

The Relationship between Cardiopulmonary Exercise Testing (CPET) and Muscle Volume in Liver Transplant Candidates

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INTRODUCTION

Sarcopenia is described as the progressive and generalised loss of skeletal muscle mass and strength¹, which often accompanies liver cirrhosis. Although mainly associated with ageing, it may accompany progressive diseases such as cancer and end-stage liver failure.

Cardiopulmonary Exercise Testing (CPET) is a fundamental clinical tool used to assess exercise capacity and is key in predicting surgical outcomes².

- Aims:**
- Primary aim - Assess the relationship between CT measures of body composition and cardiopulmonary performance in patients undergoing liver transplant assessment.
 - Secondary aims – Investigate the relationship between CT measures of sarcopenia and its effect on morbidity and mortality.

METHODS

- A single-centre retrospective cohort study of 400 patients was performed at the Royal Infirmary of Edinburgh.
- All patients underwent liver transplant assessment between 1st July 2016 and 1st July 2018.
- CPET data was collected as part of liver transplant assessment work-up.
- Routine pre-operative CT scans were used to analyse muscle and adipose tissue. CT scans were taken at the level of the third lumbar vertebrae (L3). These were indexed for height to generate a skeletal muscle index (SMI)³ and compared with CPET variables.
- SMI cut-off values to determine sarcopenia shown in Table 1 were taken from the available literature, and based on the study by *Martin et al*³:

An outline of the cut-off values to determine sarcopenia using Skeletal Muscle Index (SMI).

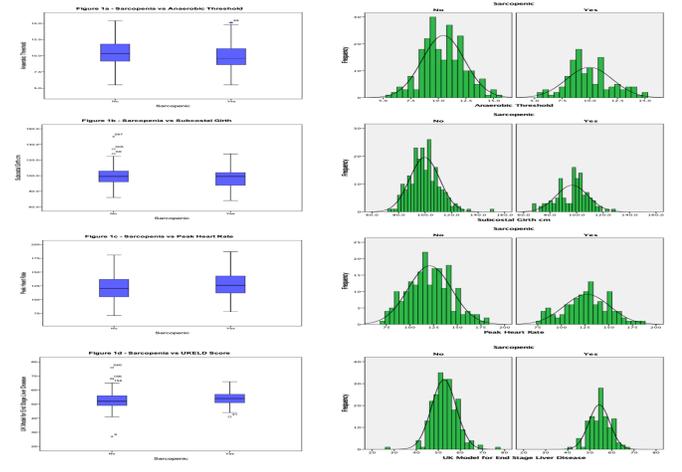
BMI Category (kg/m ²)	SMI (cm ² /m ²)	
	Men	Women
Underweight (<20.0)	<43	<41
Normal weight (20.0-24.9)	<43	<41
Overweight (25-29.9)	<53	<41
Obese (>30.0)	<53	<41

RESULTS

- Of the 400 patients, 54 met the exclusion criteria, leaving 346 for analysis.
- 121 patients were classified as sarcopenic and 225 non-sarcopenic.
- Patient height, weight and BMI did not significantly differ between sarcopenic and non-sarcopenic groups.

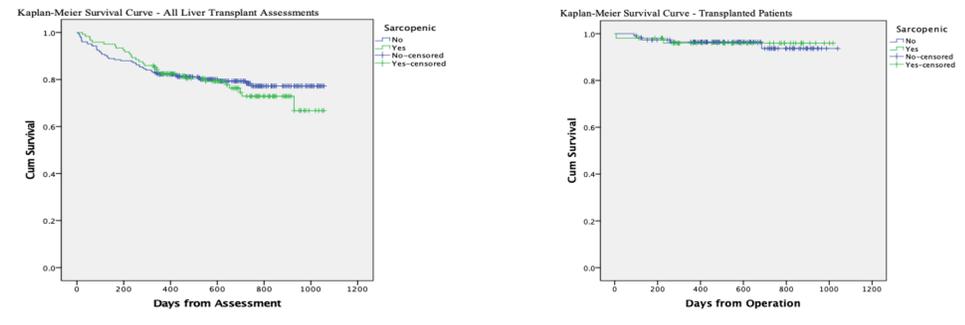
Sarcopenia vs CPET performance

- Patients in both the sarcopenic and non-sarcopenic group were compared with CPET performance, anthropometric and pulmonary function testing (PFT) results.
- Presence of sarcopenia was significantly associated with a lower anaerobic threshold (AT) (p=0.033), shown below in *Figure 1*.
- Sarcopenia also predicted a lower subcostal girth (p=0.024), predicted lung transfer factor (TCO) (p=0.010) and peak heart rate (HR) (p=0.030).
- Those in the sarcopenic category also scored significantly higher UKELD values (p=0.003) and were less likely to be considered suitable for transplant listing (p=0.020).



Sarcopenia vs Post-Operative Outcomes and Mortality

- Patients in both groups were compared to post-operative complications as classified by the Clavien-Dindo system, as well as mortality.
- There were no significant differences seen between sarcopenia and these variables, but the graphs below in *Figure 2* demonstrate a lower cumulative survival for patients with sarcopenia.



CONCLUSIONS

- 1) Sarcopenia is an accurate predictor of poorer CPET performance.
- 2) Sarcopenia also has value in predicting worse PFT's and higher UKELD scores, and a lower likelihood of being listed for liver transplantation.
- 3) However, the presence of sarcopenia is unable to predict surgical outcomes following transplant including long term survival.

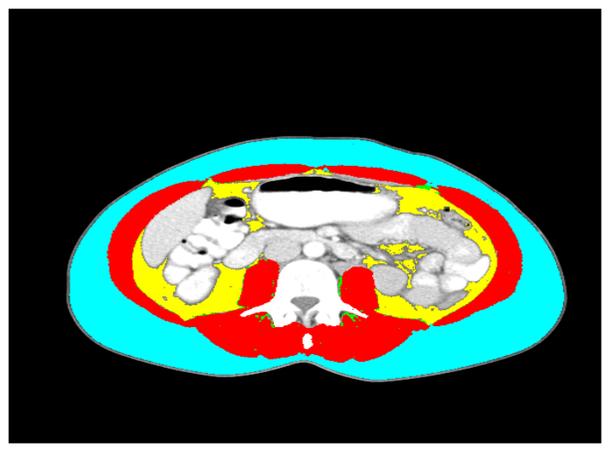


Figure 3 – Example of the Slice-O-Matic v4.2 software used to separate muscular and adipose tissue for the study.

Key - Blue – Subcutaneous Adipose Tissue, Yellow – Visceral Adipose Tissue, Green – Intramuscular Adipose Tissue, Red - Muscle

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