The effect of diuretics on spirometric parameters in patients with ischemic heart failure

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Abstract

Heart failure is the failure of the cardiac pump under physiological loading conditions to impart sufficient hydraulic energy output in order to maintain a physiological circulation. A cohort study extended over a period of 14 months from the first of august 2010 to the first of November 2011. The patient was diagnosed as having heart failure according to the recommendation of the European Society of Cardiology, depending on the result of history, examination and echocardiographic conformation. Spirometric data were collected in accordance with American Thoracic Society standards. All the patients had a restrictive spirometric defect before treatment with diuretics, but after treatment all show normal spirometric pattern. The present study recommend the followings: - The use of a cheap office spirometer in rural area by general practitioner (GP) doctors and nursing staff could be useful for follow up patients with ischemic heart failure to detect early deterioration by objective mean to refer the patient for specialized care. Also, the office spirometer needs no special skills and the nursing staff can master the procedure with a 2 weeks training course.

تاثير المدررات على المعايير الفسلجية لدى المرضى المصابين بعجز القلب الاقفاري

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الملخص

عجز القلب هو عجز في المضخة القلبية تحت حالات اجهاد وضيفي لانتاح طاقة مائية كافية للحفاظ على دوران طبيعة للدم . دراسة استمرت لمدة 14 شهر من بداية تشرين الاول 2010 و بداية أب ثاني 2011 . تم تشخيص المرضى بمرض عجز القلب الاقفاري حسب توصيات الجمعية الأوربية لإمراض القلب و اعتمادا على التاريخ المرضي و الفحص ألسريري ثم تأكيد التشخيص بواسطة فحص الايكو للمريض . نتائج الفحوص التنفسية تم جمعها اعتمادا على تو صيات الجمعية الأمريكية الصدرية. جميع المرضى الذين لديهم خلل تقيدي تنفسي قبل البدء بالعلاج بالمدررات و لكن بعد العلاج للمرضى بالمدررات تم تسجيل نتائج طبيعة للوظائف التنفسية . الدراسة الحالية توصي بالتالي :- استعمال مقياس لوظائف التنفسي في القرى و الأرياف في المراكز الطبية، لمتابعة المرضى المصابين بعجز القلب الاقفاري بعد العلاج.

Introduction

The lungs are linked in series with the cardiac pump, and they are not only influenced by mechanical alterations in pump function but likely by neurohumoral modulators and cytokines involved in the pathogenesis of heart failure (1-3). Heart failure is the failure of the cardiac pump under physiological loading conditions to impart sufficient hydraulic energy output in order to maintain a physiological circulation (4), or as defined by European Society of Cardiology is a syndrome in which the patients should have the following features: symptoms of heart failure, typically shortness of breath at rest or during exertion, and/or fatigue, signs of fluid retention such as pulmonary congestion or ankle swelling, and objective evidence of an abnormality of the structure or function of the heart at rest (5) . Clinical classification of heart failure based on symptoms and exercise capacity [the New York Heart Association (NYHA) functional classification]. The NYHA functional classification has proved to be clinically useful and it is employed routinely in most randomized clinical trials [6]. Spirometry is commonly performed in the primary care setting and can be completed in less than 15 minutes. Robust testing devices costing less than $2,000 are available for office use (7).

The aim of the study is to investigate the effect of diuretics on spirometric parameters in patients with ischemic heart failure

Patients and methods

A cohort study extended over a period of 14 months from the first of august 2010 to the first of November 2011. All patients attending echocardiographic clinic with the clinical diagnosis of heart failure at that period were included in the study. For all patients the body weight and height were measured. The body mass index was calculated as follow: **BMI=weight (**in kg**)/height^2 (**in meter**)**. A full medical history including detailed drug history was obtained. Also, medical examination was performed to all patients and 12 leads ECG were recorded. The patient was diagnosed as having heart failure according to the recommendation of the European Society of Cardiology [8], depending on the result of history, examination and echocardiographic conformation. For all subjects, a Doppler and 2D echocardiographic measurements were performed according to the recommendations of the American Society of Echocardiography [9-11]. All echocardiographic measurements were performed by using GE Vivid 3 echocardiographic machine provided by GE company-USA. Spirometric data were collected in accordance with American Thoracic Society standards [12]. Spirometries were done using BTL-08 LT spirometer provided by BTL company-England. For all patients spirometry were done on presentation, and after stabilization with adequate doses of diuretics. All patients who were included in the study were diagnosed for the first time, and were at NYHA class 3 and 4. All of them were started on the loop diuretics Bumetanide, in combination with potassium-sparing diuretics Spironolactone. The dose was adjusted for a satisfactory response that brings the patients to NYHA class 1 or 2. The patients were excluding from the study if:

The diagnosis of ischemic heart failure was not confirmed, or if they had a clear history of bronchial asthma, or severe chronic obstructive pulmonary disease (COPD), or if they had renal impairment (blood urea more than 100 mg /dL and/or serum creatinin > 2mg/dL). Or, if they fail to adhere to the prescribed medications, or if they fail to improve on drug treatment.

All the data were presented as a mean ± standard deviation (S.D). Paired student T-test was used to compare mean between

patients before and after treatment, for continues variable, while Mann-Whitney U test were used for categorical variables. Correlations were calculated using Pearson's correlation coefficients for continuous variables, and Spearman's rank correlation coefficients for categorical variable. All computed data were done using SPSS 17 for Windows.

Results

Twenty-six patients with ischemic heart failure, 15 males (57.7%) and 11 females (42.3%) were examined. The demographic features and other characters are summarized in table 1. For the New York Heart Association (NYHA) clinical class of heart failure before treatment; 21 patients (80.8%) were NYHA class 3 while the remaining 5 patients (19.2%) were in NYHA class 4. After treatment; 14 patients (53.8%) were NYHA class 1; and 12 patients (46.8%) were in NYHA class 2. The ejection fraction for patients with heart failure before treatment was 33.5 ± 6.17%, that do not change after treatment. All the patients had a restrictive spirometric defect before treatment with diuretics, but after treatment all show normal spirometric pattern. The spirometric values for the patients with ischemic heart disease were as the following:

The FVC before treatment was 41.46 ± 6.94 % of the predicted value.

The FEV1 before treatment was 48.85 ± 9.17 % of the predicted value.

The FVC after treatment was 88.38 ± 5.85% of the predicted value.

The FEV1 after treatment was 88.62 ± 5.93 % of the predicted value.

The FVC had a strong and significant positive correlation with the use of diuretics, $r = 0.870$; $p \leq 0.0001$.

The FEV1 had a strong and significant positive correlation with the use of diuretics, $r = 0.869$; $p \leq 0.0001$, (Table 2, fig. 1& 2).

Table (1):- the mean & standard deviation (SD) of age, body weight, height & pulmonary function test in patients of IHF.

Parameters	Minimum	Maximum	Mean	Std. Deviation
Age (years)	40	79	62.19	10.54
Weight (kg)	50	114	79.81	17.918
Height (cm)	145	180	163.50	10.734
FVC	32	52	41.46	6.941
FEV1	40	62	48.85	9.173
EF	21	40	33.50	6.173

Table (2):- FVC and FEV1 before and after treatment with diuretic in patients with IHF

	treatment	Mean	Std. Deviation	P value
FVC	before	41.46	6.941	0.01
	After	88.38	5.852	
FEV1	Before	48.85	9.173	0.01
	After	88.62	5.933	

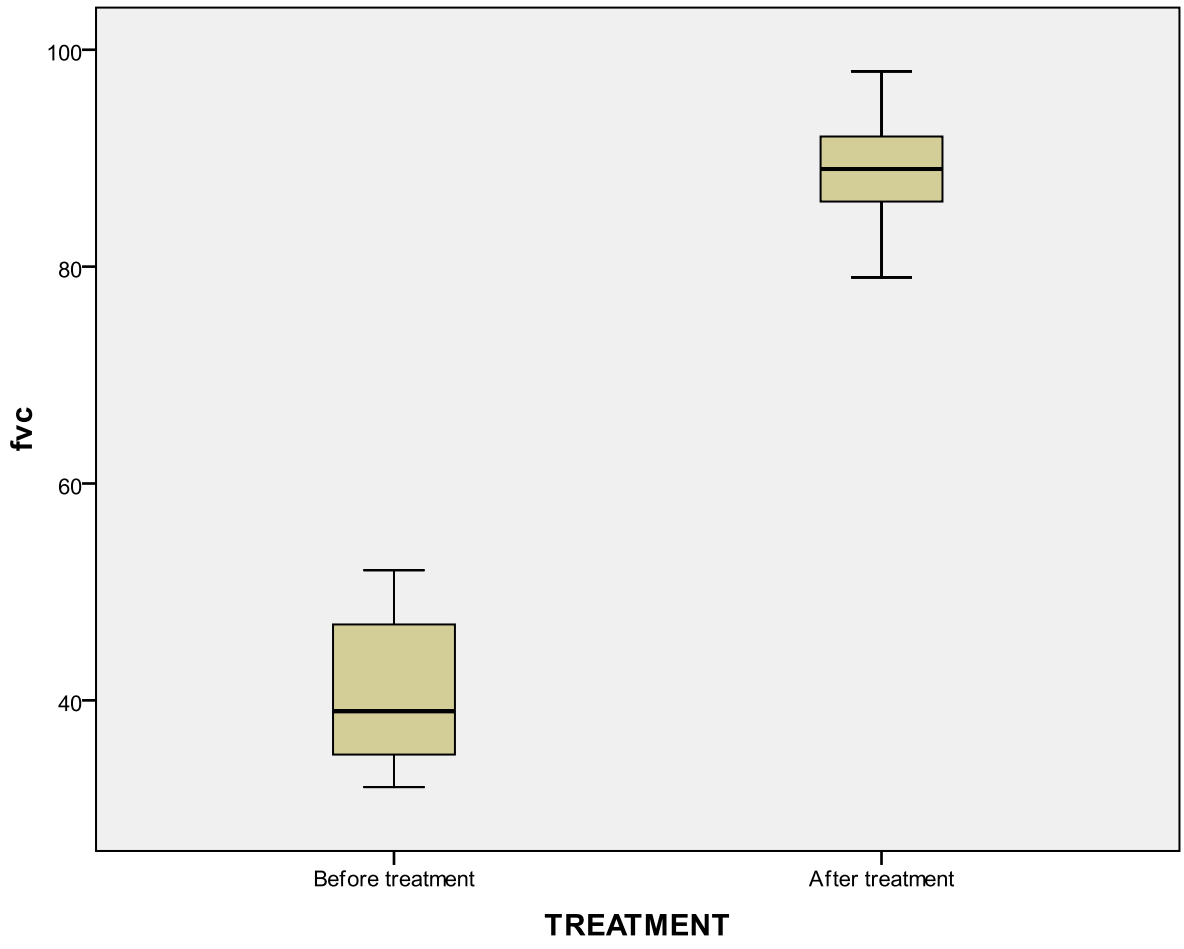

Figure (1):- correlation of FVC with the use of diuretics

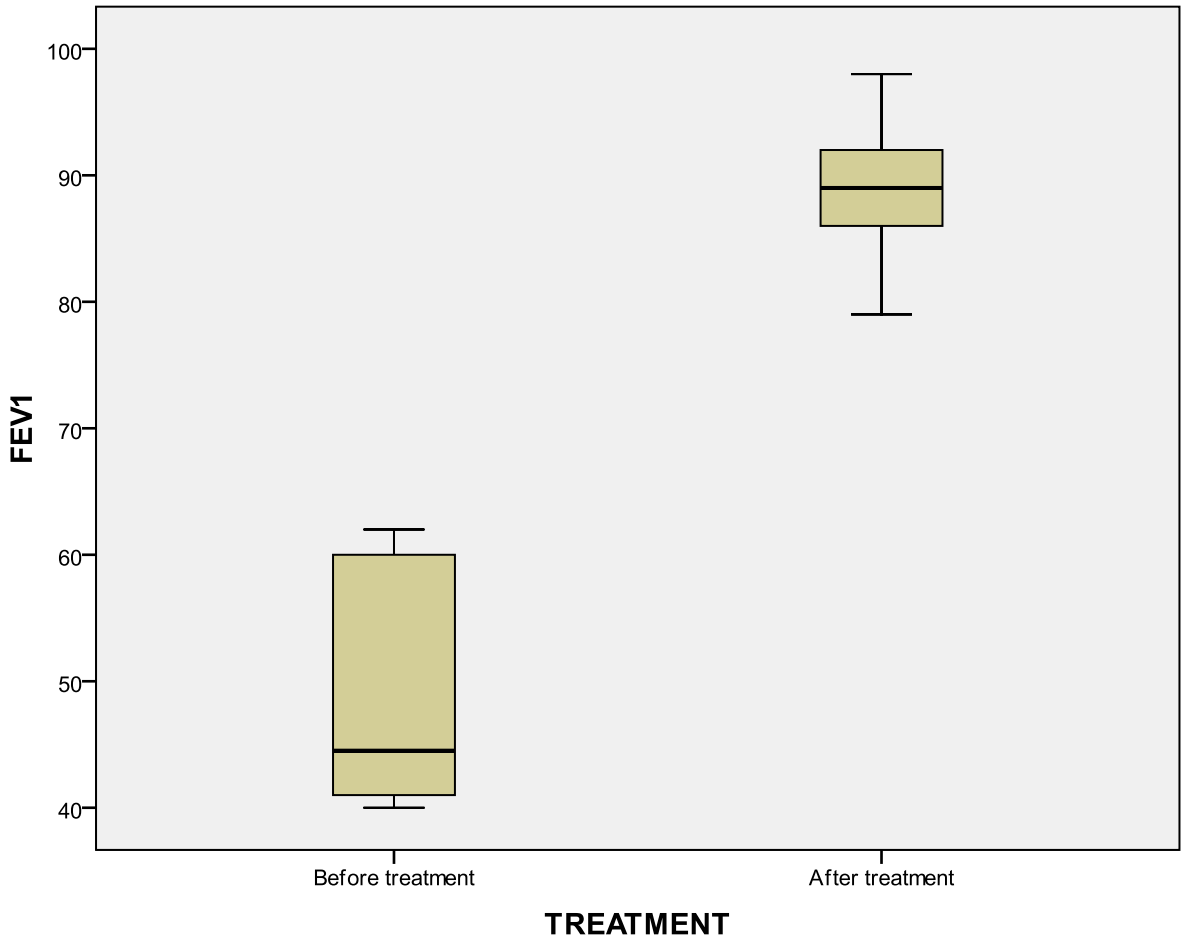

Figure (2):- correlation of FEV1 with the use of diuretics

Discussion

These findings of this study are consistent with Wright *et al*. [13] who found a restrictive spirometric pattern in most patients with congestive heart failure who were candidate for cardiac transplantation. Also, these findings are consistent with Hosenpud *et al*. [14] who study patients with congestive heart failure before and one year after cardiac transplantation. The cause of restrictive spirometric pattern in heart failure remain unclear, they have been attributed to respiratory muscle weakness, pulmonary hypertension, changes in lung fluid balance, chronic neurohumoral changes, and progressive cardiac enlargement within the thoracic cavity [15-16]. Some degree of reversal in pulmonary restriction and improvement in the ventilatory response to exercise were shown after ultrafiltration, and afterload reduction with dialysis with lung decongestive, emphasizing the role of fluid overload ([17]. Diuretics are the main drug in the treatment of both acute and chronic heart failure to produce rapid symptomatic improvement. Evaluation and optimization of volume status is a key component of treatment of patients with systolic or diastolic heart failure, [18]. The use of diuretics has a strong positive correlation with FVC and FEV1, and also a medium to

strong positive correlation with other spirometric measures. These findings are consistent with Pompilio *et al*.[19] who documents an improvement in FVC and FEV1 in patients with congestive heart failure with diuretics use, and these finding were also documented in 2 additional studies in which they found a rapid improvements in lung function following treatment of heart failure with diuretics[20] . Previous studies found that: diuresis of healthy subjects results in increased lung volumes and flows [21]. The present study recommends the followings:-

1-The use of a cheap office spirometer in rural area by general practitioner (GP) doctors and nursing staff could be useful for follow up patients with ischemic heart failure to detect early deterioration by objective mean to refer the patient for specialized care.

2-The office spirometer need no special skills and the nursing staff can master the procedure with a 2 weeks training course. The use of spirometry can be also useful for GP doctors in the primary health care centers to evaluate patients with dyspnea.

3-All patients with restrictive ventilatory defect should be referred for specialized care and investigated further by echocardiography and other investigations.

4-The use of the cheap spirometer offer extra advantaged in primary health care centers over the use of the expensive echocardiographic machine which will require a considerable skills and prolonged training course which cannot be offered usually.

Furthermore, the vital capacity has been shown to be a very useful predictor of the future development of heart failure in the normal population, and to predict the heart failure mortality.

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