# 42 - ANKLE-BRACHIAL INDEX BEHAVIOR AFTER SUBMAXIMAL EXERCISE IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE

DULCIANE NUNES PAIVA[1];
DIOGO FANFA BORDIN;
CASSIA DA LUZ GOULART;
DANNUEY MACHADO;
ANDRÉA LÚCIA GONÇALVES DA SILVA
Universidade de Santa Cruz do Sul, Santa Cruz do Sul, Rio Grande do Sul, Brasil
1-Programa de Mestrado Promoção em Saúde – PPGPS, UNISC.
dulciane@unisc.br

doi: 10.16887/85.a1.42

## INTRODUCTION

The airflow limitation is the main physiological characteristic that defines Chronic Obstructive Pulmonary Disease (COPD) and whose primary symptom is breathlessness (BOREL et al., 2013). Exercise intolerance is another consequence of COPD, which causes the adoption of a sedentary lifestyle and reduced quality of life. The continuous evaluation of these patients is critical to determine the answers to the use of exercise in pulmonary rehabilitation programs (PR) (BOREL et al, 2013; PEPIN et al., 2007).

The smoking is the main cause of COPD and can lead to a chronic inflammatory process induced lung tissue and systemic inflamation, and cause vascular endothelial cell damage via oxidative stress which may contribute to the development of atherosclerotic processes (LIN et al., 2013).

Cardiovascular diseases (CVD) are the leading causes of death worldwide, being the same chronic and secondary character to the cumulative effects of long-term (LIN, ZHANG and ZHANG, 2013). Peripheral vascular diseases are prevalent in patients with COPD, and peripheral arterial disease (PAD) has high prevalence (LIN et al., 2013), and asymptomatic high cardiovascular risk (ALZAMORA et al., 2013). PAD causes pain in the lower limb to stresse, which impairs the functional capacity and quality of life (CHENET et al., 2013).

One of the parameters used to evaluate lower blood perfusion and thus diagnose PAD is the ankle-brachial index (ABI), defined as the ratio of systolic blood lower limb (LL) (posterior tibial and dorsalispedis arteries) and upper (brachial) artery. This index allows to define and evaluate the severity of structural and functional alterations (RESNICK et al., 2004).

In healthy subjects the hemodynamic and autonomic adaptations during exercise can increase metabolic activity, cardiac output and redirection of blood flow to active muscles (LIMA; OLIVEIRA, FERREIRA, 2012). However, if these adaptations occur in COPD patients is not yet elucidated. In this sense, the present study examined the acute effect of aerobic exercise on the behavior of ABI in patients with COPD entered into a Pulmonary Rehabilitation Program.

## METHODS

These are cross-sectional study with a convenience sample that evaluated COPD patients entered into the Pulmonary Rehabilitation Program of the Santa Cruz Hospital, Santa Cruz do Sul - RS, Brazil. Project approved by the Ethics and Human Research No. 435093/2013. All subjects underwent the study signed a consent form.

Was included patients were aged 40-80 years with spirometric evidence for diagnosis of clinically stable COPD. We excluded those with musculoskeletal disorders, neurological sequelae that affected the locomotor and cognitive deficits, skin lesions in the foot region, worsening of disease in 30 prior to the study and diagnosis of lung cancer days.

Prior to the program of the exercise were measured systolic blood pressure (SBP) and diastolic blood pressure (DBP), heart rate (HR), respiratory rate (RR) and oxygen peripheral saturation (SpO2).

## PULMONARY FUNCTION

Conforms to American Thoracic Society/European Respiratory Society was evaluated the forced expiratory volume in one second (FEV1) through digital spirometry (EasyOne, model 2001, Switzerland), and its value expressed in accordance with the predicted (ATS, 2002). This variable was assessed for classification purposes of the staging of COPD.

## ANKLE-BRACHIAL INDEX

The ABIpre and ABIpost was measured with subjects in the supine position as recommended by the American Heart Association. Performed the measurement of the brachial SBP, dorsalispedis and posterior tibial arteries bilaterally through vascular portable doppler (MEDPEJ® - 2001 model, Brazil) with sphygmomanometer placed 03 cm above the cubital fossa in the upper limbs (UP) and 03 cm above the medial malleolus in LL (Figure 1). After verification of the measures, the calculation was performed by dividing the higher of the LL (SBPll) the higher of the upper limbs (SBPup) to calculate the overall ABI (ABIgeneral= SBPll/ SBPup) (ABOYANS et al., 2012). The COPD patients evaluated were classified as Kim, Wattanakit and Gornik (2012), with an index 1.00 to 1.40 is considered normal, borderline 0.91 to 0.99 and less than 0.90 DAP.

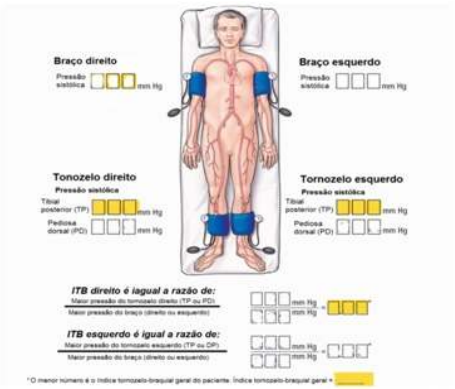


Figure 1 - Measurement and calculation Ankle Brachial Index. Adapted from Kim, Wattanakit and Gornik, 2012.

**CYCLE ERGOMETER EXERCISE**

The exercise protocol was recommended by the GOLD (2009), submaximal aerobic training was implemented for 30-40 minutes through the vertical cycle ergometer for LL (BM3500 PRO Movement Technology, Brazil) with an initial intensity of 60% HR determined by the Karvonen method modified for HR reserve (BUSCHMANN et al., 2013). This intervention was limited by symptoms of patients for the presence of dyspnea and / or stressful effort in LL, determined by the Scale of Perceived Exertion Borg and Borg Scale - Modified Dyspnea (BECKER et al., 2014;. OGA et al., 2012. ).

Data were analyzed using SPSS (version 20.0) software. Analysis of normality of the data analyzed using the Shapiro-Wilk test and expressed infrequence or median and interquartile ranges (25-75). Intergroup comparison carried out by the Wilcoxon test ($p < 0.05$).

**RESULTS**

We accessed 19 patients, of which 06 were classified as having DAP. Sample of 06 PAD patients was evaluated, 03 were male and the median age of 64 (58-70) years and BMI of 22 (20-27) kg/m2. Table 1 shows the anthropometric characteristics, vital signs and lung function of patients analyzed can be observed. The median time from inclusion in the PR program was 03 years.The stage of COPD according to GOLD (2014) were grade II and IV, with the same certificate from median values of FEV1 of 51.5% (23,5- 73.7) as a percentage of predicted.

Table 1 – Anthropometric, vital signs and lung function assessed sample characterization.

| Variables | n= 06 |
|---|---|
| Gender, male | 03 (50.0%) |
| Age (years) | 64 (58.25 – 70.50) |
| $FEV_1$ (%) | 51,50 (23.50 – 73.75) |
| Height (cm) | 1,68 (1.57 – 1.75) |
| Weight (Kg) | 70,50 (52.50 – 74.25) |
| BMI* ($Kg/cm^2$) | 22,52 (20.01 – 2719) |
| SBP (mmHg) | 120 (117,50 – 132,50) |
| DBP (mmHg) | 80 (77,50 – 82,50) |
| HR (bpm) | 67 (65,50 – 93,75) |
| $SPO_2$ (%) | 97 (93,25 – 98,00) |
| RR (irpm) | 19 (17,75 – 19,25) |

BMI: Body Mass Index; Data expressed as frequency, median, interquartile range, ranking second BMI Cuppari et al. (2002). FEV1: Forced Expiratory Volume in the first second (FEV1); SBP: systolic blood pressure; DBP: diastolic blood pressure; HR: heart rate; SpO2: oxygen peripheral saturation; RR: respiratory rate.

Regarding the classification of ABI found in our sample, the total sample studied, 31% were classified as normal, 37% as borderline and 32% as having PAD. Showed a significant difference between the ABIpreandABIpost and exercise in anvertical cycle ergometer, with the median of the pre-exercise ABI of 0.87 (0.79 to 0.90) and post-exercise ABI of 0.95 (0.88 -1.02) (Figure 2).

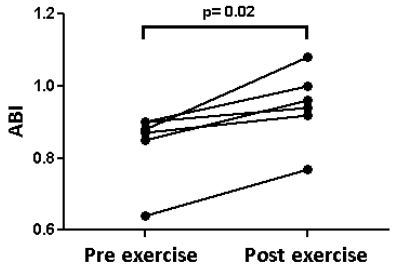


Figure 2 - Behavior Ankle Brachial Index in pre- and post-exercise conditions.

**DISCUSSION**

The results of our study indicate that COPD patients with PAD showed acutely improves peripheral arterial vascularization after exercise on a cycle ergometer translated by increasing the ABI.

A study in France found a high presence of PAD in 81.4% of COPD patients compared to 30-40% in studies conducted in Israel and Spain, respectively. However, to date there are no published studies on the prevalence of PAD in patients with COPD in Brazil (LIN et al., 2013). In our study, 31% of COPD patients evaluated had PAD diagnosed by ABI.

Age is also another factor related to PAD and it is estimated that almost 20% of people over 70 have high predisposition to develop such diseases. In the UK, the number of people aged 65 and older is expected to increase by 10 times the overall rate of population growth over the next 40 years, which means that the prevalence of PAD and its sequelae may increase (ZWIERSKA et al., 2006). In the present study, the median age of the sample assessed in our study was 64 years.

In this aspect, the heart and blood physiological parameters can be measured from the body surface by means of non-invasive tests, and can be used to identify mechanisms of the cardiovascular system, including blood pressure (LIN, ZHANG and ZHANG, 2013).The ABI evaluation allows to detect structural and functional alterations of the blood vessel being used to identify peripheral vascular disease (RESNICK et al., 2004).

An ABI > 1.0 is considered normal, ITB of 0.5 to 0.9 is indicative of impairment of a single arterial segment and the ABI of 0.5 is indicative of arterial impairment or serious injury to various arterial segments (BLUM; SIMSOLO; SIRCHAN, 2013; LEE et al., 2011). Despite controversies about which limit the ABI should be used to diagnose PAD, the ABI threshold most commonly used is ≤ 0.90, based on studies that reported 90% sensitivity and specificity to detect PAD in comparison with the angiographic examination. Ideal for identifying patients with PAD cutting depends on the pre-test probability of PAD, which in turn is based on various clinical parameters, including the presence, characteristics and intensity of symptoms, presence of cardiovascular risk factors and other information derived from the clinical history and physical examination (ABOYANS et al., 2012).

Accordingly, in our study patients with PAD showed high median ABI of 0.87 before performing cycle ergometer exercise and after it, showed an ABI of 0.95 which ranked them as borderline. These results indicate an improvement of acute peripheral arterial vascularization after exercise, a fact evidenced by the increase of ABI.

The sensitivity of the ABI can be significantly increased when the measurement is made immediately after exercise. In the case of PAD occlusive moderate pressure decreases more in the ankle during exercise on the treadmill, compared to healthy individuals without PAD. Still, the recovery time of blood pressure after cessation of exercise, for the values of pre-set rest before exercise is prolonged and proportional to the severity of PAD (ABOYANS et al., 2012).

It is emphasized that currently, the ABI has been used both for screening and for diagnosis of PAD, obtaining high sensitivity (79% to 95%) and specificity (95% to 96%). However, despite the ITB be a prognostic marker for cardiovascular events and disability, even in the absence of symptoms of PAD, the use of this within the Pulmonary Rehabilitation Program for determination of PAD, mortality risk stratification and therapeutic management of COPD is still underestimated.

**CONCLUSION**

Our study found presence of PAD in patients with COPD rehabilitated. The submaximal aerobic exercise in an vertical cycle ergometer resulted in greater translated peripheral blood flow by increasing the ABI. However, it is necessary to continue the study for higher extrapolation of the results.

**SUPPORT AND FUNDING**

DECIT/SCTIE-MS/FAPERGS/CNPq 1264-2551/13-1 and Hospital Santa Cruz.

**REFERENCES**

ABOYANS, V.CRIQUI, M. H. ABRAHAM, P.et al. Measurement and interpretation of the ankle-brachial index: A scientific statement from the Americam Heart Association. CirculationJournaloftheAmerica Heart Association, v.126, n. 24, p. 2890-2909, 2012.

ALZAMORA, M. T. FORÉS, R. PERA,G. et al. Ankle-brachial index and the incidence of cardiovascular events in the Mediterranean low cardiovascular risk population ARTPER cohor.BMCCardiovascularDisorders,v. 13,n. 119, p. 13, 2013.

American Thoracic Society/European Respiratory S. ATS/ERS Statement on respiratory muscle testing. Am J RespirCrit Care Med. 26: 319–338, 2005.

BOREL, B. PROVENCHER, S. SAEY,D. et al. Responsiveness of various exercise-testing protocols to therapeutic interventions in COPD.PulmonaryMedicine, DOI: 10.1155/2013/410748, 2013.

BLUM, A. SIMSOLO,C. SIRCHAN,R. Vascular responsiveness in patients with chronic obstructive pulmonary disease (COPD).European Journal of Internal Medicine, http://dx.doi.org/10.1016/j.ejim.2013.03.017, 2013.

BUSCHMANN, I. D. et al. Programming exercise intensity inpatients on beta-blocker treatment: the importance of choosing anappropriate method. European Journal of Preventive Cardiology, DOI: 10.1177/2047487313500214, 2013.

CHEN, Q. et al. Disease location is associated with survival in patients with peripheral arterial disease. Journalofthe American Heart Association, DOI: 10.1161/JAHA.113.000304, 2013.

GRINBERG, M. ACCORSI, U.T. Estenose aórtica no idoso: perspectiva brasileira.ArquivoBrasileirodeCardiologia, v. 92, n. 2, p. 36-39,2009.

KIM, E.H. WATTANAKIT, K. GORNIK, H.L. Using the ankle-brachial index to diagnose peripheral artery disease and assess cardiovascular risk. Cleveland Clinic Journal of Medicine, v.79, n.9, p.651-61 2012.

LEE, Y. H. SHIN, M. H. KWEON, S. S. et al. Cumulative smoking exposure, duration of smoking cessation, and peripheral arterial disease in middle-aged and older Korean men. BMC PublicHealth,doi:10.1186/1471-2458-11-94, 2011.

LIMA, J. R. P.OLIVEIRA,T. P. FERREIRA, J. Recuperação autonômica cardíaca pós-exercício: Revisão dosmecanismos autonômicos envolvidos e relevância clínica e desportiva. Motricidade, v. 8, n. 2, p. 419-430, 2012.

LIN, M. S. HSU, K. Y. CHEN, Y. J. et al. Prevalence and risk factors of asymptomatic peripheral arterial disease in patients with COPD in Taiwan.Plos One,DOI:10.1371/journal.pone.0064714, 2013.

LIN, W. H. ZHANG, H. ZHANG, Y.T. Investigation on cardiovascular risk prediction using physiological parameters.Computational and Mathematical Methods in Medicine, DOI: 10.1155/2013/272691,2013.

PEPIN,V. SAEY, D. LAVIOLETTE, L. et al. Exercise capacity in chronic obstructive pulmonary disease: mechanisms of limitation. JournalofChronicObstructivePulmonaryDisease,v. 4, n. 3, p. 195–204, 2007.

RESNICK, H.E. LINDSAY, R. S.McDERMOTT, M. M. et al. Relationship of high and low ankle brachial index to all-cause and cardiovascular disease mortality: the strong heart study.Circulation, v. 109, n. 6, p. 733–739, 2004.

ZWIERSKA, I. WALKER, R.D. CHOKSY, S. A.et al. Relative tolerance to upper- and lower-limb aerobic exercise in patients with peripheral arterial disease.Eur J VascEndovascSurg, v. 31, n. 2, p. 157-63, 2006.

Rua Conselheiro Trockel, 408, casa 02, Bairro Verena
Santa Cruz do Sul, RS, CEP: 96820510.

**ANKLE-BRACHIAL INDEX BEHAVIOR AFTER SUBMAXIMAL EXERCISE IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE**

**ABSTRACT**

Chronic obstructive (COPD) Pulmonary Disease presents inflammatory profile and may result in progressive peripheral arterial disease (PAD), as the Ankle-Brachial Index (ABI) allows the measurement of blood flow in the lower limbs (MI). Objective is to evaluate the ABI before (ABIpre) and after (ABIpost) vertical cycle ergometer exercise in COPD patients participating in the Pulmonary Rehabilitation Program with PAD. The ABI was accessed by measuring systolic blood pressure (SBP) of the ankle and brachial SBP bilaterally through sphygmomanometer and Doppler Vascular Laptop. Measurements taken before and after submaximal for 30-40 minutes through vertical cycle ergometer for MI with 60% of FC determined by the Karvonen method modified for FC reserve aerobic exercise. Evaluated 06 patients with a median age of 64 (58-70) years and BMI 22 (20-27) kg/m2. Showed a significant difference between the ABIpre and ABIpost vertical cycle ergometer exercise in patients evaluated (ABIpre: 0.84; ABIpost 0.94; p = 0.007). The results indicate that COPD patients with PAD showed acute improvement of peripheral arterial vascularization after exercise, this finding being translated by an increase Ankle Brachial Index.

**KEYWORDS:** COPD, peripheral artery disease, rehabilitation.

**COMPORTEMENT INDICE CHEVILLE-BRAS SUBMAXIMAL APRÈS EXERCICE CHEZ LES PATIENTS SOUFFRANT DE CHRONIQUES MALADIE PULMONAIRE OBSTRUCTIVE**

**RÉSUMÉ**

Obstructive chroniqueMaladiePulmonaire (MPOC) présente unprofilinflammatoirepeuten traîner unemaladieartériellepériphérique (MAP). Index cheville-bras (ICB) permet la mesure de la circulation sanguine dans les membresinférieurs (MI).L'objectifestd'évaluer ICB avant (ITBpre) et après (ITBpos) vertical exerciceergomètre chez les patients atteints de MPOC, dans le programme de réadaptationpulmonaire avec MAP. ICB a étéévaluéepar la mesure de la pressionartériellesystolique (PAS) de la chevilleet brachial SBP bilatéralement par sphygmomanomètre et Doppler vasculaire portable. Mesures prises avant etaprèssubmaximal pendant 30-40 minutes par ergomètre vertical pour MI avec 60% de FC déterminée par laméthodeKarvonenmodifiépourréserve FC exerciceaérobie. Évalué 06 patientsavecunâgemédian de 64 (58-70) ansetl'IMC 22 (20-27) kg/m2. Montré une différencesignificative entre leITBpre et ITBposergomètreverticaleexercice chez lespatientsévalués (ITBpre: 0,84; ITBpos 0,94; p = 0,007). Lesrésultatsindiquent que lespatientsatteints de BPCO avecMAPontmontré une améliorationaiguë de lavascularisationartériellepériphériqueaprèsl'exercice, ceconstattraduit par une augmentation de lachevilleindicebrachial.

**MOTS-CLÉS:** BPCO, maladieartériellepériphérique, réhabiltation

**COMPORTAMIENTO DEL ÍNDICE BRAQUIAL DEL TOBILLO DESPUÉS DEL EJERCICIO SUBMÁXIMA EN PACIENTES CON ENFERMEDAD PULMONAR OBSTRUCTIVA CRÓNICA**

**RESUMEN**

Obstructiva crónica (EPOC) Enfermedad Pulmonar presenta perfil inflamatoriopuede resultar enlaenfermedad arterial periférica (EAP). A medida que el índice tobillo-brazo (ITB) permite lamediciónde lflujo sanguíneo enlosmiembros inferiores (MI). El objetivoesevaluarla ITB antes (ITBpre) y después (ITBpos) ejercicio ergométrica vertical enlos pacientes con EPOC que participanenel Programa de Rehabilitación Pulmonar conEAP.El ITB se evaluó mediante lamedición de lapresión arterial sistólica (PAS) deltobillo y la PAS braquial bilateral mediante esfigmomanómetro y Doppler Vascular portátil. Lasmediciones tomadas antes y después de submáxima durante 30-40 minutos a través de ergómetro vertical para MI con 60% de FC determinado por el método de Karvonen modificado para elejercicio aeróbico FC reserva. Evaluado 06 pacientes con una mediana de edad de 64 (58-70)años y el IMC de 22 (20-27) kg/m2. Mostraron una diferencia significativa entre elITBpre y ITBposejercicio ergométrica vertical enlospacientes evaluados (ITBpre: 0,84; ITBpos 0,94; p = 0,007). Los resultados indican que los pacientes con EPOC conEAPmostraron una mejoría aguda de lavascularización arterial periférica despuésdelejercicio, este hallazgo se traduce por un aumento de la altura deltobillo Índice braquial.

**PALABRAS CLAVE:** EPOC, enfermedad arterial periférica, de rehabilitación.

**COMPORTAMENTO DO ÍNDICE TORNOZELO-BRAQUIAL APÓS EXERCÍCIO SUBMÁXIMO EM PORTADORES DE DOENÇA PULMONAR OBSTRUTIVA CRÔNICA**

**RESUMO**

A Doença Pulmonar Obstrutiva Crônica (DPOC) apresenta perfil inflamatório progressivo podendo resultar em doença arterial periférica (DAP). A medida do Índice Tornozelo-Braquial (ITB) permite a medida do fluxo arterial nos membros inferiores (MI). Objetiva-se avaliar o ITB antes (ITBpre) e após (ITBpos) exercício em cicloergômetro vertical em portadores de DPOC participantes de Programa de Reabilitação Pulmonar com DAP. O ITB foi avaliado através da medida da pressão arterial sistólica (PAS) dos tornozelos e da PAS braquial bilateralmente através de esfigmomanômetro e Doppler Vascular Portátil. Medidas realizadas antes e após exercício aeróbico submáximo por 30-40 minutos através de cicloergômetro vertical para MI com intensidade de 60% da FC determinada pelo método Karvonen modificado para FC de reserva. Avaliados 06 pacientes com mediana de idade de 64 (58-70) anos e IMC de 22 (20-27) Kg/m2. Constatou-se diferença significante entre o ITBpre e ITBpos exercício em cicloergômetro vertical nos pacientes avaliados (ITBpre: 0,84; ITBpos 0,94; p = 0,007). Os resultados indicam que portadores de DPOC com DAP apresentaram melhora aguda da vascularização arterial periférica após o exercício, sendo tal achado traduzido pelo aumento do Índice Tornozelo Braquial.

**PALAVRAS-CHAVE:** DPOC, arteriopatia periférica, reabilitação.