



# VENOUS THROMBOEMBOLISM IN THE EMERGENCY DEPARTMENT – SINGLE-CENTER EXPERIENCE

Ivan Jurić<sup>1</sup> and Višnja Neseck Adam<sup>1,2,3,4</sup>

<sup>1</sup>Department of Emergency Medicine, University Hospital Sveti Duh, Zagreb, Croatia;

<sup>2</sup>University Department of Anesthesiology, Resuscitation and Intensive Care, University Hospital Sveti Duh, Zagreb, Croatia;

<sup>3</sup>Faculty of Medicine, University J.J. Strossmayer in Osijek, Croatia;

<sup>4</sup>Faculty of Dental Medicine and Health Osijek, Croatia

**SUMMARY** – Given the importance of early recognition of acute venous thromboembolism (VTE) and the nonspecificity of its symptoms and signs, it is essential to follow the guidelines for diagnostic and therapeutic decisions. Ultrasound examination of the entire lower extremity is currently the standard diagnostic method for symptomatic patients with a clinical probability of deep vein thrombosis (DVT) according to the Wells scoring system. The aim of this study is to show the demographic structure and analyze the number of patients in the emergency department with suspected venous thrombosis. In the past 10 years, 2,022 patients with DVT and 686 with pulmonary emboli have been diagnosed. Despite adherence to the diagnostic protocol, nearly two-thirds of patients require early ultrasound diagnosis. One-fifth of patients had thrombosis of the superficial venous system of the leg or arm. Thrombus was present in the veins of the lower leg in 37% of patients with DVT. The presence of thrombi above the knee, involving the deep femoropopliteal venous system, was found in as much as one-third of patients. These findings and current guidelines suggest that there is a paradigm shift toward more frequent use of DOAC in patients with DVT. However, greater educational efforts may be needed for many physicians to become comfortable with the use of DOAC in the outpatient management of patient populations at low risk for pulmonary embolism.

**Key words:** *venous thrombosis, pulmonary embolism, venothromboembolism, emergency medicine*

## Introduction

Acute venous thromboembolism (VTE) refers to deep vein thrombosis (DVT) and pulmonary embolism (PE), potentially fatal conditions with a one-year mortality rate of 9% to 23%.<sup>1,2</sup> The incidence of DVT is approximately 1-2 ‰ annually.<sup>3,4,5</sup> One-third of patients with untreated DVT develop clinically significant PE, and the mortality rate of PE patients admitted to the emergency department exceeds 20%.<sup>3</sup> In 95% of pulmonary emboli, the origin of the embolus is DVT, including 85 to 90% of lower extremity emboli.<sup>4</sup>

Despite significant improvements in the diagnosis, prophylaxis, and treatment of these conditions, the incidence of VTE has remained the same in recent years.<sup>3,4</sup> Accurate and timely diagnosis of DVT determines immediate and long-term patient outcomes. Because the signs and symptoms of DVT are not specific, clinical assessment alone is not a reliable tool for diagnosis.<sup>5</sup> Laboratory determination of serum D-dimer levels is important for the diagnosis of DVT, but exclusively with negative predictive value and unsatisfactory specific values.<sup>6</sup> Although contrast venography is considered the “gold standard” of diagnosis in patients with suspected DVT, this test has been replaced by compression color Doppler ultrasound due to its invasiveness and complications, both in clinical practice and as a reference test for clinical trials.<sup>6,7</sup>

Correspondence address: *Ivan Jurić, dr. med.*, Department of Emergency Medicine, University Hospital Sveti Duh, Zagreb, Croatia  
E-mail address: [ivan.juric@me.com](mailto:ivan.juric@me.com)

Ultrasound examination of the entire lower extremity is currently the standard diagnostic method for symptomatic patients with clinical probability of DVT according to the Wells scoring system<sup>6,7</sup>.

## Materials and method

A retrospective analysis of the database of visits to the Emergency Department of University Hospital Sveti Duh from January 1, 2011, to December 31, 2021, included all patients with suspected DVT. In addition, data from the radiological database of confirmed pulmonary emboli were included. The aim of this study is to show the demographic structure, the number of patients in the emergency department with suspected venous thrombosis, the localization of the thrombus confirmed by ultrasound, the presence of concomitant diseases, the treatment, and early outcomes of VTE. Continuous data is provided as median  $\pm$  interquartile range. Categorical data are given as n / N (%).

## Results

In the period from January 1, 2011 to December 31, 2021, 6,509 cases of suspected venous thrombosis of the extremities in 5,349 patients were treated in the emergency department of the University Hospital Sveti Duh, 256 patients were excluded from the analysis due to incomplete data (Figures 1).

Of the 5,093 patients, DVT was excluded in 1,420 (27.9%) because the risk was low according to the Wells scoring system and D-dimer levels were within the reference range. Ultrasound diagnosis of DVT was excluded in 1,651 (32.4%) and confirmed in 2,022 (39.7%) patients. The median age was 62.18 years (49.2-73.5 IQR) and 56.43% were female. Six hundred sixty-one patients (32.7%) with DVT were hospitalized. There were 686 hospitalizations, 50.7% of which were female, the median age was 67.7 years (53.1-77.1 IQR), 67% were over 60 years old, and the median hospital stay seven days (5-9 IQR).

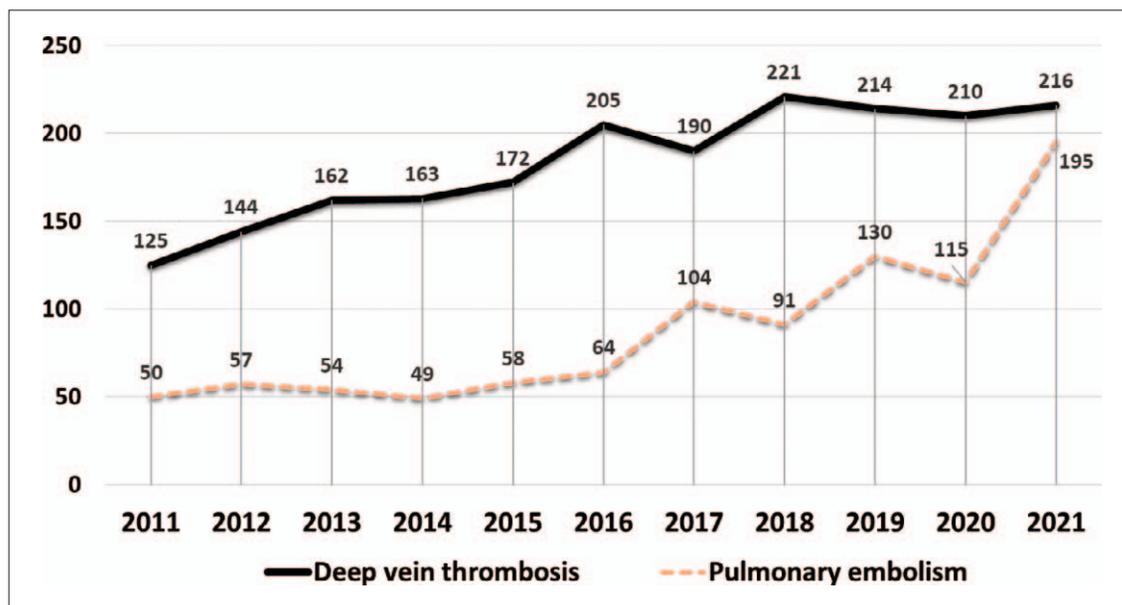
During the observation period, 967 cases of pulmonary embolism were registered: 60.9% female and 60% older than 65 years old. Of the patients hospitalized for pulmonary embolism (92%), 74 patients (7.65%) died at the time of hospitalization, the median age was 73.96 years (64.0-81.1 IQR), 80% were older

than 60 years. Fibrinolysis therapy was performed in 94 cases.

The most common concomitant diseases in patients with VTE were arterial hypertension (47%), hyperlipidemia (12%), diabetes (14%), active tumor disease (13%), recent trauma (11%), and renal injury (4%). Each of the prolonged conditions was more common in patients with PE than in patients with DVT alone. Estrogen therapy was noted in 7.6% of women with VTE. Patient histories included data on previous VTE, which was significantly more common in the DVT group than in PE (24.2% vs. 16.5%).

The median time from onset of symptoms to first medical contact was longer in the DVT group (median three days, IQR 2-5) than in PE (median one day, IQR 0-10). The most common symptoms and signs in patients with DVT were pain (88.7%), limb swelling (75%), and local extremity warmth (34%). The most common symptoms in PE were dyspnea (79.1%), chest pain (34.5%), rapid heart rate (21%), and syncope (5%). Forty-five percent of patients with suspected DVT were examined during working hours from 8 a.m. to 4 p.m., with an average treatment time of 169 minutes; 82.1% in the period from Monday to Friday, without major variations in the number of inputs by month. In 90% of the cases, the time from patient admission to ED to radiological findings suggestive of pulmonary embolism was within three hours.

One-fifth of patients, 21%, had thrombosis of the superficial venous system of the leg or arm. Thrombus was present in the veins of the lower leg in 37% of patients with DVT, which was localized in the posterior tibial veins in 31% of cases, in the peroneal veins in 60%, and in the muscular veins (gastrocnemius or soleus) in 29%. The presence of thrombi above the knee involving the deep femoropopliteal venous system was found in 38% of patients and was evenly distributed among the common femoral, superficial femoral, and popliteal venous segments. The presence of thrombus in the iliac region was less frequent, in 10% of patients on ultrasound. Thrombus in the femoropopliteal segment was found in all patients with external iliac thrombosis, and 60% also had thrombosis in one or more tibial veins. Deep vein thrombosis in the arms was present in only 4.7% of patients. Isolated lower leg thrombosis was more often associated with leg pain (60% vs. 40%) and less often with subjective leg swelling (20% vs. 60%).



Figures 1. Annual incidence of venous thromboembolism in the emergency department.

Among patients with nonthrombotic findings, the most common diagnoses were edema (34.9%), Baker cysts (22.6%), and unspecified fluid collections (16.3%).

Hospitalization was elected for 95% of proximal DVT. For distal DVT, hospitalization increased from 20% in patients aged 18 to 40 years to 70% in patients aged 60 years.

A total of 95% of patients were treated in the emergency department, prophylactically until diagnostic exclusion of thrombosis, or therapeutically in hospitalized patients with DVT with anticoagulants, mostly low-molecular-weight heparin (enoxaparin, dalteparin).

## Discussion

Patients with suspected deep vein thrombosis and pulmonary embolism report to the emergency department almost daily.

The symptoms and signs of deep vein thrombosis are nonspecific, and several other pathologic conditions may mimic them, such as Baker cyst, thrombophlebitis, lymphadenopathy, subcutaneous edema, chronic deep vein thrombosis, fluid collection, hematoma, and muscle tears.

The clinical onset of symptoms and the timing of diagnostic tests were different in patients with DVT and PE, with a shorter duration in the latter group.

This difference is to be expected since PE is the more severe form of VTE.

Despite adherence to the diagnostic protocol, nearly two-thirds of patients require early ultrasound diagnosis, which is increasingly accepted by physicians, especially in emergency medicine. However, CDUV is not available in certain situations, requiring time and the availability of trained medical personnel.

Nearly half of patients with deep vein thrombosis report to the emergency department between 4 p.m. and 8 a.m., when ultrasound diagnosis is performed with limited exclusion of distal thrombosis. Alternatively, if ultrasound diagnosis of the veins is not available, empiric anticoagulation is required, most commonly with low-molecular-weight heparin, until DVT is definitively confirmed or excluded<sup>8,9</sup>.

The sensitivity of US diagnosis for proximal DVT (above the knee) has been reported to be 97% but is much lower for isolated distal DVT<sup>9</sup>.

Isolated calf vein thrombosis is common, accounting for 28% to 70% of all lower extremity DVT diagnosed by ultrasound<sup>10,11</sup>. These findings are consistent with other reports, as we found in our series that 37% of thromboses diagnosed by full-duplex ultrasonography at the initial examination were isolated calf vein thromboses. This suggests that an initial ultrasound examination performed with a limited range (from the groin to the popliteal fossa) misses nearly one-third of

DVT cases. We found that isolated deep vein thrombosis of the calf was more commonly associated with leg pain than proximal deep vein thrombosis. It is generally believed that acute DVT triggers an inflammatory response and that the pain associated with DVT is primarily due to inflammation of the vein wall around the clot.

Isolated calf thrombosis was less frequently associated with subjective leg swelling and objectively measured circumferential difference. One explanation for this finding is that in most patients there is a single iliac, femoral, and popliteal vein for each leg. Thrombosis in these veins therefore results in occlusion of all deep venous outflow at this level. In contrast, there are multiple deep veins in the calf. In most cases of isolated calf vein thrombosis, one or some of these veins are occluded, leaving other deep calf veins open.

Although the clinical significance of isolated distal DVT is unclear, up to 25% of these thrombi may spread to proximal veins, increasing the risk of PE and post thrombotic syndrome<sup>10</sup>, guidelines recommend anticoagulant therapy for isolated distal DVT in patients with severe symptoms or with risk factors for spread<sup>8,12</sup>.

The location of the primary DVT influenced the decision of emergency department physicians for hospitalization. Hospitalization was chosen more frequently in patients with proximal DVT than in patients with distal DVT.

In addition, the approach to patients with DVT changed significantly after the introduction of new forms of direct-acting oral anticoagulants (DOACs). In the last two years, the shift in prescribing ambulatory therapy has reversed in favor of DOACs, with the possibility of switching to warfarin therapy for socioeconomic reasons, contraindications, and patients with active tumor disease. The same trend is not seen in patient groups requiring hospitalization, and heparin remains the first choice of therapy. No change was observed in the number of hospitalizations or choice of therapy for pulmonary embolism, even in the patient groups with low risk of mortality and severity of complications according to the PESI scoring system.

## Conclusion

Given the importance of early recognition of deep vein thrombosis and pulmonary embolism, the non-

specificity of symptoms to and signs, and the congestion of hospital emergency departments, it is necessary to follow guidelines for diagnostic and therapeutic decisions. Diagnosis of isolated calf vein thrombosis is particularly difficult in the ED when the definitive diagnostic test, whole-leg ultrasonography, is not available. These findings and the current guidelines suggest that there has been a paradigm shift toward more frequent use of DOAC in patients with DVT. However, greater educational efforts may be needed for many physicians to become comfortable with the use of DOAC in the outpatient management of patient populations at low risk for pulmonary embolism complications.

## References

1. Tagalakis V, Patenaude V, Kahn SR, Suissa S. Incidence of and mortality from venous thromboembolism in a real-world population: the Q-VTE Study Cohort. *Am J Med.* 2013 Sep; 126(9):832.e13-21. doi: 10.1016/j.amjmed.2013.02.024. Epub 2013 Jul 3. PMID: 23830539.
2. Alotaibi GS, Wu C, Senthilselvan A, McMurtry MS. Secular Trends in Incidence and Mortality of Acute Venous Thromboembolism: The AB-VTE Population-Based Study. *Am J Med.* 2016 Aug;129(8):879.e19-25. doi: 10.1016/j.amjmed.2016.01.041. Epub 2016 Feb 27. PMID: 26925811.
3. Cohen AT, Gitt AK, Bauersachs R, Fronk EM, Laeis P, Mismetti P, Monreal M, Willich SN, Bramlage P, Agnelli G, Prefer In VTE Scientific Steering Committee and The Prefer In VTE Investigators OBOT. The management of acute venous thromboembolism in clinical practice. Results from the European PREFER in VTE Registry. *Thromb Haemost.* 2017 Jun 27;117(7):1326-1337. doi: 10.1160/TH16-10-0793. Epub 2017 Apr 13. PMID: 28405675; PMCID: PMC6291854.
4. Silverstein MD, Heit JA, Mohr DN, Petterson TM, O'Fallon WM, Melton LJ 3rd. Trends in the incidence of deep vein thrombosis and pulmonary embolism: a 25-year population-based study. *Arch Intern Med.* 1998 Mar 23;158(6):585-93. doi: 10.1001/archinte.158.6.585. PMID: 9521222.
5. Wells PS, Hirsh J, Anderson DR, Lensing AW, Foster G, Kearon C, Weitz J, D'Ovidio R, Cogo A, Prandoni P. Accuracy of clinical assessment of deep-vein thrombosis. *Lancet.* 1995 May 27;345(8961):1326-30. doi: 10.1016/s0140-6736(95)92535-x. Erratum in: *Lancet* 1995 Aug 19;346(8973):516. PMID: 7752753.
6. Di Nisio M, Squizzato A, Rutjes AW, Büller HR, Zwiderman AH, Bossuyt PM. Diagnostic accuracy of D-dimer test for exclusion of venous thromboembolism: a systematic review. *J Thromb Haemost.* 2007 Feb;5(2):296-304. doi: 10.1111/j.1538-7836.2007.02328.x. Epub 2006 Nov 28. Erratum in: *J Thromb Haemost.* 2013 Oct;11(10):1942. PMID: 17155963.
7. de Valois JC, van Schaik CC, Verzijlbergen F, van Ramshorst B, Eikelboom BC, Meuwissen OJ. Contrast venography: from

- gold standard to 'golden backup' in clinically suspected deep vein thrombosis. *Eur J Radiol.* 1990 Sep-Oct;11(2):131-7. doi: 10.1016/0720-048x(90)90162-5. PMID: 2253634.
8. Bates SM, Jaeschke R, Stevens SM, Goodacre S, Wells PS, Stevenson MD, Kearon C, Schunemann HJ, Crowther M, Pauker SG, Makhadmeh R, Guyatt GH. Diagnosis of DVT: Antithrombotic Therapy and Prevention of Thrombosis, 9th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. *Chest.* 2012 Feb;141(2 Suppl):e351S-e418S. doi: 10.1378/chest.11-2299. PMID: 22315267; PMCID: PMC3278048.
  9. Goodacre S, Sampson F, Thomas S, van Beek E, Sutton A. Systematic review and meta-analysis of the diagnostic accuracy of ultrasonography for deep vein thrombosis. *BMC Med Imaging.* 2005 Oct 3;5:6. doi: 10.1186/1471-2342-5-6. PMID: 16202135; PMCID: PMC1262723.
  10. Heller T, Becher M, Kröger JC, Beller E, Heller S, Höft R, Weber MA, Meinel FG. Isolated calf deep venous thrombosis: frequency on venous ultrasound and clinical characteristics. *BMC Emerg Med.* 2021 Oct 30;21(1):126. doi: 10.1186/s12873-021-00516-1. PMID: 34717549; PMCID: PMC8557054.
  11. Seyedhosseini J, Fadavi A, Vahidi E, Saeedi M, Momeni M. Impact of point-of-care ultrasound on disposition time of patients presenting with lower extremity deep vein thrombosis, done by emergency physicians. *Turk J Emerg Med.* 2017 Dec 16;18(1):20-24. doi: 10.1016/j.tjem.2017.12.003. PMID: 29942878; PMCID: PMC6009805.
  12. Olaf M, Cooney R. Deep Venous Thrombosis. *Emerg Med Clin North Am.* 2017 Nov;35(4):743-770. doi: 10.1016/j.emc.2017.06.003. Epub 2017 Aug 23. PMID: 28987427.

#### Sažetak

### VENSKA TROMBOEMBOLIJA U HITNOJ MEDICINSKOJ SLUŽBI – ISKUSTVA JEDNOG CENTRA

I. Jurić i V. Neseck Adam

Venski tromboembolizam označava duboku vensku trombozu i plućnu emboliju, a uzevši u obzir važnost ranog prepoznavanja, nespecifičnosti simptoma i znakova, neophodno je pridržavanja smjernicama prilikom donošenja dijagnostičkih i terapijskih odluka. Ultrasonografija je trenutno standardna dijagnostička metoda za simptomatske bolesnike s kliničkom vjerojatnosti VTE prema Wellsovom bodovnom sustavu. Cilj rada je prikazati demografsku strukturu i analizirati broj bolesnika u hitnoj službi sa sumnjom na vensku trombozu. Unazad 10 godina, dijagnosticirano je 2022 bolesnika s DVT i 686 plućnih embolija. Unatoč protokolu, u gotovo dvije trećine bolesnika neophodna je rana ultrazvučna dijagnostika, sve više prihvaćena od strane liječnika, posebno u uvjetima hitne medicinske pomoći. U petine bolesnika, 21%, utvrđena je tromboza površinskog venskog sustava noge ili ruke. U 37% bolesnika s DVT tromb je bio prisutan u venama potkoljenice. Prisutnost tromba iznad razine koljena, uz zahvaćenost femoropoplitealnog dubokog venskog sustava, dokazan je u 38% bolesnika. Rezultati istraživanja i trenutne smjernice sugeriraju da je došlo do promjena u izboru antikoagulacijske terapije kod bolesnika s DVT, u prilog DOAK-a. Međutim, možda će biti potrebni veći naponi kako bi se liječnici odlučili za DOAK u vanbolničkim uvjetima liječenja bolesnika s plućnom embolijom.

Ključne riječi: *venska tromboza, plućna embolija, venotromboembolizam, hitna medicina*