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Effects of athletic training on the equine heart: Do horses with big hearts run faster?

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Is heart size directly related to the ability to deliver oxygen to the body in mature Thoroughbreds?

The laboratory approach



- 7 conditioned Thoroughbreds
- Age 2 - 10 years
- 8 horses specifically bred for, or employed, in National Hunt racing
- 5 horses owned by the Animal Health Trust
- 4 horses specifically bred for, or engaged in, flat racing



Is heart size directly related to the ability to deliver oxygen to the body?



- Heart scans (i.e. echocardiography) were performed by one scientist and used to obtain indicators of heart size
- An indicator of oxygen consumption, VO_{2max} was calculated on stored data by other scientists who were unaware of the measurements of heart size

Materials & methods



Is heart size directly related to the ability to deliver oxygen to the body?



- Yes! An excellent correlation was found between the estimated mass of the left ventricle (the main heart chamber pumping blood to the body) and maximal oxygen consumption, VO_{2max}
 - VO_{2max} is the maximum capacity of an individual's body to transport and use oxygen during exercise
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Cardiac responses to exercise



Endurance



Power



Heart muscle walls

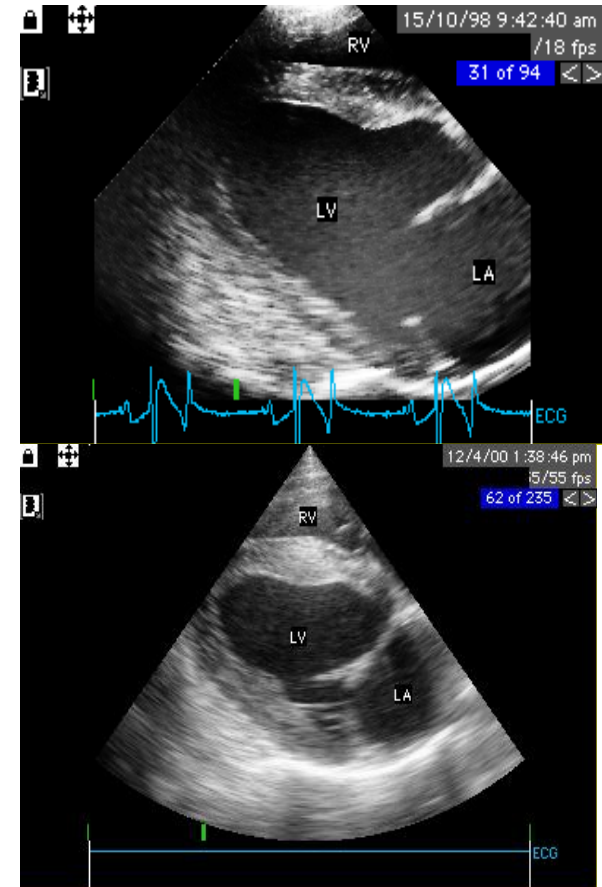


Blood filled chamber

- Human endurance athletes have large hearts with large blood pumping chambers
- Human power athletes have large hearts with thick walls.

• We wanted to find out if the same was true in equine athletes.

Do typical cardiac adaptations occur in horses? Arabian horses: endurance and racing



The epidemiological approach:



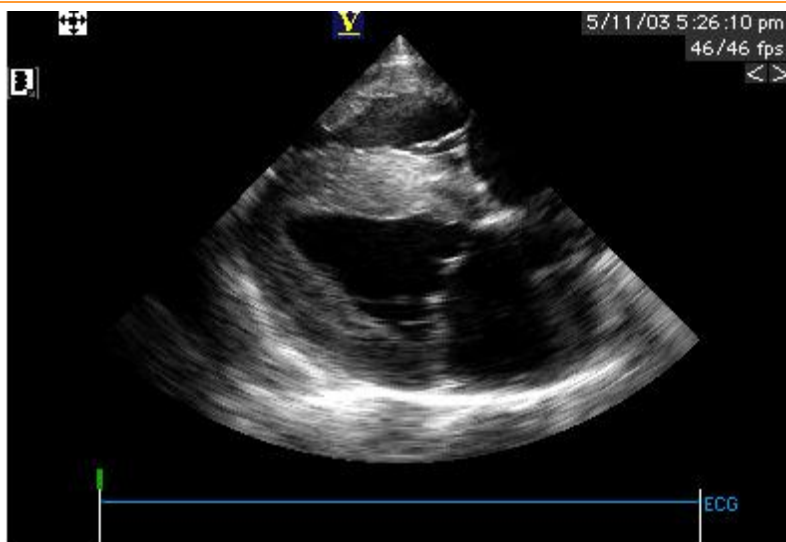
- A large group of race-fit flat and National hunt horses (483 race-fit Flat and NH TB)
- Echocardiography on the training yard (total 10 yards)
- Compare cardiac measurements with indices of racing success: official/timeform rating and earnings data using generalised linear regression modelling





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- Absolute and relative cardiac dimensions are affected by race discipline
 - The 8% difference in the diameter of the left ventricle, the main pumping chamber supplying the muscles and organs, between 2 year olds and steeplechasers is similar in magnitude to that between sedentary humans and athletes
 - There is important evidence that racehorses adapt to training and racing with cardiac remodelling that is appropriate to the endurance component of their event
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Compare the heart scans:



4 year-old TB colt

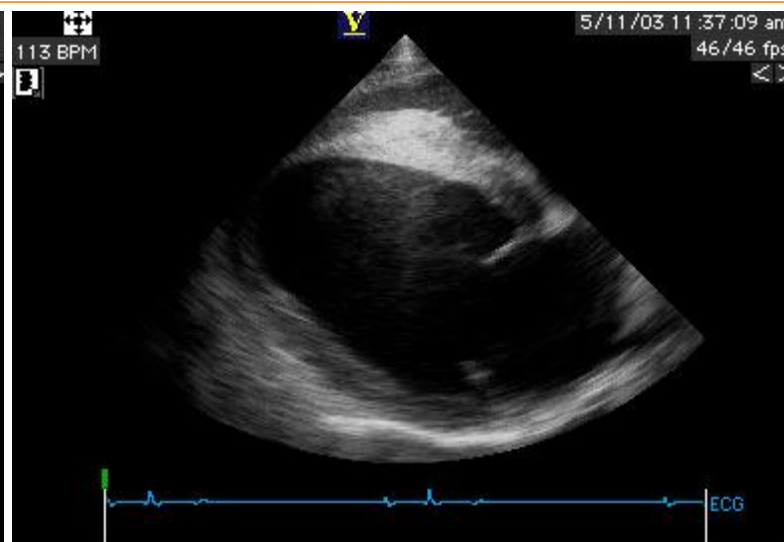
Heart width 13.4cm

Bwt 505kg

Peak rating 121

Distance 1 mile

Career earnings approx 550k



7 year old TB gelding

Heart width 15.6 cm

Bwt 535 kg

Peak rating 176

Distance 2 mile

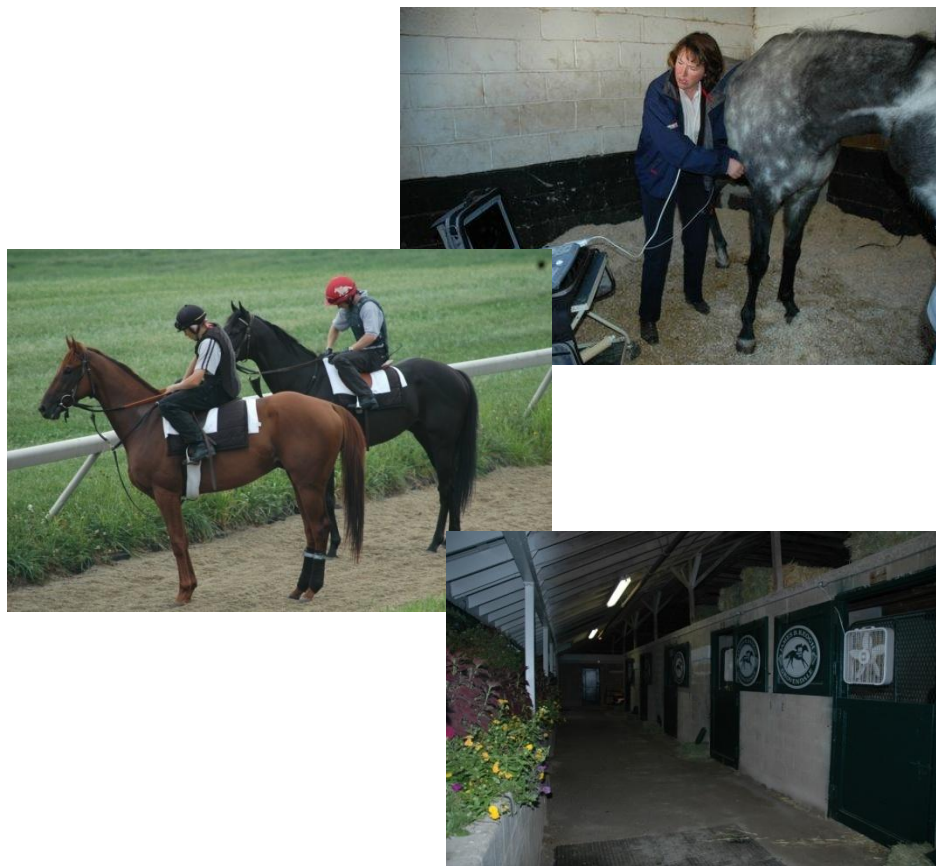
Career earnings approx 550k

The horse on the left has thick walls, shown white on the echocardiogram while the horse on the right has large chambers, shown black on the echocardiogram

Does heart size relate to racing performance?



- There was a positive association between Timeform rating and a combination of indicators of the heart mass and function for all groups of racehorses studied, except 2 year old flat horses
- The data analysis indicated that the models explained between 26 and 35% of the variation in Timeform ratings in older flat and NH horses





Things to consider

- These were race fit horses
- These data do not show that echocardiography can ***predict*** performance in untrained animals
- We need larger studies to validate these conclusions.



Scientist's summary



- This project has shown that heart size is linked to performance in racing Thoroughbreds.
 - This relationship is especially important for long distance chasers.
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Find out more about the equine athlete's heart



- Young, L E. Equine athletes, the equine athlete's heart and racing success.

Journal of Experimental Physiology **88**: 615-663, 2003.

- Young LE, Rogers K, Wood JL. Left ventricular size and systolic function in Thoroughbred racehorses and their relationships to race performance.

J Appl. Physiol 2005; **99**:1278-1285
