A prophylaxis algorithm for deep vein thrombosis in ankle and foot surgery

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ABSTRACT

Introduction: Deep vein thrombosis (DVT) is a major complication in orthopedic surgery. According to the literature, thromboprophylaxis in foot and ankle surgery is not a standardized practice due to the low incidence of DVT. **Materials and Methods:** We reviewed the medical records of surgical patients. Between 2011 and 2015, 1591 surgeries were performed, 6 of them due to symptomatic deep vein thrombosis. **Results:** The incidence of DVT in major orthopedic surgeries, such as knee and hip, is well documented, but there are only a few reports about its incidence in foot and ankle surgery. It is considered a relatively rare complication in many published studies; thus, preventive drug therapy is not routine practice. **Conclusions:** A multimodal approach to deep vein thrombosis prophylaxis for high-risk patients is recommended. All risk factors should be addressed, such as mechanical prophylaxis, early mobilization, and the use of chemoprophylaxis. Low molecular weight heparin is effective in reducing the rate of clinically significant deep vein thrombosis and is also likely to reduce the rate of pulmonary embolism.

Key words: Deep vein thrombosis; surgery; ankle; foot; prophylaxis.
Level of evidence: IV

Trombosis venosa profunda en cirugías de tobillo y pie. Algoritmo de profilaxis

RESUMEN

Introducción: La enfermedad tromboembólica es una de las complicaciones serias en la cirugía ortopédica. La tromboprofilaxis para las cirugías de tobillo y pie no está estandarizada, porque la incidencia es baja, según la bibliografía. El objetivo de este estudio es aportar un algoritmo de prevención para la trombosis venosa profunda y una revisión de la bibliografía. **Materiales y Métodos:** Se llevó a cabo una revisión de las historias clínicas de los pacientes operados entre 2011 y 2017. La muestra estaba integrada por 696 hombres (28,98%) y 1706 mujeres (71,02%), con un promedio de edad de 51 años (rango 20-82). Se realizaron 2402 procedimientos, 575 (23,94%) fueron por patologías traumáticas y 1827 (76,06%), por patologías ortopédicas. **Resultados:** Nueve pacientes (0,37%) presentaron trombosis venosa profunda y solo dos, tromboembolismo pulmonar (0,08%). Los procedimientos en los que ocurrieron fueron: artroscopia, reparación aguda del tendón de Aquiles, hallux valgus y fractura del 5.° metatarsiano. **Conclusiones:** Se recomienda un enfoque multimodal para la profilaxis de la trombosis venosa profunda. Esto incluye abordar los factores de riesgo modificables, mediante la profilaxis mecánica, la movilización temprana y la profilaxis química. La heparina de bajo peso molecular es eficaz para reducir la tasa de trombosis venosa profunda y tromboembolismo pulmonar.

Palabras clave: Trombosis venosa profunda; cirugía; tobillo; pie; complicaciones, profilaxis.
Nivel de Evidencia: IV

INTRODUCTION

Thromboembolism is one of the main complications in knee and hip orthopedic surgery, and a situation that has been widely recorded to be best prevented by antithrombotic therapy following any major orthopedic procedure.[1]

Venous thromboembolism is well known for being a relatively common surgical complication, which is associated with a significant morbidity and mortality rate.[2] Pulmonary embolism is the most preventable cause of death for patients at any medical center, representing 10% of all inpatient deaths.[3] In general, venous thromboembolism is the main cause of death worldwide, the global incidence is estimated to be no less than three million new

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deaths per year; approximately 300,000 venous thromboembolism-associated deaths in the United States[4] and over 500,000 in Europe every year.[5,6]

Notwithstanding these figures, thromboprophylaxis in foot and ankle surgery is not standardized, because, according to the consulted literature, the risk of venous thromboembolism is low.[7-9]

This study seeks to provide an algorithm to help preventing deep venous thrombosis (DVT) during foot and ankle surgery, based on our own experience as well as an international bibliographic search.

Risk factors

In 1860, Virchow associated the development of DVT to the triad consisting of venous stasis, vascular injury, and a hypercoagulability state. Venous stasis and vascular injury are possible complications of foot and ankle surgery, particularly associated with non-weight-bearing immobilizations. Hypercoagulability states may result from hereditary or acquired factors,[8,9] the most important factors include: Factor V Leiden (which causes protein C antithrombotic resistance), Antiphospholypid Syndrome, Lupus, Hyperhomocysteinemia, and intravenous anticoagulant deficiencies of protein C, protein S, or antithrombin III.[1,10]

Other risk factors associated with thrombosis are: age >50, sepsis, prolonged hospitalization, air traveling, respiratory failure or congestive heart failure, nephrotic syndrome, obesity, congenital predisposition to varicosity, oral contraceptives, estrogen therapy, spinal cord injuries, stroke history, inflammatory bowel disease, smoking, pregnancy, history of femoral venous catheterization, diabetes, high blood pressure and hyperlipidemia.[1,10,11] Additionally, some risk factors are highly prevalent, such as personal or family history of thromboembolism or undergoing cancer treatment.[1,10,12,13]

Aging may result in losing venous elasticity, thus enabling dilatation, tortuosity, and stasis. Additionally, muscle mass decreases and the venous return systems become less effective. Finally, the elderly develop more cases of congestive heart failure, hyperlipidemia, and varicose veins that may aggravate the primary factors. It should be acknowledged that obese patients may have an altered fibrinolytic system which correlates with relative hypercoagulability.[14]

Clots in the lower limbs may form in the superficial or deep venous system, Deep venous system clots are classified as distal (contained in the lower leg) or proximal. Superficial venous thrombosis may be benign; however, some tests may increase DVT risk. In a retrospective review comprising 40,013 patients, Van Weert *et al*. found that 185 patients developed superficial venous thrombosis during the six months following treatment. Five of then (2.7%) developed DVT and one patient (0.5%) suffered a pulmonary embolism.[8]

The use of a blood pressure cuff for more than 90 minutes, postoperative immobilization, and non-weight-bearing are risk factors associated with foot and ankle surgery.[9,15-18]

MATERIALS AND METHODS

A retrospective, multicentric study considered the medical records of patients from January 2011 to September 2017, searching for complications inherent to thromboembolism. The study comprised 2402 foot and ankle surgeries, consisting both of trauma and orthopedic surgeries. The population was composed of 696 men and 1706 women who averaged 51 years old (ranging from 20 to 82). Surgeries were performed due to traumatic conditions in 23.94% of the cases (575 surgeries) and due to orthopedic reasons in 76.06% of the cases (1827 surgeries).

Prophylaxis treatment was prescribed to patients >60 years, with hematological condition history, with a cancer diagnosis, who were taking oral contraceptives and those with prolonged immobilization and that did not put weight on their injured leg. Enoxaparin 40mg/day was administered for three weeks, following American College of Chest Physicians (ACCP) recommendations. Presumptive DVT diagnosis was made based on patient clinical signs and symptoms (**Figure**) and confirmed by Doppler ultrasound. Consultations were held on all cases and all the patients continued their treatment in the Haematology Department.

RESULTS

Nine patients (0.37%) developed DVT and only two suffered pulmonary thromboembolism (PTE) (0.08%). Regarding conditions and their medical procedures, three cases (0.98%) of DVT were diagnosed out of 304 ankle arthroscopies and two cases (2.77%) out of 72 acute Achilles tendon repairs. It is worth mentioning that these two patients were under prophylactic treatment with subcutaneous enoxaparin 40mg/day. Clinical features presented

Figure. Swelling and edema of the DVT affected region.

two weeks after the surgery. The patients were assessed by the Haematology Department and were prescribed outpatient treatment plan for six months.

From 520 operations for *hallux valgus*, there were three cases (0.57%) of acute DVT. One of these patients was also under enoxaparin prophylactic treatment and continued treatment as an outpatient, without hospitalization, for six months.

Finally, one patient experienced postoperative DVT away from the original fracture of the fifth metatarsal bone for weeks after the procedure (1 out of 284 procedures [0.35%]), and the only two cases of PTE occurred in a patient who sustained medial malleolus fracture, who did not require surgery, and used a walking boot for immobilization, with no weight-bearing, and in another patient recovering from carpal tunnel release surgery, also with non-weight-bearing immobilization.

DISCUSSION

In September 2004, the ACCP draft a consensus concerning antithrombotic therapy. Based on evidence, the ACCP considers acceptable protocols that use low-molecular-weight heparin (LMWH) during postoperative period, and establish that the routine practice of venous ultrasound as a procedure for venous thromboembolic diseases at the time of hospital discharge (in asymptomatic patients) was unnecessary.[19-21]

In the scientific literature, the incidence of DVT in major orthopedic surgeries, such as knee and hip, is well documented, but there are only a few reports about its incidence in foot and ankle surgery. It is even considered a relatively rare complication in many published studies; thus, preventive drug therapy is not routine practice.[1,12]

Hickey *et al*. conducted a study to evaluate if there is a marker that would enable to predict which patients may develop DVT. They recorded that thromboplastin, vascular cell adhesion molecule-1, interleukin-6 and D-dimer levels showed no link to the development of DVT.[22]

In a multicentre study, Mizel reported a prevalence of 0.22% for asymptomatic DVT, for which no treatment was prescribed.[17] Solis and Saxby published their findings of 3.5% positive cases detected during the postoperative period, in cases where Doppler ultrasound was performed before and after surgery. Solis and Saxby report that all cases were asymptomatic.[18] In 2006, Hanslow *et al*. evaluated 643 patients and found that 4% had DVT. After considering the cost-benefit ratio for the preventive treatment, they concluded that its use as a routine prophylaxis for thromboembolism was unwarranted. In that research study, they found no grounds for the association between thromboembolism, the use of drugs, the type of surgery, the type of anesthesia or whether a blood pressure cuff was used or not. They further report that the specialized literature provides no evidence concerning a decrease on thromboembolism risk by using regional blocks; however, they did find an inverse relationship between thromboembolism and prophylaxis with LMWH. They suggest that these findings may imply that the at-risk group for DVT was accurately predicted but the prophylactic regimen was suboptimal.

In a paper on thromboembolism in orthopaedic trauma, Scolaro suggests keeping pharmacologic and mechanical prophylaxis for inpatients and that considering if outpatients should continue these procedures would depend on the risk factors and on the morbidity rate of the condition for which they were assisted.[23]

Several authors suggest pharmacologic prophylaxis for patients who undergo prolonged immobilizations with splints or boots so as to reduce the chance of DVT.[24-27]

In 2015, Craig *et al*. conducted a study to control the blood flow on lower limbs while at rest, ambulating weight-bearing, partial weight-bearing, and immobilized in a walking boot. Their results showed that patients ambulating with immobilization had no significant increase in venous blood flow measurements compared with patients resting. These findings suggest that there is no reason to stop pharmacologic prophylaxis once patients can walk, irrespective of their weight-bearing conditions.

In 2002, Wang published three cases of PTE following ankle fractures. The three patients were over age 40, obese and immobilized following surgery. Thromboembolic events occurred within two to four weeks from the procedure. He suggests prescribing thromboprophylaxis and immobilization regarding ankle fractures.

In 2011, Griffiths *et al*. concluded that the reported risks pertaining to routine thromboprophylaxis probably outweigh any potential benefits and that aspirin does not appear to provide any significant protection against symptomatic DVT. An alternative thromboprophylaxis should be considered for at-risk patients, such as obese patients, and those taking oral contraceptives, having a DVT history or a procoagulant condition.[6]

In a prospective, randomized study, Spannagel proved that LMWH was effective in reducing DVT frequency in immobilized patients treated with plaster splints. Using ultrasound, they were able to identify DVT in 21 (16.5%) of the 127 patients with no LMWH administration and 6 (4.8%) of the 126 patients under LMWH treatment ($p < 0.01$).[18]

However, treatment for Achilles tendon injuries represents an important risk factor for thromboembolic disease. Lapidus reported formation of DVT in more than 33% of 105 consecutive patients that underwent Achilles tendon rupture surgery, which were diagnosed by means of Doppler ultrasound.[29] Nilsson-Helander *et al*. published a similar ratio in their prospective study, performing the ultrasound examinations on 100 patients following an Achilles tendon rupture.[30]

In a meta-analysis, Calder and van Dijk reported that incidence of DVT for this condition is high.

Bullock published a greater postoperative risk ($p = 0.048$), which he assumed was due to long-term limited mobility and chronic inflammation.[28]

Makhdom *et al*. advise that, until further data are published and evidence-based recommendations are established, clinicians maintain a high level of suspicion regarding DVT development during the postoperative term.

In an analysis of the US National Trauma Data Bank, the statistically significant and clinically meaningful risk factors associated with DVT and PTE were concluded to be older age, obesity, and sepsis. DVT and PTE hospitalization incidence was low for those patients who sustained foot and ankle traumas, without poly-trauma. The research team of this study considers that routine DVT prophylaxis is contraindicated, as there is a greater possibility of complications associated with heparin products. Therefore, when considering the administration of chemoprophylaxis, it is important to evaluate the risk factors. In light of the above, pharmacologic thromboprophylaxis effectiveness for ankle and foot surgery is questionable.[10,20,32]

Besides the increase in the cost involved in starting with a routine drug treatment, there are also potential and significant adverse reactions, such as strokes, scarring issues, and increased infection and bleeding rates. According to a recent meta-analysis by Martel *et al*., heparin-induced thrombocytopenia syndrome is a potential complication of a 0.2% absolute risk for LMWH and of 2.6% for unfractionated heparin.[33,34]

CONCLUSIONS

Currently, two concepts seem to be clear: 1) not every patient sustaining ankle and foot trauma requires DVT prophylaxis, and 2) DVT potential complications associated with ankle and foot surgery are serious and must not be ignored.

There are primary and secondary factors that predispose patients to DVT or PTE (Table). There is no evidence concerning the systematic use of antithrombotic prophylaxis in patients with no thromboembolic risk factor. If a patient has a primary risk factor or two coexisting secondary risk factors for thromboembolism, antithrombotic prophylaxis must be instituted.

Women taking oral contraceptives who will undergo an elective surgery will be advised to suspend them for the duration of the treatment. In the event that this is the only risk factor and the patient is not expected to undergo postoperative immobilization with no weight-bearing, oral contraceptives may not be suspended and preventive treatment may not be prescribed if an informed patient agrees knowing the potential risks. When in doubt, we suggest instituting prophylaxis.

LMWH is clinically effective in reducing DVT incidence and is possible that it may help to reduce PTE rates. There is no sufficient evidence to support the use

Table. Primary and secondary criteria for prophylaxis.

Primary criteria
Personal or family history of DVT.
Hypercoagulability state.
Personal history of undergoing cancer treatment.
Immobilization with non-weight-bearing for more than three weeks.
Achilles tendon rupture.
Secondary criteria
Advanced age (>50 years old).
Ongoing infection.
Obesity (body mass index >30).
Oral contraceptives.
Personal history of cancer treatment.
Smoking habit.
High blood pressure.
Hyperlipidemia.
Congenital predisposition to varicosity.
Diabetes.
No weight-bearing and no immobilization for more than three weeks.
Immobilization with weight-bearing for more than three weeks.
Prolonged hospitalization.
Use of a blood pressure cuff during surgery for more than 90 minutes.

of aspirin as prophylaxis in high-risk patients. There is no published evidence concerning the election of an antithrombotic agent in this specific group. LMWH, unfractionated heparin and direct oral anticoagulant agents may all be viable options. As selection criteria, we should consider which drugs are available, the patient history, the costs, and the treating team's preference and practical experience.

Inferior vena cava filter should only be considered for high-risk patients (e. g., DVT history) when pharmacological and mechanical prophylaxis cannot be instituted and only if the vascular surgeon agrees to it.

LMWH therapy should be started within 12-24 hours following surgery and continued for no less than 2 weeks, according to the American College of Chest Surgery. The administration may be extended depending on the particular case and the treating physician criteria.

Following an ankle or foot injury requiring prolonged non-weight-bearing immobilization, the recommendation is to start LMWH prophylaxis as soon as immobilization is instituted. The same recommendation is valid for postoperative Achilles tendon rupture patients. There is no published evidence concerning the extension of the usual thromboprophylactic period. A possible parameter is to extrapolate the period from major orthopedic surgery, which has a minimum of 10-14 days. However, in prolonged immobilization, it seems advisable to extend it up to 28-35 days.

Achilles tendon rupture is a condition that should be considered apart from the rest on account of its high thromboembolic risk, which would call for antithrombotic prophylaxis.

A multimodal approach to DVT high-risk patients is recommended. All risk factors should be addressed, such as mechanical prophylaxis, early mobilization, and the use of chemoprophylaxis.

In our series, we found no evidence accounting for the lower frequency of thromboembolic events associated with lower leg, ankle and foot conditions. We recommend the conduction of a prospective, randomized study with specific complementary diagnostics and stratification of the different ankle and foot orthopedic and trauma conditions, as well as of the different anatomic regions, in order to assess thromboembolic events more accurately.

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