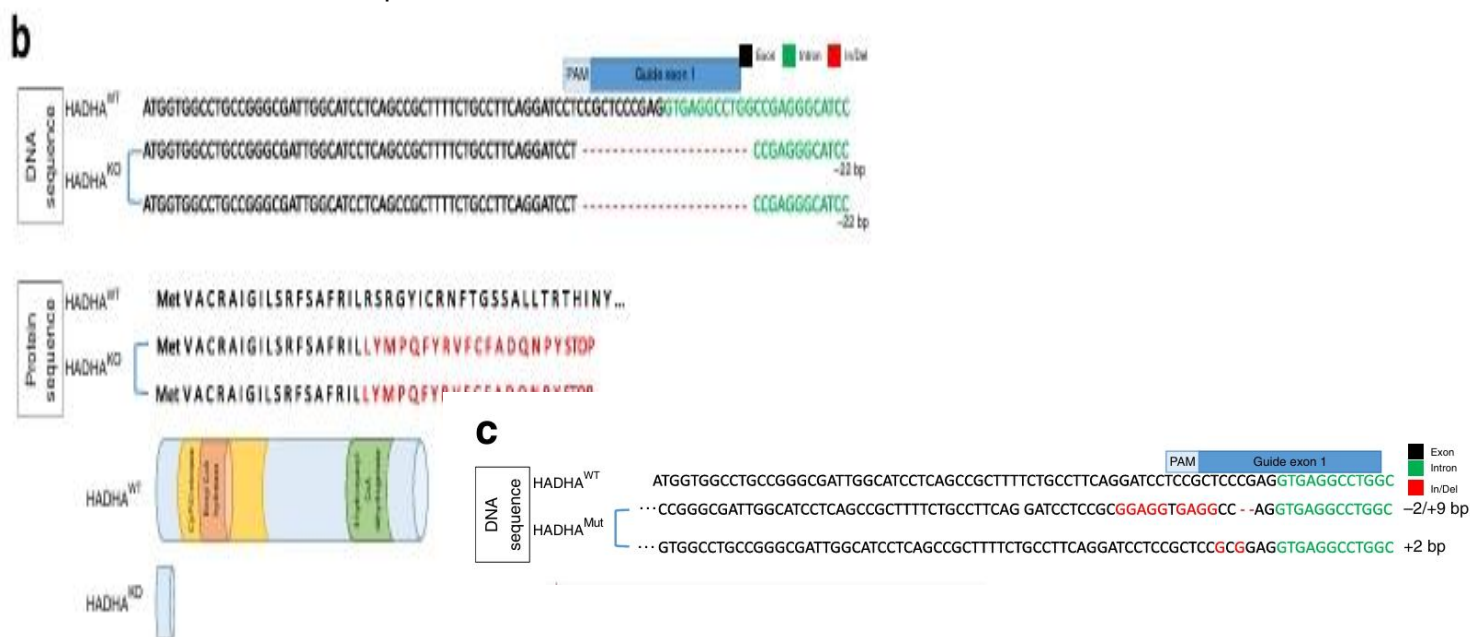
Designated Activity:

Read the research on articles on the structure and functionality of fatty acids, the oxidative process involved and the genetical level of functioning of these molecules. While reading counter question the thought of why oxidation of fatty acids is necessary when being transported and what causes the fatty acids to act abnormally that can lead various cardiac.

Predict the answers to your questions through observation and evidence like the length of fatty acid chains or heart energy requirement are bases of fatty acids' oxidation.

Draw the flow chart of fatty acid oxidation and **practice the sequencing** for proteins and DNA for that are essential for oxidation. This will help students to remember the core elements involved in whole process.

The flow chart and Sequences are as follow



Figur1. DNA sequence and protein sequence for HADHA (TFPa/HADHA is required for fatty acid beta-oxidation and cardiolipin re-modeling in human cardiomyocytes)³.

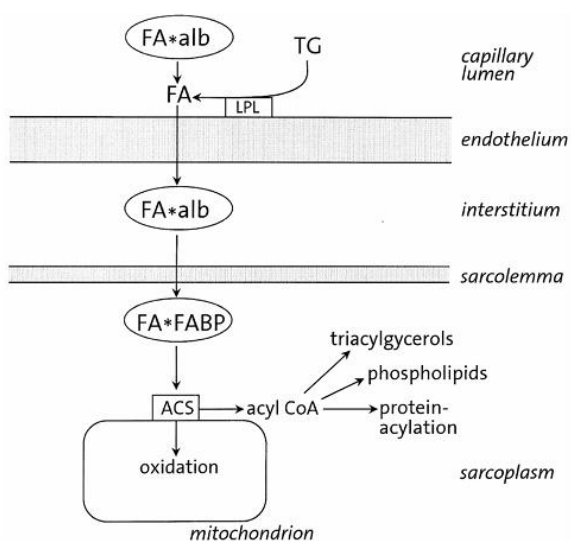


Figure 2. Barriers in movement of fatty acids through heart wall to mitochondria (Cardiac fatty acid uptake and transport in health and disease)¹.

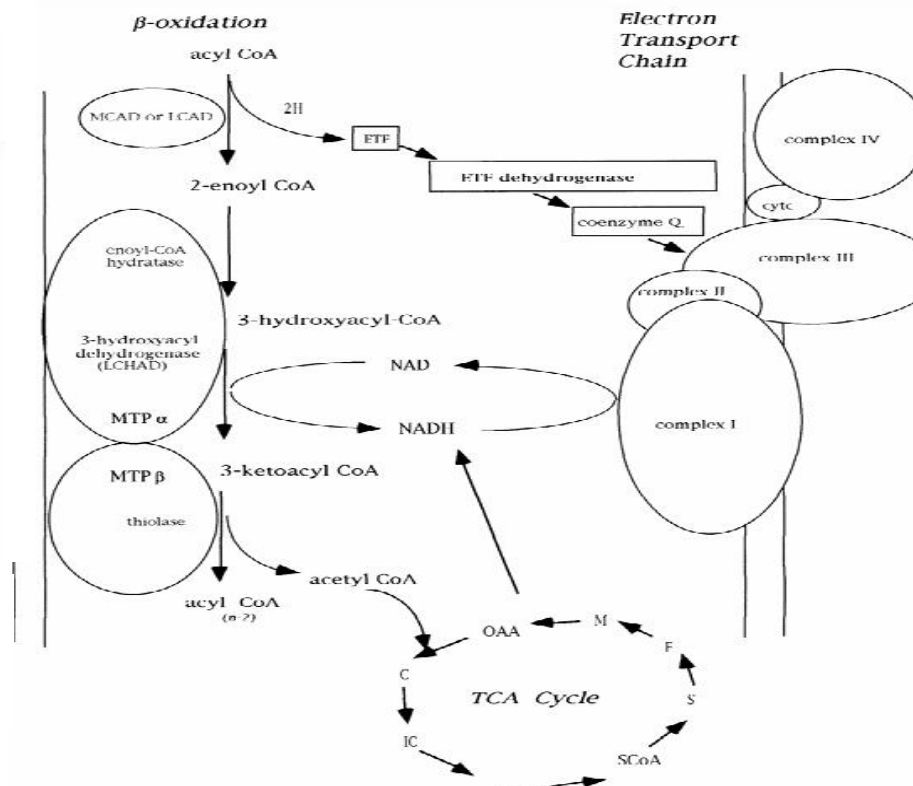


Figure 3. Fatty acid oxidation in cardiac mitochondria (Fatty acid metabolism in cardiac failure: biochemical, genetic and cellular analysis)².

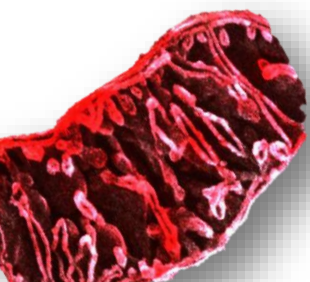
Explain your research question with evidence and support it with proper research papers **Extend/ Reflect** on further explanation towards relation between normal working of HADHA genes and fatty acids. How fatty acids respond to the genetic information provided by HADHA?

Instructor Guide:

Purpose: The activity helps to visually portray the complexity of metabolic activities happening at cellular level. This shows a connection between the level of organisation **genetic/cellular – molecular – organ**. Which shows a disruption at minute level can hinder activity at larger level.

Material:

- Interactive worksheets with activities related to oxidative cycle, and genetics sequencing.
- Pen or colored pencil to color code the steps or nitrogenous bases.



Facilitated notes: Encourage learners to grasp the concept behind the topic critically and go through all the factors that can affect the normal functioning of this pathway before explaining conclusions.

Expected Response:

The answer to the question can be that the long chain fatty acids are impermeable through the mitochondrial membrane and hence required to go through oxidation in contrast to short chain fatty acids that can easily pass through. Another reason for oxidation is the energy production ATP which is required for heart in large quantity at constant rate to work smoothly. The disruption at genetic level for HADHA can affect the oxidative process of fatty acids and cause abnormal cardiac functioning.

Safety Notes:

No safety notes are required as the activity is handwritten based.

Accessibility notes:

Instructor can demonstrate the concept by interactive videos or diagrams that can help students to illustrate the ongoing activity in more easy and meaningful way.

Connection to UNSDG:

The purpose of this activity and topic of research is to enlighten students with the importance of core elements that are responsible for normal functioning of a human body. By reviewing different articles student can gain knowledge beyond the things they usually learn in their course outline in this way they can connect from what they are learning in class and implement it to external gained knowledge.

References:

1. Ger J. van der Vusse et al. (2000). Cardiac fatty acid uptake and transport in health and disease. *Cardiovascular Research*, (45). 279–293.
[https://doi.org/10.1016/S0008-6363\(99\)00263-1](https://doi.org/10.1016/S0008-6363(99)00263-1).
2. Jose Marin-Garcia et al. (2002). Fatty acid metabolism in cardiac failure: biochemical, genetic and cellular analysis. *Cardiovascular Research*, (54). 516-527.
[https://doi.org/10.1016/S0008-6363\(01\)00552-1](https://doi.org/10.1016/S0008-6363(01)00552-1).
3. Jason W. Miklas et al. (2019). TFPa/HADHA is required for fatty acid beta-oxidation and cardiolipin re-modeling in human cardiomyocytes. *Nature communications*. (10). 4671. <https://doi.org/10.1038/s41467-019-12482>.

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