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Contribution of muscle efficiency in heart failure patients post phase 2 cardiac rehabilitation

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Background: Muscle efficiency (ME), can help explain the observed improvement in patients without increase in oxygen uptake (VO2) after cardiac rehabilitation programme (CRP). The better use of energy, independent to the oxygen delivery to muscle, may improve the functional capacity in Heart failure (HF) patients. Our aim was to evaluate the contribution of muscle efficiency improvement after CR on functional capacity.

Methods: We analyse consecutive patients data that had their phase 2 CR concluded, with HF as admission indication with no medical therapy changes and CRT implantation during this period. The aetiology of HF and biometric data, functional class, BNP, Minnesotta and EuroQol questionnaires and cardiorespiratory test pre and post 4 months of CRP were collected. The average of the exercise load in the first two and last two training sessions were recorded. ME was calculated at peak exercise during cardiopulmonary exercise test in pre and post CRP (see formula above).

Results: From 55 HF patients sequentially admitted in our CRP, during the last 24 months, 45 were included, since 2 were transplanted, 1 died and the 7 didn’t concluded the program or not had all the data mentioned in the methods. The mean age was 60,5 ± 10,3 years and 78% were male. Ischemic aetiology with depressed ejection fraction (64%) was the main admission indication, followed by cardiomyopathies (18%). Betablockers, ACEi or ARBs or ARNi and MRA were taken in 91%, 93%, 46%, respectively. ICD and CRT were previously implanted in 44% of the patients. Comparing pre and post CRP VO2 at peak exercise and aerobic threshold levels no statically differences were found. In this cohort 27 (60%) patients increased ME. At the end of the CRP, this group had a higher improvement in METs (p=0,021), higher gain in lean mass (p=0,041), in EuroQoL (p=0,002) and in physical dimension of Minnesotta questionnaire (p= 0,032), when compared with patients that didn’t improve the ME in at least 5%. In 22 patients that increased ME, the VO2 at aerobic threshold level didn’t improve by at least 5% and in this group the same benefits were confirmed.

Conclusions: The improvement in exercise load reached in the post CRP cardiopulmonary test, independently of possible cardiac output changes (VO2 peak), seems to be explained in part by the increase in ME improvement.

**Muscle Efficiency** = \[ \frac{\text{Weight (Kg) x Speed (m/s)} x \text{Sine of the angle of incline} \times 0.01433}{\text{VO2 (liters/min)} \times 5} \]