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Post aortic dissection: Gap between activity recommendation and real life patients aerobic capacities

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ABSTRACT

Back ground: Regular exercise at a safe level, i.e. 3–5 metabolic equivalents, is recommended to improve blood pressure control and quality of life even after aortic dissection, although aerobic exercise capacities in these patients are unexplored yet.
Methods: We prospectively collected data from 105 patients with a history of post aortic dissection referred for a cardiopulmonary exercise testing (CPX) aiming to guide exercise rehabilitation.
Results: The population was composed of 76% of male, with a mean age of 57.9 ± 12.4 years. There were an equal distribution between the two type of dissection (47% of type A and 53% of type B aortic dissection). No cardiac event occurred during or after CPX. One third of patients have normal aerobic exercise capacity defined as peak oxygen uptake upper than 85% of their predicted capacity. Mean oxygen uptake peak was quite low 19.2 ± 5.2 ml/kg/min (5.5 ± 1.5 metabolic equivalents). Aerobic capacity was limited by cardiac chronotropic incompetence in 42% or peripheral deconditioning in 45%. Blood pressure remained in an acceptable range during the exercise. Systolic and diastolic blood pressures were respectively 151 ± 20 and 77 ± 13 mm Hg at first ventilatory threshold.
Conclusions: CPX is a safe exploration in patients with post aortic dissection syndrome. Given the fact that most of these patients are faced with significant alteration of aerobic capacities, the recommended daily practice of moderate exercise at 3–5 METS should be adapted and personalized to each patient thanks to CPX.

1. Introduction

Management of patients surviving aortic dissection is mainly focused on the blood pressure control thanks to intensive anti-hypertensive drug cocktails. Recent American recommendations encourage daily moderate activities, i.e. exercise at 3 to 5 metabolic equivalents (METS), for these patients to improve global cardiovascular health and blood pressure control [1]. Data supporting this recommendation are however lacking and it remains difficult to define a safe range of exercise in a population in which the physician fears that too intense exercise might initiate or aggravate aortic expansion. To cope with this lack, we prospectively evaluated aerobic capacities with CPX in all stable post aortic dissection patients referred to our center.

2. Methods

2.1. Study population

We collected data from patients referred for post aortic dissection follow-up between November 2012 and August 2015. Intramural aortic haematomas were considered to be aortic dissections with thrombosis of the false lumen. Patients with penetrating aortic ulcers, nor post traumatic aortic dissection were excluded. Patients with type A aortic dissection having undergone non-surgical treatment (e.g. medications only), because of severe comorbidities, were not included in the study. Patients with type A aortic dissection were hospitalized in one of two different cardiac surgery units. Patients with type B aortic dissection were hospitalized in a vascular medicine department or (in those requiring emergency treatment as a result of complications) a vascular surgery department. Clinical and morphological follow-up assessments were performed in the Vascular Medicine and Arterial Hypertension

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Department few months after the initial treatment for aortic dissection. Study protocol was conformed to the ethical guidelines of the 1975 Declaration of Helsinki and we obtained an authorisation of our local ethical committee (CNIL reference #DEC2015-19), and oral informed consent was obtained from patients. Connective tissue disease was defined as physician-diagnosed Marfan syndrome on Ghent criteria or annuloaortic ectasia. Clinical and biological cardiovascular risk factors were noted.

2.2. Blood pressure data

A 24-H blood pressure monitoring ensured blood pressure control before exercise testing. The equipment used was a Spacelabs Medical 90207 ambulatory blood pressure monitor (Spacelabs Medical Ltd., Issaquah, WA). A BP measure was performed every 15 min. Daytime BP was measured between 6:00 am and 10:00 pm, and nighttime BP was measured between 10:00 pm and 6:00 am. The dipping status was defined as a drop in BP over 10% between the average daytime BP and the average nighttime BP for the systolic and/or the diastolic BP.

2.3. Morphological data

Before exercise testing, an angio-computed tomodensitometry confirmed an aortic diameter below surgical indication. CT angiograms were realized with an acquisition from the apex of the lungs to the femoral heads. For the statistical analysis, we used the maximal diameter of the descending behind the left pulmonary artery. An echocardiography was performed in all patients. Left ventricular ejection fraction was estimated with Simpson's rules. Left ventricle mass was measured according the American Society of Echocardiography and normalized against body surface area and against taille$^{2.7}$ [2].

2.4. Cardiopulmonary exercise testing

Cardiopulmonary exercise testing was performed under antihypertensive drugs including a beta-blocker to guide further cardiovascular rehabilitation [3]. Cardiopulmonary exercise testing was performed in standard manner on a cycle ergometer. Patients were encouraged to exercise to exhaustion (symptom-limited maximal test). Blood pressure was measured every 2 min. A 12-lead electrocardiogram was monitored during exercise test. Incremental exercise tests were performed on a calibrated electromagnetically braked cycle ergometer (ER-900; Jaeger, Hochberg, Germany), using a 1-min step protocol at 10 W min − 1 until exhaustion. Maximal incremental exercise was performed with the subjects maintaining a pedalling frequency of 60 ± 5 revolutions per min. Peak exercise was defined as the highest work level reached during the incremental exercise test. During testing, continuous non-invasive monitoring of heart rate and blood pressure was done (Marquette electrocardiogram system, Marquette Electronics, WI, USA). Cardiopulmonary exercise testing was performed with a metabolic cart (Oxycon Pro, Viasys, France). Continuous measurement of inspired and expired oxygen and carbon dioxide output were done with inline sensors. Peak O_2 pulse was calculated by dividing peak oxygen uptake (VO_2) by heart rate at the time of peak VO_2.

The quality of effort was assessed by the respiratory exchange ratio, i.e. maximal exercise was defined when peak respiratory exchange ratio > 1.05. Alteration of aerobic capacity was defined as a peak VO_2 < 85% of the predicted value [4]. Aerobic capacity alteration was classified as secondary to cardiac limitation if oxygen pulse (VO_2/heart rate) does not reach 110% of the predictive value in this population under beta blocker, to anemia if hemoglobin level was <12 g/dl in men and <11 g/dl in women, to ventilatory limitation in case of fall of SaO_2 ≥ 4% or SaO_2 ≤ 88% or if ventilatory reserve was <20%, to chronotropic incompetence if despite reaching a peak exercice the patient fails to achieve a maximal heart rate ≥ 80% of the predicted maximal heart rate [5]. In case of aerobic capacity limitation without those main explanations, the diagnostic of deconditioning was retained.

2.5. Quality of life

Health-related quality of life was measured using the French version of the Short-Form (SF-36) [6]. Health Survey questionnaire which is composed of 36 items that assess the following eight dimensions or scales: physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional and mental health. For each of the eight domains, scores were transformed linearly to a scale ranging from 0 (maximal impairment) to 100 (no impairment).

2.6. Statistical analysis

Continuous variables are expressed as mean ± standard deviation and categorical variables as count (percentage). Intergroup comparisons of categorical variables were performed with a chi^2 test or Fisher's exact test (when required). Student's *t*-test or Mann–Whitney were used for continuous variables. The population was divided into two groups if they have normal aerobic capacity (defined as predictive peak VO_2 ≤ 84% or their theoretical functional capacity) or not [4]. In a second analysis, a comparison of the population was made between type A and type B post aortic dissection. The threshold for a statistical significance was set at $p < 0.05$. Analyses were conducted using the SAS V9.3 statistical package.

3. Results

3.1. Global population

49.5% of patients displayed type A post aortic dissection and 50.5% of type B post aortic dissection. The baseline characteristics of the 105 included patients are presented in Table 1. The population consisted of 69.5% of male, with a mean age of 57.9 ± 12.4 years. Mean body mass index was 28 ± 5.2 kg/m^2 and mean abdominal circumference was 105 ± 15 cm. 94.2% of the population was under beta-blocker therapy, the mean treatment score (number of antihypertensive drug's taken per day) was 3.1 ± 1.3 drugs per day. The mean systolic and diastolic 24-h blood pressures were respectively 125 ± 15.4 and 72.3 ± 9.3 mm Hg. Mean haemoglobin level was 13.1 ± 1.6 g/dl and mean glomerular filtration rate was 84.2 ± 26.8 ml/mn/1.73 m^2. Biological and blood pressure data are presented in Table 2. The mean left ventricular ejection fraction was 61.6 ± 7.6%. The mean delay between aortic dissection and exercise testing was 21.9 ± 30.3 months. No serious adverse event occurred during exercise tests. One test was stopped because of ventricular tachycardia, without clinical consequence.

3.2. Aerobic capacity in post aortic dissection

The mean peak VO_2 was 19.2 ± 5.2 ml/kg/min, corresponding to 5.5 ± 1.5 METS. 34.2% of patients had normal aerobic exercise capacity defined as peak oxygen uptake upper than 85% of their theoretical capacity. Peak respiratory exchange ratio was at 1.2 ± 0.1 reflecting maximal exercises. The percentage of predictive O_2 pulse was 98.3 ± 23.6%. Data of the cardiopulmonary exercise test are summarized in the Table 3. A correlation (Spearman test) was noted between physical score on SF-36 scale and oxygen uptake at first ventilatory threshold, ($r = 0.21$, $p = 0.05$).

3.3. Patient characteristics according to aerobic capacities

The proportion of male was higher in the altered aerobic capacity group (78.3% vs 52.3%, $p = 0.007$), the abdominal circumference was higher the altered aerobic capacity group (107 +/− 16 cm vs 101 ±