Exploring factors related to good exercise capacity in patients undergoing ERIC-HF program.

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Background: Decompensated Heart Failure (HF) patients are characterized by functional dependence and low exercise capacity. The factors associated to a good response to exercise are still unexplored. The ERIC-HF program is an aerobic exercise training program developed for HF inpatients and includes cycloergometer training, walking and climbing stairs in order to promote patient's functional capacity during the in-hospital stay period.

Purpose: to identify the factors related to good response to an aerobic exercise training program for decompensated heart failure (HF) patients.

Methods: Cross-sectional study with 143 inpatients who performed the ERIC-HF program. Functional capacity was evaluated using three different tools: the London Chest of Activity of Daily Living (LCADL) scale, the Barthel Index (BI) and the 6-minute walking test (6MWT). A good response to the program was defined as a $\geq$ 300 meters distance at the 6MWT at discharge. Univariate analysis was performed between patients who walked 300 meters or more at the 6MWT and patients who walked less than 300meters, using Chi-square tests and Student's T-test. Logistic regression analysis was performed to describe factors that were independently related to better functional capacity at discharge. Variables with a p-value smaller than 0.15 in the univariate analyses were entered into the logistic regression. A significance level at p <0.05 was assumed.

The dependent variables were: 1) distance walked at the 6MWT, 2) the change between admission-to-discharge scores of BI and 3) LCADL. Independent variables were: 1) gender, 2) age, 3) number of exercise sessions, 4) number of days of in-hospital stay, 5) Blad, 6) LCADLad, 7) NYHA functional class, 8) left ventricular ejection fraction (LVEF) and 9) etiology.

Results: The mean age of the patients was 67 ($\pm$10) years, 15.4% were NYHA class IV and 80% had reduced ejection fraction. The aetiology of HF was similar between ischaemic disease (32.9%) and valvular (33.6%). Patients presented a high level of impairment on FC. The majority were male (97; 67.8%), with an average of three CVRF and mostly sedentary, with only 17% performing regular physical activity. There was no significant difference between etiologies of HF.

Comparison between the group of patients who walked 300meters or more, at the 6MWT, and patients who walked less than 300metrs, showed statistically significant differences in terms of gender, age, BI, LCADL, etiology of HF and LVEF. After logistic regression, age (p = 0.002), gender (p = 0.001) and BI (p < 0.000) at admission showed to be statistically significant factors that affect the distance walked.

Conclusions: The ERIC-EF programe appears to be more effective in male, younger patients and with low FC at admission. Apparently, reduced ejection fraction does not interfere with progression during the programe. Gender influences the performance of patients, since men presented with higher FC at discharge.

Effectiveness and reproducibility of an exercise training program: THE ERIC-HF - multicenter randomized controlled trial

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Background: Decompensated Heart Failure patients are characterized by functional dependence and low exercise tolerance. Aerobic exercise can improve symptoms, promoting functional capacity and increasing exercise tolerance. Little is known about the effectiveness and feasibility of it. The ERIC-HF program is an aerobic exercise training program developed for HF inpatients and includes cycloergometer training, walking and climbing stairs in order to promote patient's functional capacity during the in-hospital stay period.

Objective: To analyze the effect of an aerobic exercise training program (ERIC-HF) on exercise capacity of patients with decompensated heart failure. Secondary objectives were to assess the effects of an aerobic exercise training on functional independence and experience of dyspnea during activities of daily living.

Design and setting: A randomised controlled clinical trial with follow-up at discharge. Eight different hospitals were included where patients with decompensated heart failure, admitted to the hospital, were randomly assigned to training (aerobic exercise program) or control (usual rehabilitation care guideline recommended). Patients were randomized (at a ratio of 1:1) to training group or control group using the software available online. After randomization, patients were clarified about the study and asked to provide informed consent. Patients were not informed about the group they were part of and no one declined participation. Only the investigators knew in which group patients were. The main outcome was exercise capacity, measured by 6-minute walking test at discharge. Other outcomes were the indepedence for the activitiers of daily living and the dyspnea associated to the activiites of daily living.

Results: 257 patients were included. The mean age of the patients was 67 $\pm$ 11 years, 84% (n = 205) presented reduced ejection fraction and the inhospital stay average was 16 $\pm$ 10 days. At discharge, patients in the ERIC-HF group walked further compared to the control group (278 $\pm$ 117m vs 219 $\pm$ 115m) and this difference stayed significant after correcting for confounders (p-value<0.001). A statistically significant difference was found favoring the ERIC-HF exercise group in functional independence (96 $\pm$ 7 vs 93 $\pm$ 12) and dyspnea associated to ADL (13$\pm$5 vs 17$\pm$7) and these differences stayed in correcting for baseline values and confounders (functional independence p-value=0.002; dyspnea associated to ADL p = 0.018).

Conclusion: The ERIC-HF program is safe, feasible and an effective exercise program to increase exercise capacity and functional independence and to decrease dyspnea during ADL in in-hospital patients admitted due to decompensated HF.

Hospital Information Systems, Electronic Medical Records, Clinical Decision Support

Risk prediction for heart failure rehospitalization using deep learning with real-world data

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Background: Heart failure rehospitalization (HFH) after acute decompensation is closely related to heart failure death. The risk assessment of risk for HFH is important for managing and treating patients with HF. Therefore, some risk prediction models have been introduced. However, there was no study for using deep learning method with real-world data. The aim of study was to develop the prediction model for HFH within 30, 90, and 365 days after acute HF (AHF) discharge.

Methods: We analyzed the data of patients admitted due to AHF between January 2014 and January 2019 in an university hospital. To select potential independent features, we used univariate analysis based on statistical tests including t-test, chi-squared and Kolmorogov Smirnov test and then used Recursive Feature Elimination with Cross-Validation. In performing deep learning-Based survival algorithms, we use hyperbolic tangent activation layers followed after recurrent layers with gated recurrent units. The prediction model was trained with the batch size set to 20. To assess the 30-day, 90-day, and 365-day readmission prediction, we used the AUC, precision, recall, specificity, and F1 measure. We applied Shapley value to identify which features contributed to HF readmission and were the most important at various scales or levels

Results: The data of 919 patients aged $\geq$ 20 years were collected. Two hundred eighty-eight patients were readmitted within 365 days of discharge or follow-up visit date. Twenty-two prognostic features that exhibit statistically significant associations with HFH were identified (age, blood pressure, hospital stay, the previous history of hypertension, diabetes, atrial fibrillation and coronary artery disease, WBC and platelet count, the level of hemoglobin, sodium, albumin, creatinine, use of intravenous furosemide during index admission and the use of angiotensin-converting-enzyme inhibitors or angiotensin receptor blocker, beta-blocker, mineralocorticoid receptor antagonist, diuretics and anticoagulants). When the acceptable percentage for missing data is 30%, the AUC value had shown moderate discrimination (AUC:0.63, 0.74, and 0.76, respectively, for predicting readmission within 30, 90, and 365 days of follow-up [FU]). The contribution of each feature for HFH within 365-days of FU is shown in Figure by order of importance. The features at the follow-up period have a relatively higher contribution to HFH than features from other time points

Conclusion: Our deep learning-based model using real-world data could provide valid predictions of HFH in 1yr FU. And It can be easily utilized to guide appropriate interventions or care strategies for patients with HF. The closed monitoring and blood test in daily clinic are important and are helpful for accessing the risk of HFH.

Use of an innovative humanized virtual digital interactive heart failure clinical cases training strategy for cardiologist in the covid 19 pandemic

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