

TITLE PAGE

UPPER EXTREMITY DEEP VEIN THROMBOSIS IN A TRIATHLETE: AGAIN INTENSE ENDURANCE EXERCISE AS A THROMBOGENIC RISK

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Running head: deep vein thrombosis in a triathlete

ABSTRACT

Triathlon followers increase each year and long-distance events have seen major growth worldwide. In the cycling phase, athletes must maintain an aerodynamic posture on the bike for long periods of time. We report a case of a 38-year-old triathlete with symptoms of an axillary vein thrombosis 48 hours after a long triathlon competition. After 3 days of hospitalization with a treatment consisted on enoxaparin anticoagulant and acenocumarol, the patient was discharged with instructions to continue treatment under home hospitalization with acetaminophen. Four weeks after the process, the patient was asymptomatic and the diameter of his arm was near normality. Due to the growing popularity of events based on endurance exercise, it is necessary more research to determine the etiopathogeny of deep venous thrombosis in athletes.

Keywords: triathlon, endurance exercise, deep vein thrombosis, tromboembolism, Paget-Schroetter

Abbreviations:

UEDVT: upper extremity deep vein thrombosis

ER: emergency room

APTT: activated partial thromboplastin time

Background

Effort-induced thrombosis or Paget-Schroetter disease, is defined as a spontaneous deep vein thrombosis, localized typically in the axillary and/or subclavian veins, which occurs spontaneously associated with repetitive movements of the upper limbs[1], in the absence of known thrombotic risk factors.

To date, cases have been reported in relation to weight training[2], wrestling[3], marathon[4], baseball[5], triathlon[6, 7] and dumbbell exercises[8]. Although the incidence of this disease is low, it is the most common vascular pathology in professional athletes [2].

Deep vein thrombosis requires early diagnosis and treatment to mitigate significant associated morbidity and mortality. Rates of pulmonary embolism are essentially the same for upper extremity deep vein thrombosis (UEDVT) and lower extremity at approximately 12%[9].

UEDVT can also lead to postthrombotic syndrome, a chronic, potentially debilitating complication[9]. Up to 25% of UEDVT patients have postthrombotic syndrome 12months after resolution of the thrombus[10].

The patient consented to the publication of this report.

Case presentation

A 38-year-old male (height, 1.89cm; weight, 80kilos) without any medical history of interest arrived in the Emergency Room (ER) complaining of edema and pain in his upper left extremity which had begun spontaneously 24 hours before. His entire extremity felt cold.

The patient had never suffered from coagulopathies nor did he recall any cases in his family. He wasn't a smoker, did not drink alcohol and denied having taken any abusive drugs or illicit ergogenic substances.

He had been regularly doing the triathlon as a federated athlete, training and competing for years. Just 48 hours prior to his visit to the ER, he had completed an event known as the Half-Ironman (1900 m swimming, 90 k on bike and 21 k running).

The patient denied any type of trauma or problem in his left arm while participating in the event. His hydration and nutrition before, during and after the event were correct.

The two days following the event had been normal as the patient recovered from the effort without any symptoms.

During the physical exam, there proved to be inflammation from the underarm to his fingers. The largest diameter of his arm was 33cm on the left side and 30cm on the right.

The extremity was compressible and soft, showing no pain from palpation. There was complete mobility in all axes of the joints.

The radial, cubital, brachial and axillary pulses were normal and symmetric. There were no lymph nodes palpable or any collateral venous circulation.

Neither the electrocardiogram nor the chest x-ray showed any pathological findings.

Blood analysis: RBC $4.8 \times 10^{12}/l$, hemoglobin 14.4 g/dl, hematocrit 42.8%, prothrombin time 12.5seconds, prothrombin activity 100%, INR 1, cephalin time 30.4seconds, D-dimer value 492ng FEU/ml (1-500).

With a clinical suspicion of deep vein thrombosis, a Doppler ultrasound was ordered which clearly showed an extensive clot extending from the subclavian vein to the axillary vein. (Figure 1)

A computed tomography was done of the patient's chest without any radiological signs of a pulmonary embolism. (Figure 2)

The patient was admitted to hospital and began treatment with 1 mg/kg of an enoxaparin anticoagulant every 12 hours and subsequently acenocumarol until reaching right range of anticoagulation without bleeding complications. After three days of hospitalization, he was discharged with instructions to continue treatment under home hospitalization with acetaminophen, 1g every 8 hours.

During a check-up four weeks after the process, the patient was asymptomatic and the diameter of his arm was near normality. A doppler ultrasound objectified endovascular recanalization in the affected area.

Discussion

UEDVT is a thrombus in the radial, ulnar, brachial, axillary, subclavian, internal jugular, or brachiocephalic veins. The prevalence is 6 times less than lower extremity deep vein thrombosis[11], with an incidence of 16/100,000 inhabitants a year[2], which most often occurs in young people and is generally associated with repetitive physical activity in the upper limbs[2]. It is more common in men than in women and affects the dominant arm in 80% of all cases [12].

Deep venous thrombosis is classically associated with immobility, although paradoxically, intense endurance exercise also has been associated with multiple

thrombogenic risk factors, such as dehydration, micro fractures, inflammation, heat stress[13, 14].

The few reports of venous thromboembolism occurring during a sports activity have been related to different sports activities[15-17], with a bigger incidence in long strenuous running as in a marathon ^[18][4], or in a triathlon [6, 7], meaning therefore, that effort induced deep vein thrombosis is a relatively well-studied event in sports medicine. However, the etiopathology of upper extremity deep vein thrombosis is not completely clear; the external compression and/or stress on the lining membrane of the axillary or subclavian veins due to postures or gestures associated with the retroversion and hyperabduction of the arm are possible causes[2]. These elements could cause local inflammation in the lining membrane with turbulences that, in combination with increased blood flow in response to exercise, would foster the formation of a blood clot [12, 19].

Thrombosis occurs most commonly in the subclavian vein due to compression. In our patient, the blood clot was located from the subclavian vein to the axillary vein meaning it is possible the compression could have had an influence as a pathogenic mechanism. In this sense, it has been argued that the effort-induced thrombosis is a clinical manifestation of thoracic outlet syndrome caused by distortion and narrowing of the vein within the tunnel by repetitive upper extremity Exercise[8].

The hypercoagulability that is associated with exercise could also have contributed to the appearance of the thrombosis[19]. Any alteration in the overall balance between platelet function, blood coagulability and fibrinolysis might increase the possibility of suffering thrombosis during intense exercise. It has been documented, on the other hand, that exercise performed at a high intensity (i.e., above 85% of maximal heart rate) could induce a transitory state of hypercoagulability [20]. Such phenomenon, in turn,

can be evidenced by a decrease of activated partial thromboplastin time (APTT) in response to exertion[21]. However, several studies have described an increase in platelet aggregability in response to exertion particularly when highly intense exercise (above the anaerobic threshold)[22]. Nonetheless, there is no evidence of any change in the overall balance of hemostatic mechanisms with moderate exercise [23] in healthy individuals since fibrinolytic activity of plasma also rises after exercise, as has been proven by a number of studies[23] .

Although the relative intensity of the exercise done by our patient during the triathlon competition is unknown, the data from the various studies situate this at around the lactic threshold (75% of maximal heart rate) and, therefore, there was no justification for the thrombosis in this athlete unless there were other underlying or enabling co-existing factors present.

Factors such as dehydration and perhaps a certain relative circulatory stasis in the arms due to the triathlete's "coupled" position could have fostered the appearance of the deep vein thrombosis. Dehydration appears to be the most likely cause leading to hemorheological disturbances due to increased blood viscosity, high hematocrit and red cell aggregation[2]. On the other hand, high pressure in the venous territory may cause turbulence and reduced blood flow [12].

The case of the long-distance triathlon is special because it exposes athletes to the mentioned risk factors simultaneously.

Given the international rise of the discipline and the exponential increase in its followers, there is speculation that cases such as the one described will become more and more common.

Athletes in these competitions participate in swimming, cycle and running resistance events consecutively. In the cycling phase, the athlete must maintain an aerodynamic posture on the bike for long periods of time. This posture is known as "coupled" in triathlon terminology (Figure 3). Just like a cervical rib or fibromuscular band can cause a mechanical conflict with the upper extremity veins, the position triathletes adopt coupled to the bike handlebar with their shoulders and elbows flexed can foster the development of Paget-Schroetter disease.

Although the incidence of Paget-Schroetter disease is low, long-distance triathletes must receive medical recommendations to prevent this pathology like proper hydration, changes in the trunk and arm posture on the bike as well as periodic isometric mobilization or contractions of the arm and forearm.

FIGURE LEGENDS

Figure 1. Doppler ultrasound imaging showing echogenic content in the axillary vein (arrow) in relation to deep vein thrombosis.

Figure 2. Axial plane of computed tomography with intravenous contrast where the absence of filling in the left axillary vein from ipsilateral subclavian vein (arrow) is observed, without any adjacent abnormality.

Figure 3. Posture known as "coupled" in triathlon terminology.

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