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Arterial pathology of the upper limb in athletes

Patologia arterială a membrului superior la sportivi

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Abstract

Sports activities, at any level, expose athletes to high physical strain. Musculoskeletal lesions are the most frequent cause of pain or functional impotence in athletes. In addition to musculoskeletal lesions, they can develop traumatic or non-traumatic vascular disease, arterial or venous.

The incidence of vascular involvement in athletes is increasing, especially in sports characterized by repetitive movements or in which high speed collision occurs. Unfortunately, vascular disease in athletes is frequently overlooked.

Delayed diagnosis may have serious consequences on both the affected limb, resulting in loss of mobility or even amputation, and subsequent sports activity, leading to withdrawal from sport.

In this paper, we focused on the non-traumatic arterial pathology of the upper limb in athletes, presenting the symptoms and red flags that should be taken into consideration by the doctor, as well as diagnostic methods. We also described the treatment and rehabilitation methods required for resumption of sports activity.

Key words: athletes, physical exercise, arterial involvement, upper limb arteries

Rezumat

Activităţile sportive, la orice nivel, supun sportivii la o mare solicitare fizică. Leziunile musculo-scheletale reprezintă cea mai frecventă cauză de durere sau impotenţă funcţională la sportivi. Pe lângă lezunile musculoscheletale, ei pot dezvolta şi o afectare vasculară (traumatică sau nontraumatică) arterială sau venoasă.

Incidenţa afectării vasculare la sportivi este în creştere, în special în sporturile caracterizate prin mişcări repetitive sau în care apar coliziuni de mare viteză. Din păcate afectarea vasculară la sportivi, este frecvent trecută cu vederea.

Întârzierea diagnosticului poate avea consecinţe grave, atât asupra membrului afectat, putând duce la pierderea mobilităţii sau chiar la amputare, cât şi asupra activităţii sportive ulterioare, putând duce la retragerea din sport.

În lucrarea de faţă ne-am oprit asupra patologiei arteriale nontraumatice a membrului superior la sportivi, cu prezentarea simptomelor şi semnelor de alarmă care trebuie luate în considerare de către medic, precum şi a metodelor de diagnostic. De asemenea, am precizat tratamentul şi mijloacele de recuperare necesare în vederea reluării activităţii sportive.

Cuvinte cheie : sportivi, exerciţiu fizic, afectarea arterială, arterele membrului superior

Introduction

Sports activities, at any level, expose athletes to high physical strain. The movements performed or positions adopted frequently test the limits of human anatomy or physiology. Musculoskeletal lesions are the most frequent cause of pain or functional impotence in athletes. In addition to musculoskeletal lesions, they can develop traumatic or non-traumatic vascular disease, arterial or venous (Mosley, 2003; Perlowski & Jaff, 2010; Para et al., 2015).

The incidence of vascular involvement in athletes is increasing, especially in sports characterized by repetitive movements or in which high speed collision occurs. Unfortunately, vascular disease in athletes is frequently overlooked. This is due, on the one hand, to the fact that these are young, otherwise healthy persons, in whom vascular disease seems unlikely, and a musculoskeletal cause explaining the symptoms (pain, muscle weakness or functional impotence) is more plausible. On the other hand, on clinical routine examination performed at rest,

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pathological changes may not occur, which requires the use of specific triggering procedures and imaging investigations to establish diagnosis. Delayed diagnosis may have serious consequences on both the affected limb, resulting in loss of mobility or even amputation, and subsequent sports activity, leading to withdrawal from sport (Mosley, 2003; Akuthoka & Casey, 2009; Perlowski & Jaff, 2010; Para et al., 2015).

Arterial involvement in athletes may occur post-traumatically, following open or closed trauma, which is beyond the scope of this paper. However, it may also occur in the absence of obvious trauma, through repetitive intense overstrain of a particular area, during training. Hemodynamic and mechanical stress not only affects the musculoskeletal system, but can also lead to arterial involvement by: kinking, compression, stenosis or thrombosis, the development of aneurysms or even artery dissection (Casey et al., 2009; Akuthoka & Marlowki, 2009).

Arterial pathology of the upper limb

Thoracic outlet syndrome (TOS)

TOS is a neurovascular compression syndrome of the thoracic outlet, which was first described by Peet in 1956 (Laker et al., 2009). The thoracic outlet is delimited between: the scalene triangle (formed by the anterior, middle and posterior scalene muscles), the costoclavicular space (delimited between the clavicle and the first rib), and the subcoracoid space (delimited between the pectoral muscle and the coracoid process). The brachial plexus, the subclavian artery and vein pass at this level (Akuthoka & Marlowski, 2009; Laker et al., 2009; Perlowski & Jaff, 2010; Para et al., 2015).

TOS comprises 2 distinct types: neurogenic, which is more frequent (90% of cases) and vasculogenic, which occurs more rarely (3-5% of cases). Vasculogenic TOS can be in turn venous: Paget-Schroetter syndrome, or arterial (less common) (Laker et al., 2009; Klaasen et al., 2014; Kuhn et al., 2015).

Vascular compression more frequently occurs in the scalene triangle and is due to the presence of the cervical rib (0.5-1.5%), first rib malformations or scalene muscle changes secondary to sport practice. Although rare in athletes, it may have devastating effects (Koffer & Kelly, 2002; Perlowski & Jaff, 2010; Povlsen & Povlsen, 2018; Larsen, 2018).

Subclavian artery stenosis/aneurysm

It is the rarest manifestation of TOS. It occurs in sports involving frequent elevation of the arm: baseball (pitchers), weight lifting, tennis, volleyball, basketball, handball, swimming. Artery stenosis occurs through repeated injuries due to mechanical arterial compression during the arm elevation movement, through the cervical rib, first rib malformations or scalene muscle hypertrophy. Post-stenotic dilatation can lead to arterial wall degeneration and aneurysm development (Mosley, 2003; Laker et al., 2009; Perlowski & Jaff, 2010; Thompson & Driskill, 2008).

Athletes clinically complain of: muscle weakness, pain in the shoulder or upper limb increased by elevation of the arm, paresthesia, a sensation of cold. In case of microembolism, digital ulcers or gangrene may occur (Laker et al., 2009; Akuthoka & Maslowski, 2009; Perlowski & Jaff, 2010; Kuhn et al., 2015).

Objective examination can evidence sensitivity on palpation of the scalene muscle or the supraclavicular region, or a supra- or infraclavicular pulsatile mass can be palpated in the case of aneurysm. The upper limb skin is cold, pale, and pulse (brachial, radial, ulnar) is diminished or absent. Differences in arterial pressure between the two arms can be observed, or digital ulcers or gangrene can be present (Laker et al., 2009; Perlowski & Jaff, 2010; Reeser, 2007).

The following complementary examinations are useful: chest X-ray (to evidence bone abnormalities), color Doppler ultrasound (to assess blood flow and evidence possible aneurysms), angio-CT (computed tomography arteriography) or angio-MRA (magnetic resonance arteriography) (useful for diagnosis particularly when performed with the arm in maximum abduction and external rotation, also providing information about the anatomy of adjacent muscles and bones). The gold standard for diagnosis is catheter arteriography (evidencing artery stenosis or aneurysm) (Gillard et al., 2001; Akuthoka & Casey, 2009; Gillet et al., 2018; Povlsen & Povlsen, 2018).

Treatment involves non-surgical measures: adjustment of activity with the avoidance of arm elevation movements and kinesiotherapy to stretch and strengthen the scalene and pectoralis minor muscles, and to strengthen the posterior scapular stabilizer muscles.

If these are not effective, surgical treatment can be performed: thoracic outlet decompression (scalenectomy, cervical rib or first rib resection), endarterectomy, removal of the aneurysm, bypass with vein graft. In case of microembolism, catheter thrombolysis can be conducted, and in refractory cases, thrombectomy is used (Mosley, 2003; Perlowski & Jaff, 2010; Povlsen et al., 2014).

Axillary artery stenosis/aneurysm

It is less frequent than subclavian artery stenosis and is found in baseball players (pitchers) and volleyball players. Compression occurs as the artery passes beneath the pectoralis minor muscle tendon when the humeral head shifts forward. Over time, arterial wall intimal hyperplasia occurs with: stenosis, aneurysmal degeneration with thromboembolism or even arterial dissection (Arko et al., 2001; Newton, 2006; Reeser, 2007; Thompson & Driskill, 2008; Duwayri et al., 2011).

Symptoms are the same as in subclavian artery stenosis/aneurysm, with progressive development in the case of stenosis/aneurysm or sudden onset in the case of arterial embolism. Clinical examination evidences cold, pale skin, diminished or absent pulse (brachial, radial, ulnar). Differences in arterial pressure between the two arms occur, and in severe forms, digital ulcers or gangrene are present (Mosley, 2003; Perlowski & Jaff, 2010; Duwayri et al., 2011).

Complementary examinations are the same as for subclavian artery involvement. It should be mentioned that for conclusive arteriography, this should be performed with an elevated arm in external rotation (a position in which arterial occlusion occurs) (Akuthoka & Casey,

2009; Perlowski & Jaff, 2010; Gillet et al., 2018).

Treatment should start with anticoagulant therapy, or catheter thrombolysis can be performed if a thrombus is present, before surgery. Definitive treatment is surgical. Stent angioplasty or bypass with vein graft can be carried out. Recovery after surgery lasts about 3 months (Molina et al., 2007; Reeser, 2007; Povlsen et al., 2018).

Quadrilateral space syndrome

It occurs in athletes with intense activity of the shoulder: baseball players (pitchers) and volleyball players (Mosley, 2003).

The quadrilateral space is formed by: the teres minor muscle superiorly, the teres major muscle inferiorly, the long head of the triceps medially and the humerus laterally. The posterior circumflex humeral artery arises from the distal third of the axillary artery and traverses the quadrilateral space along with the posterior axillary nerve. It may increase in diameter by 7-8 mm in baseball players and thus, it is susceptible to compression, particularly in the context of adjacent muscle hypertrophy (Mosley, 2003; Akuthoka & Maslowski, 2009; Perlowski & Jaff, 2010; Welsh et al., 2013).

The following symptoms are described: discomfort in the scapular girdle, paresthesia, numbness, muscle weakness in the arm in abduction and external rotation. Distal microembolism symptoms may occur in the case of aneurysm development (Akuthoka & Maslowski, 2009; Perlowski & Jaff, 2010).

Diagnosis is usually incidental, on the occasion of MRI examination for assessment of a discomfort in the shoulder, when atrophy and fat loading of the teres minor muscle are found. Definite diagnosis is established by arteriography (with the arm in maximum abduction and external rotation) (Dugas & Weiland, 2000; Akuthoka & Casey, 2009; Perlowski & Jaff, 2010).

Treatment consists of surgical decompression of the quadrilateral space associated with rehabilitation kinesiotherapy (Duralde, 2000; Perlowski & Jaff, 2010).

Palmar arterial arch injury

It occurs in sports involving strong blows to the palm of the hand (cricket, baseball (catchers), handball), which can lead over time to palmar arterial arch injury, with the development of arterial thrombosis or the formation of aneurysms (Mosley, 2003; Perlowski & Jaff, 2010).

Hypothenar hammer syndrome is typical, being described in baseball players – catchers, in whom the palmar branch of the ulnar artery as it passes over the hammer bone is affected (Mosley, 2003; Perlowski & Jaff, 2010).

The symptoms described include pain in the palm or fingers, paresthesia, a sensation of cold in the fingers or Raynaud-like symptoms (episodic pallor-redness) (Mosley, 2003; Akuthoka & Maslowski, 2009; Perlowski & Jaff, 2010).

Clinical examination evidences painful sensitivity on palpation of the hand or fngers, or a pulsatile mass is palpated in the case of ulnar artery aneurysm (Arko et al., 2001; Mosley, 2003; Perlowski & Jaff, 2010).

The following investigations can confirm diagnosis: angio-MRA, angio-CT or color Doppler ultrasound of the hand, which can show palmar arterial arch thrombosis or aneurysm. Definite diagnosis is established based on catheter arteriography of the upper limb (Akuthoka & Casey, 2009; Perlowski & Jaff, 2010).

Treatment is conservative and consists of avoiding the causative movements, wearing protection gloves, administering antiplatelet and vasodilator (calcium channel blocker) therapy to improve digital perfusion. Surgical treatment is indicated only if ischemia persists or if ulcers are present (Mosley, 2003; Perlowski & Jaff, 2010).

Digital ischemia

It is the final form of presentation of all forms of upper limb artery involvement. It can be due to thromboembolism (of cardiac origin, through subclavian or axillary artery stenosis/aneurysm), palmar arterial arch injury or direct injury to digital arteries with thrombosis, through repeated blows to the fingers (cricket, baseball, handball). A vasospasm in the digital arteries occurs as a result of repeated trauma associated with exposure to cold, vasoconstrictor drug use, smoking or cocaine consumption (Akuthoka & Maslowski, 2009; Perlowski & Jaff, 2010).

Paraclinical examinations useful for diagnosis are angio-CT and angio-MRA, particularly if arterial involvement is proximal, catheter arteriography being the gold standard for diagnosis (Akuthoka & Casey, 2009; Perlowski & Jaff, 2010).

Treatment depends on the cause, duration and severity of ischemia. In the case of distal embolism, anticoagulant treatment with unfractionated heparin is administered. Thrombolysis and administration of vasodilators (nitrates, Ca channel blockers) can also be used, or in refractory cases, cervical sympathetic nerve block can be performed. Surgery is indicated if there is a proximal source of thromboembolism or when thrombembolectomy or reconstruction of the brachial, radial or ulnar arteries is required (Mosley, 2003; Perlowski & Jaff, 2010).

Conclusions

1. Although arterial disease in athletes is rare, it can represent a serious handicap in young, otherwise healthy persons. It should be suspected in any athlete who has discomfort during sports activity that is refractory to conventional therapy for musculoskeletal involvement.

2. For correct diagnosis, during clinical examination and complementary investigations, the movements, positions and effort intensity specific to the sport performed should be reproduced.

3. Delayed diagnosis may have serious consequences on both the affected limb (resulting in loss of mobility or even amputation), and subsequent sports activity, leading to withdrawal from sport.

Conflicts of interest

Nothing to declare.

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