

Identification of diagnostic maneuvers positive for arterial compression in symptomatic or asymptomatic individuals who engage in regular weight training

Identificação de manobras semiológicas positivas para a compressão arterial em indivíduos sintomáticos e assintomáticos que realizam regularmente musculação

Andreza Lamônica¹, Carlos Alberto Engelhorn¹, Nehru Barcos Balbino¹, Ana Luiza Dias Valiente Engelhorn¹

Abstract

Background: Arterial compression syndromes can be identified in asymptomatic individuals using specific diagnostic maneuvers involving palpation of peripheral pulses. **Objective:** To identify diagnostic maneuvers positive for extrinsic compression in the upper and lower limbs of people who exercise regularly. **Methods:** The sample consisted of people over 18 years old who had been attending a gym for a minimum of 1 hour per week and for at least 1 month. A data collection instrument comprising 20 questions was administered to the study participants, covering personal characteristics, the types of exercises engaged in and possible symptoms. The Adson, Hyperabduction and Costoclavicular maneuvers and also tests to reveal popliteal artery entrapment were performed. Data from the questionnaires and the maneuver results were analyzed using SPSS v.20.0. **Results:** The study enrolled 202 volunteers who attended the gyms investigated, comprising 98 women and 104 men aged 18 to 63 (mean of 27 years). One hundred and seventy (84.2%) subjects were asymptomatic and 32 (15.8%) people reported some type of discomfort such as pain, paresthesia or a cool sensation. Ninety of the 202 individuals analyzed (44.6%) exhibited at least one positive maneuver. Total numbers of compressions per subject were as follows: two people (1%) had four positive maneuvers; 19 (9.4%) had three positive maneuvers; 31 (15.3%) had two positive maneuvers, 38 (18.8%) exhibited one positive maneuver and 112 (55.4%) people were positive for none of the maneuvers. The hyperabduction maneuver was the most prevalent maneuver. **Conclusion:** Diagnostic maneuvers positive for extrinsic arterial compression were identified in 44.6% of the asymptomatic individuals analyzed.

Keywords: thoracic outlet; popliteal artery entrapment; arterial compression.

Resumo

Contexto: As síndromes compressivas arteriais podem ser identificadas em indivíduos assintomáticos por manobras semiológicas específicas, com a palpação dos pulsos periféricos. **Objetivo:** Identificar manobras semiológicas positivas para compressão extrínseca em membros superiores e inferiores em indivíduos que realizam regularmente musculação. **Métodos:** a amostra consistiu de pessoas maiores de 18 anos que frequentaram, por pelo menos um mês, no mínimo uma hora por semana, a academia. Os participantes da pesquisa preencheram um questionário de 20 questões que abordava características pessoais, exercícios praticados e eventuais sintomas. Foram realizadas as manobras de Adson, Hiperabdução, Costoclavicular e para aprisionamento da artéria poplítea. Os resultados dos questionários e das manobras realizadas foram avaliados com o programa computacional SPSS v.20.0. **Resultados:** foram incluídos no estudo 202 voluntários que frequentaram as academias escolhidas, sendo 98 mulheres e 104 homens, com idade entre 18 e 63 anos (média de 27 anos). Cento e setenta (84,2%) indivíduos eram assintomáticos e 32 (15,8%) referiram algum tipo de desconforto, como dor, sensação de esfriamento ou parestesia. Dos 202 indivíduos avaliados, 90 (44,6%) apresentaram alguma das manobras positivas. Com relação ao número de compressões, dois indivíduos (1%) apresentaram quatro manobras positivas; 19 (9,4%), três manobras; 31 (15,3%), duas manobras; 38 (18,8%), uma manobra, e 112 (55,4%), nenhuma. A manobra de hiperabdução foi a mais prevalente dentre as manobras realizadas. **Conclusão:** foram identificadas manobras semiológicas positivas para compressão extrínseca arterial em 44,6% dos indivíduos assintomáticos avaliados.

Palavras-chave: desfiladeiro torácico; aprisionamento da artéria poplítea; compressão arterial.

¹Pontifícia Universidade Católica do Paraná – PUCPR, Curitiba, PR, Brazil.

Financial support: None.

Conflicts of interest: No conflicts of interest declared concerning the publication of this article.

Submitted: June 08, 2014. Accepted: October 23, 2014.

The study was carried out at Pontifícia Universidade Católica do Paraná and at the following gyms: Fitness Center (downtown Curitiba), Academia da PUC (located in the university premises), and Fit. time (downtown Curitiba).

■ INTRODUCTION

Thoracic Outlet Syndrome (TOS) and Popliteal Artery Entrapment Syndrome (PAES) are conditions in which extrinsic compression of arteries is caused by anatomic variants, muscular hypertrophy or postural abnormalities.^{1,2}

As a result of the population's growing tendency to frequent gyms and engage in weight training and resistance exercises, muscular hypertrophy is not just inevitable, but is often the desired result. Irrespective of whether there are also anatomic variants present, muscular hypertrophy can result in the phenomenon of vessel compression, with the possibility of risk of vascular complications.

The most common manifestations of TOS are the neurological symptoms such as pain and paresthesia that are triggered by positions that compress the neurovascular bundle at the exit from the thorax (95%). Arterial complications are less common (2-3% of cases), but are more serious and can lead to acute arterial occlusion and even loss of the affected limb. The presence of normal arterial pulses at rest does not rule out the existence of arterial compression; which is why it is important to conduct diagnostic maneuvers to identify compression with a view to prevention of complications.¹⁻³

The maneuvers used to detect the arterial compressions involved in TOS are the Hyperabduction maneuver, or Wright's test, (subcoracoid tunnel or retropectoralis space), the Adson test (interscalene triangle) and the Costoclavicular interval maneuver (between the clavicle and the first rib); however, none of these tests have been accepted as the gold standard for diagnosis and they offer 53% mean specificity and 72% mean sensitivity.^{2,4}

Although patients with positive maneuver results do not always develop the disease, it is believed that for the syndrome to occur, in addition to the anatomic narrowing, some degree of repetitive trauma is also required for the symptoms to develop and this may occur during regular exercise at gyms.^{3,4}

In the lower limbs, PAES may be the result of anatomic variants in arterial and/or venous trajectories, of abnormal insertion of the gastrocnemius muscles into the medial condyle of the femur, or of muscular hypertrophy (the functional form).

If left untreated, PAES can leave the patient incapacitated for sport and can cause arterial thrombosis with acute arterial occlusion or distal embolism; which why early diagnosis is so important.

The objective of this study was to identify diagnostic maneuvers that are positive for extrinsic

arterial compression in the upper and lower limbs of people who regularly engage in body building, in addition to identifying which of the maneuvers is the most prevalent.

■ METHODS

The sample comprised volunteers who regularly attended a gym in the Brazilian city of Curitiba, Paraná, for weight training and/or aerobic exercises. Inclusion criteria were as follows: people over the age of 18 years, of either sex, who had been attending the gym for a minimum of 1 hour per week for at least 1 month and who agreed to sign a free and informed consent form. Exclusion criteria were: incomplete completion of the patient details questionnaire or refusal to perform any of the maneuvers.

Since this was a cross-sectional study, the examiners only assessed the volunteers at the time of data collection and enrollment on the study and there was no prior assessment. No additional variables, such as daily posture or profession, were taken into account for data analysis.

Data on the study population were acquired using a questionnaire-based data collection instrument (Appendix 1) comprising 20 objective questions that was administered after signature of the free and informed consent form. The questions covered H, sex, weight, height, profession, time attending the gym and hours per week spent training and the specific type of exercise engaged in (weight training, aerobic exercises, or both).

Subjects were also asked whether they experienced any type of discomfort during or after performing any specific exercises, such as, for example pain, coldness, tingling or altered sensitivity in the extremities.

The instrument was administered either by supervised self-completion or during structured interviews to people who regularly attended three gyms in the city of Curitiba, Paraná, and gave consent to taking part in research. After administration of the questionnaire the researchers conducted the diagnostic maneuvers, specifically: the Hyperabduction (M1), Adson (M2), Costoclavicular (M3), Dorsiflexion (M4) and Plantar Flexion (M5) maneuvers. These maneuvers were standardized by two examiners.

The study was approved by the Research Ethics Committee at PUCPR under protocol number 9308.

Maneuvers employed to screen for TOS were the Hyperabduction (M1), Adson (M2) and Costoclavicular (M3) maneuvers, with monitoring of the radial artery pulse during maneuvers (Figures 1, 2 and 3).



Figure 1. Hyperabduction maneuver (M1).



Figure 2. Adson maneuver (M2).

The popliteal artery entrapment tests consisted of taking distal pulses (pedal and posterior tibial) by palpation at rest and then with active and forced dorsiflexion (Maneuver M4) and plantar flexion (Maneuver M5) of the feet. The maneuvers are considered positive if the pulses are present at rest and absent during the movement (Figures 4 and 5).

Although a minimum period of attending the gym was stipulated, no tests were conducted to confirm whether or not hypertrophy had taken place and so no analysis was conducted of differences in muscle volume gain during the time the subjects had been attending the gyms.

While presence of symptoms was covered in the questionnaire, the objective of this study was to screen for positive diagnostic maneuvers suggestive of arterial compression in regular gym attendees, and there was no intention to attempt to correlate symptoms with positive maneuvers.

The study results are presented in the form of means, medians, ranges and standard deviations (quantitative variables) or as frequencies and percentages (qualitative variables). Fisher's exact test or the chi-square test were used to test for associations between qualitative



Figure 3. Costoclavicular maneuver (M3).



Figure 4. Dorsiflexion maneuver (M4).



Figure 5. Plantar flexion maneuver (M5).

variables and presence of compression. Groups defined by presence or absence of compression were compared in terms of the quantitative variables using Student's *t* test for independent samples or the Mann-Whitney nonparametric test. Multivariate analysis was conducted by constructing a logistic regression model taking compression as the dependent variable and variables that exhibited significance in the univariate analysis as explanatory variables. Values of $p < 0.05$ indicate statistical significance. Data were analyzed using the SPSS v.20.0 computer program.

■ RESULTS

Population and symptomology

A total of 202 volunteers who regularly attend the gyms investigated were enrolled, comprising 98 women and 104 men aged from 18 to 63 years (mean of 27 years). A total of 37 individuals were excluded because they were under 18, because they had started attending the gym less than 1 month previously

or because they did not agree to sign the free and informed consent form. Those who were enrolled had been attending the gym for periods that ranged from 1 month to 30 years (mean of 3.0 ± 4.2 years).

A total of 82 (40.6%) of the 202 individuals assessed were students and the majority (41.6%) spent from 4 to 6 hours per week at the gym; 68 (33.7%), spent 6 hours; 26 (12.9%) less than 2 hours, and 24 (11.9%) subjects spent from 2 to 4 hours at the gym per week.

In response to the item on which muscle groups they exercised at the gym, 127 people (62.9%) reported that they worked all muscle groups during the week's training, and 189 people (93.6%) reported they had direct supervision by a professional while conducting their physical exercises.

The samples' body mass indexes (BMI) ranged from 17.1 to 35.2 (mean of 23.7 and median of 23.5 ± 3.2), and the types of exercises they performed broke down as follows: 2.5% (5) only performed aerobic exercises, 31.7% (64) only engaged in weight training, and 65.8% (133) did both weight training and aerobics. Weight training was therefore a prevalent response, with 97.5% of the sample, whether in isolation or in combination with aerobic activities.

In response to the items on symptoms while engaging in physical activity, 170 individuals (84.2%) reported having no symptoms and 32 (15.8%) reported some type of complaint. Of the latter, 14 (43.8%) reported pain or sensations of coldness in the left lower limb; 14 (43.8%) in the right lower limb; 14 (43.8%) in the left upper limb, and 15 (46.9%) reported symptoms in the right upper limb. Additionally, 22 individuals (10.9%) reported paresthesia, predominantly affecting the right lower limb (54.5%), followed by the left lower limb (50%), the left upper limb (36.4%) and the right upper limb (45.5%).

Diagnostic maneuvers

Ninety of the 202 individuals assessed (44.6%) exhibited at least one positive maneuver. With regard to the number of compressions, two individuals (1%) exhibited four positive maneuvers; 19 (9.4%) exhibited three positive maneuvers; 31 (15.3%), two positive maneuvers; 38 (18.8%), one positive maneuver, and 112 (55.4%) exhibited no positive maneuvers whatsoever. The most prevalent of the five maneuvers was hyperabduction (M1).

Hyperabduction maneuver (M1)

Fifty-three of the 202 individuals assessed (26.2%) exhibited a positive hyperabduction maneuver, of whom one person (1.9%) exhibited an absent pulse with the arm abducted less than 90° , 18 (34%) with

the arm at 90° and 34 (64.1%) with the arm abducted beyond 90°. The left side was most often involved, with 32 individuals (60.4%); while 7 people (13.2%) exhibited a right-side positive maneuver and 14 (26.4%) were positive for both left and right.

Table 1 lists the p values for the results of the statistical tests and the estimated odds ratios (OR) with their respective 95% confidence intervals, showing that, irrespective of the variables sex, hours spent training, pain/coldness or muscle groups trained, age is a factor that is significantly associated with M1 compression (p=0.033). Each extra year of age is associated with a 4% increase in the OR in favor of M1 compression.

A relationship was also observed indicating that pain/coldness in any limb (Q9) tended to be associated with M1 compression (p=0.074).

Adson's maneuver (M2)

Forty-eight of the 202 individuals assessed (23.8%) exhibited a positive Adson maneuver, 26 on the left side (54.2%), 12 on both sides (25%) and ten on the right side (20.8%).

Since none of the variables, with the exception of exercising the arm and forearm most, exhibited statistical significance in the univariate analysis, no multivariate model was constructed (Table 2).

Costoclavicular maneuver (M3)

Forty-two of the 202 individuals assessed (20.8%) exhibited absence or reduction of the arterial pulse when they performed this movement, mentioned earlier. The left side was most involved, with

20 individuals (47.6%) affected, while 18 exhibited bilateral compression (42.9%) and four had right-side compression (9.5%).

Since none of the variables, with the exception of age, exhibited statistical significance in the univariate analysis, no multivariate model was constructed (Table 3).

Table 3 shows that mean age was higher (32.6 years) among individuals who exhibited a positive M3 maneuver, with statistical significance (p= 0.02) in favor of compression.

Foot dorsiflexion maneuver (M4)

Fourteen of the 202 individuals assessed (6.9%) exhibited a positive M4 maneuver, ten bilaterally (71.4%), two only on the right (14.3%) and two on the left only (14.3%).

Since none of the variables, with the exception of exercising the thighs and legs most, exhibited statistical significance in the univariate analysis, no multivariate model was constructed (Table 4).

Plantar flexion maneuver (M5)

Eleven of the 202 individuals assessed (5.4%) exhibited this maneuver, eight of whom were bilateral (72.7%), one right-side (9.1%) and two of whom were left-side positive (18.2%).

Since none of the variables exhibited statistical significance in the univariate analysis, no multivariate model was constructed.

DISCUSSION

The etiopathogenesis of thoracic outlet syndrome is determined by the following characteristics: individual anatomy; habitual poor posture; accentuated physical activities; professions that overload the upper limbs; voluminous mammaries, and longilineal biotype.^{5,6}

In TOS, the vascular and nervous involvement is of multifactorial origin and although engaging in weight training may be an aggravating risk factor when

Table 1. Analysis in conjunction of factors associated with the hyperabduction maneuver.

VARIABLE	p	OR (95%CI)
AGE	0.033	1.04(1.00-1.07)
SEX	0.155	1.78 (0.80- 3.92)
Q7		
2h or less (ref)		
2-4h	0.103	3.36 (0.78- 14.44)
4-6h	0.874	1.11 (0.30- 4.09)
More than 6h	0.188	2.39 (0.65- 8.76)
Q9	0.074	2.03 (0.92-2.20)
Q17		
Arms/forearms (ref)		
Upper/lower alt. days*	0.443	0.46 (0.06-3.32)
All groups regularly	0.303	0.39 (0.07- 2.33)
Gluteal muscles/thighs/legs	0.082	0.14 (0.01-1.28)

Q7: Responses to question 7 – “How many hours per week do you train at the gym?”, Q9: responses to question 9 - “Do you feel pain or a sensation of coldness in your arms or legs during or after any exercise?”, and Q17: responses to question 17 - “Which muscle groups do you exercise most?”. For the purposes of this study, significant p values are lower than 0.05. *Upper limbs one day and lower limbs the next.

Table 2. Relationship between choosing response C to question 17 and a positive M2 maneuver.

M2	1 (YES)	2 (NO)
POSITIVE	4 66.67%	43 21.4%
NEGATIVE	2 33.33%	153 78.06%
TOTAL	6	196

p= 0.027

Question 17 is “Which muscle groups do you exercise most?” and response C indicates that subjects exercised their upper arms and forearms more than the other muscle groups.

Table 3. Relationship between age and a positive costoclavicular maneuver.

	M3	n	Mean	Median	Minimum	Maximum	Standard deviation	p
AGE	Positive	41	32.6	28.0	18.0	63.0	12.9	0.002
	Negative	161	25.8	24.0	18.0	61.0	7.9	

Individuals with a positive M3 maneuver were older.

Table 4. Relationship between choosing response A to question 17 and a positive M4 maneuver.

M4	1 (YES)	2 (NO)
POSITIVE	3 30.00%	11 5.73%
NEGATIVE	7 70.00%	181 94.27%
TOTAL	10	192

p= 0.024.

The p value of 0.024 demonstrates a relationship between individuals with a positive (M4) maneuver and exercising the musculature of the lower limbs most.

combined with other factors, it was not the objective of this study to investigate the relationship between muscular hypertrophy and positive maneuvers. Rather, the primary objective was to evaluate the prevalence of positive maneuvers in a population potentially at risk of vascular complications, due to frequent exercise and, as such, is a warning that should be heeded by professionals who work at gyms.

With age, as the shoulders drop the pectoral girdle tends to narrow the space through which the neurovascular bundle passes, thereby making compression of these structures more likely, particularly among women. The results provide evidence in support of this, showing a proportional relationship between increasing age and the positive maneuver. For each additional year of age, there was a 4% increase in OR in favor of M1 compression.^{5,6}

A tendency was also observed for people exhibiting a positive M1 maneuver to report pain/coldness in the limb. This could be an indication suggesting that repetitive arterial compression truly can cause symptoms, but since these subjects did not undergo clinical assessments prior to starting to frequent the gym, this cannot be confirmed.

Published studies that have investigated the pectoralis minor syndrome by screening with the hyperabduction or Wright maneuvers have reported it as a rare form of compression; however, in this study it was the most commonly detected maneuver of those investigated.^{2,3}

People who trained their upper limbs (arm and forearm) more than other muscle groups most often exhibited a positive M2 (Adson) maneuver. Muscular

hypertrophy is one possible explanation for the presence of compression.^{1,2}

The results for the costoclavicular (M3) maneuver showed that age was the only variable associated and the mean age of people with compression was greater than the mean age of people free from the condition. This can be explained by lowering of the pectoral girdle due to hypotonia of the suspending muscles: the trapezius, levator scapulae and rhomboid, that can take place during the aging process. Additionally, hypotonia of the rectus abdominus raises the rib cage, approximating the first rib towards the clavicle.^{3,4}

Individuals who engage in weight training and exhibit one of the positive maneuvers for TOS may also exhibit other maneuvers associated with the syndrome, since if muscular hypertrophy is present it may compress adjacent structures during other maneuvers. The costoclavicular interval is also smaller during hyperabduction and hyperextension of the head, showing that the maneuvers are not so specific to each syndrome as was classically described and that there may be interconnections between them, since a given structure may have an influence on more than one maneuver.

It should also be taken into consideration that normal individuals can exhibit positive maneuvers, such as the interscalene maneuver (M2). The importance of this fact is that these asymptomatic people with positive maneuvers should be instructed not to engage in repetitive exercises with loads, such as weight training, which reduce even further the space afforded by the thoracic outlet, since they may exhibit symptoms with potential complications in the future.^{4,7,8}

The other condition investigated in this study was Popliteal Artery Entrapment Syndrome (PAES), which is an uncommon anatomic abnormality that can provoke intermittent claudication in young people who do not have cardiovascular risk factors.

There are several classifications for categorizing anatomical variants of the popliteal fossa. The most widely used classification is one proposed by Delaney and Gonzales with descriptions by Rich and Hughes, and Levien and Veller: Type I - medial dislocation of the popliteal artery with normal gastrocnemius muscle insertion; Type II - the artery follows a normal path and the tendon of the gastrocnemius muscle is inserted more laterally to the internal condyle of the

femur; Type III - arterial compression is caused by the popliteal muscle; Type IV - arterial compression at the popliteal vein, and Type V - functional compression in which arterial and venous compression is caused by anatomically normal, but hypertrophied, muscles. According to studies by Almeida et al., the functional form of the disease is more common than the anatomic form.^{1,5-7}

The only variable of those assessed by the questionnaire that had a relationship with the M4 maneuver was exercising the thighs and legs more than the other muscle groups. When people engage in more exercises to train thighs and legs, there is tendency for these muscles to undergo hypertrophy and so it is to be expected that a positive dorsiflexion maneuver may be present in such cases. None of the variables had a statistically relevant relationship with the plantar flexion (M5) maneuver.⁹⁻¹¹

One possible limitation of this study is related to performance of the maneuvers because although the examiners were calibrated under supervision, study participants were assessed individually by just one examiner and so checking for pulses, which is operator-dependent, may have suffered bias. In order to obtain more trustworthy results, it would have been ideal for more than one examiner to assess each volunteer; however this was only done in cases in which an examiner was in doubt, in addition to confirmation of compression by vascular echography with Doppler.

The maneuvers were used in isolation partly because of the barriers to employing portable vascular ultrasound equipment in gyms, but primarily because of the practical possibilities of training professionals who work in gyms to perform the maneuvers and recommending that they do so before planning training programs.

The results of this study, which showed a tendency for people who attend gyms to exhibit compression, demonstrate the importance of awareness of these syndromes, particularly on the part of professionals who work in the industry and supervise people who engage in weight training. It is important to take a multidisciplinary approach in which professionals working in gyms and physicians work together to achieve early diagnosis of compressions, since,

although they are rare, the consequences of these syndromes can be drastic for the people affected.

In conclusion, diagnostic maneuvers positive for arterial TOS were observed in 67% of a sample of people who regularly engage in weight training. These people merit a reassessment of their exercise programs and sequential assessments for early detection of symptoms. Just 5% and 7% of the people assessed exhibited positive dorsiflexion and plantar flexion maneuvers, respectively. The most prevalent of the five maneuvers performed was the hyperabduction maneuver.

REFERENCES

- Almeida MJ, Yoshida WB, Melo NR. Síndrome do aprisionamento da artéria poplítea. *J Vasc Bras.* 2003;2(3):211-9.
- Francisco MC, Yang JH, Barella SM, Francisco FC, Natour J, Fernandes AR. Estudo por imagem da síndrome do desfiladeiro torácico. *Rev Bras Reumatol.* 2006;46(5):353-5. <http://dx.doi.org/10.1590/S0482-50042006000500009>.
- Thomazinho F, Sardinha WE, Silvestre JM, Morais Filho D, Motta F. Complicações arteriais da síndrome do desfiladeiro torácico: relato de caso. *J Vasc Bras.* 2008;7(2):150-4. <http://dx.doi.org/10.1590/S1677-54492008000200009>.
- Silvestri K, Wagner F, Moro AN. Síndrome do desfiladeiro torácico: revisão teórica. *ACM Arq. Catarin. Med.* 2005; 34(4):92-6.
- Araújo JD, Filho JD, Ciorlin E, Oliveira AP, Manrique ES, Pereira AD. Aprisionamento de vasos poplíteos: diagnóstico e tratamento e o conceito de aprisionamento funcional. *J Vasc Bras.* 2002;1(1):22-31.
- Delaney TA, Gonzalez LL. Occlusion of popliteal artery due to muscular entrapment. *Surgery.* 1971;69(1):97-101. PMID:5538955.
- Levien LJ, Veller MG. Popliteal artery entrapment syndrome: more common than previously recognized. *J Vasc Surg.* 1999;30(4):587-98. [http://dx.doi.org/10.1016/S0741-5214\(99\)70098-4](http://dx.doi.org/10.1016/S0741-5214(99)70098-4). PMID:10514198
- Rich NM, Collins GJ Jr, McDonald PT, Kozloff L, Clagett GP, Collins JT. Popliteal vascular entrapment. Its increasing interest. *Arch Surg.* 1979;114(12):1377-84. <http://dx.doi.org/10.1001/archsurg.1979.01370360031004>. PMID:534457
- Gourgiotis S, Aggelakas J, Salemis N, Elias C, Georgiou C. Diagnosis and surgical approach of popliteal artery entrapment syndrome: a retrospective study. *Vasc Health Risk Manag.* 2008;4(1):83-8. <http://dx.doi.org/10.2147/vhrm.2008.04.01.83>. PMID:18629362
- Adams JGJ, Silver D. Síndrome do Desfiladeiro Torácico. In: Sabiston DCJ, Lyerly HK. *Tratado de Cirurgia. As Bases Biológicas da Prática Cirúrgica Moderna.* 15. ed. Rio de Janeiro: Guanabara Koogan; 1999. p. 1752-55.
- Macedo TA, Johnson CM, Hallett JW Jr, Breen JF. Popliteal artery entrapment syndrome: role of imaging in the diagnosis. *AJR Am J Roentgenol.* 2003;181(5):1259-65. <http://dx.doi.org/10.2214/ajr.181.5.1811259>. PMID:14573416

Correspondence

Andreza Lamônica
Via Puccini 1-16
CEP 17053-095 - Bauru (SP), Brazil
Tel: +55 (14) 997022922
E-mail: andreza_lamonica@hotmail.com

Author information

AL is a medical student at Pontifícia Universidade Católica do Paraná.

NBB is a medical student at Pontifícia Universidade Católica do Paraná.

ALDVE is an adjunct professor of Angiology at PUCPR; an MSc in Internal Medicine from UFPR; and Board certified in Angiology and Vascular Ultrasound from SBACV.

CAE is a full professor of Angiology at PUCPR; a PhD in Vascular Surgery from UNIFESP; and Board certified in Angiology, Vascular Surgery, and Vascular Ultrasound from SBACV.

Author contributions

Conception and design: AL, NBB

Analysis and interpretation: AL

Data collection: AL, NBB

Writing the article: AL

Critical revision of the article: CAE, ALDVE

Final approval of the article*: AL, CAE, NBB, ALDVE

Statistical analysis: AL

Overall responsibility: AL, CAE

*All authors have read and approved of the final version of the article submitted to J Vasc Bras.

Appendix 1.

QUESTIONNAIRE

- 1) Age
- 2) Sex
- 3) Weight
- 4) Height
- 5) Profession
- 6) How long have you been attending the gym regularly?
- 7) How many hours per week do you train at the gym?
 2h or fewer 2-4h 4-6h more than 6h
- 8) What do you do at the gym?
 weight training only aerobic exercises only weight training and aerobics
- 9) Do you feel pain or a sensation of coldness in your arms or legs during or after any exercise?
 yes no
- 10) If you replied 'yes' to the previous question, which limbs are affected?
A) Left leg
B) Right leg
C) Left arm
D) Right arm
- 11) Do you often feel cramps or muscle pains?
 yes no
- 12) If you replied 'yes' to the previous question, which limbs are affected?
SIDES:
A) Calf (leg) left right
B) Thigh left right
C) Shoulder left right
D) Upper arm left right
E) Forearm left right
- 13) Do you feel tingling and/or reduced sensitivity to heat and cold or loss of the sense of touch in your arms or legs during or after any exercise??
 yes no
- 14) If you replied 'yes' to the previous question, which limbs are affected?
A) Left leg
B) Right leg
C) Left arm
D) Right arm
- 15) Do you feel your arms or legs are heavy, swollen or unusually warm during or after any exercise?
 yes no
- 16) If you replied 'yes' to the previous question, which limbs are affected??
A) Left leg
B) Right leg
C) Left arm
D) Right arm
- 17) Which muscle groups do you exercise most?
 Thighs, legs
 Gluteal muscles, thighs, legs
 Upper arms and forearms
 I regularly train all muscle groups
 I train arms and legs on alternate days
- 18) Does a professional supervise you while you exercise at the gym?
 yes no

19) Do you feel pain in the calf area (lower leg) when you make a physical exertion that improves when at rest?

yes no

20) If you replied 'yes' to the previous question, which side is the affected leg?

left right

RESULTS FOR MANEUVERS:

1) Hyperabduction maneuver: positive negative

A) If the maneuver was positive, at what angle did the patient no longer have a pulse?

less than 90 degrees 90 degrees more than 90 degrees

2) Adson: positive negative

3) Costoclavicular maneuver: positive negative

4) Dorsiplantar flexion maneuver: positive negative

5) Plantar hyperextension maneuver: positive negative

NB: A positive maneuver means that the patient did not have a pulse when the maneuver was performed. Patients who have any positive maneuvers or symptoms should be instructed to consult a specialist to investigate their case, in order to avert complications.