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Correlations between clinical probability and Doppler ultrasound results in the assessment of deep venous thrombosis

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Abstract

Although the assessment of deep venous thrombosis (DVT) is based on clinical examination, the complementary tests and especially Doppler ultrasound plays the most important role in DVT diagnosis. **Objectives:** We aimed to establish the correlations between the clinical probability of DVT based on Wells score and the results of Doppler ultrasound exam. **Method:** We included 382 patients with clinical supposition of DVT divided into 3 groups based upon the probability of DVT (Wells score): low, moderate and high, respectively. All the patients were examined by Doppler ultrasonography. **Results:** We noticed that DVT was confirmed by Doppler ultrasonography in more than half of the cases; the highest percent of confirmed cases were in the patients with a high probability of DVT (70.58%) whereas the lowest percent was associated with the low clinical probability (14.63%). **Discussions:** These findings show the importance of the correct management of cases, starting with clinical data and including a complete anamnesis to identify the risk factors for DVT. **Conclusions:** There is a significant correlation between the Wells score reflected in the probability of DVT and the Doppler ultrasonography findings.

Keywords: deep venous thrombosis, Doppler ultrasonography, Wells score

Rezumat

Deşi evaluarea cazurilor de tromboză venoasă profundă (DVT) se bazează pe examenul clinic, explorările complementare şi în special ecografia Doppler joacă rolul cel mai important în diagnosticul DVT. **Obiective:** Am urmărit să stabilim corelaţiile între probabilitatea clinică a DVT bazată pe scorul Wells şi rezultatele examenului ecografic Doppler. **Metodă:** Am inclus 382 pacienţi cu suspiciune clinică de DVT împărţiţi în 3 grupuri în funcţie de probabilitatea de DVT (scorul Wells): mică, moderată şi respectiv înaltă. Toţi pacienţii au fost investigaţi prin ecografie Doppler. **Rezultate:** Diagnosticul de DVT a fost confirmat în peste 50% dintre cazuri. Cel mai mare procent de cazuri confirmate a fost în grupul cu probabilitatea clinică mare (70.58%), iar cel mai mic procent s-a asociat cu probabilitatea clinică mică (14.63%). **Discuţii:** Aceste constatări arată importanţa managementului corect a cazurilor, începând cu datele clinice şi incluzând o anamneză completă pentru identificarea factorilor de risc pentru DVT. **Concluzii:** Există o corelaţie semnificativă între scorul Wells reflectat în probabilitatea de DVT şi rezultatele ecografiei Doppler.

Cuvinte cheie: tromboză venoasă profundă, scor Wells, ecografie Doppler

Introduction

Venous thromboembolism, including deep venous thrombosis (DVT) and pulmonary embolism, is associated with a significant morbidity and mortality. It is considered to be the most common cause of death that may be prevented in hospitalized patients. The overall incidence of DVT is 1-2/year/1000 people [1].

The correct approach of DVT cases begins with the assessment of clinical probability based upon the Wells score that includes the presence of some risk factors as well as clinical signs [2]. DVT is a multi causal disease, the result of interaction between genetic and acquired risk factors. Although proximal DVT of the lower limbs is manifested with pain and edema in the affected leg, distal thrombosis may be less symptomatic or even asymptomatic leading to diagnosis difficulties. The clini-

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cal manifestations of DVT depend upon the degree of obstruction of the venous flow and the inflammation of the vein wall. Unilateral edema is considered to be the most specific sign of DVT [2].

The main risk factors DVT include: genetic thrombophilia (factor V Leiden, prothrombin mutation, deficits of protein C, S, antithrombin), surgical interventions, cancer, severe congestive cardiac failure, prolonged immobilization, partum and postpartum period, use of oral contraceptives [1].

Doppler ultrasound represents the most common used complementary examination for DVT diagnosis. For more than 12 years ultrasound has been considered to be an accurate method of detecting proximal lower limb thrombosis.

The sensitivity and specificity of this examination vary by vein; the best results are obtained for symptomatic proximal lower limb thrombosis showing a 96% sensitivity [1,2]. In asymptomatic patients with thrombosis of the proximal veins the specificity is still high but the sensitivity is lower. Studies reported a sensitivity of Doppler ultrasound of 73-75% for calf vein thrombosis [2]. Optimal sensitivity of the method is acquired using duplex ultrasound examination. The sensitivity of this method seems to be lower when the results are interpreted by a radiologist; the explanation of the authors was the fact that Doppler and color techniques may result in a higher variability [3]. The highest specificity and the lowest sensitivity are achieved by compression ultrasound alone. In symptomatic patients a single ultrasound examination of the venous system is feasible and safe [4].

The aim of the study was to assess the correlations between clinical probability of DVT based on Wells score and the confirmation of the diagnosis by ultrasound examination.

Method and material

We performed a prospective study during 01.01.2004-01.01.2007; we included 382 patients admitted to the 2nd Medical Clinic, Cluj-Napoca with the clinical supposition of DVT of the lower limb. The Wells score (table I) for the clinical probability of DVT (high probability of DVT if the score is ≥3 points; a moderate probability if the score is 1 or 2 points and a low probability if ≤0 points) was calculated and an ultrasound examination was performed in all cases. Based upon Wells score results the patients were divided into 3 groups: 82 with a low probability based on Wells score (first group), 130 with a moderate probability (second group) and 170 with a high probability (third group).

The ultrasound examination was performed using a 3-5 MHz (for iliac veins) convex transducer and 5-10 MHz (from femoral level to distal) linear transducer (Aloka Premiere alpha10). The findings for DVT diagnosis were considered to be the following: identification of a thrombus (with different degrees of echogenicity depending upon the moment of formation), the lack of compressibility of the vein, the distension of the recent thrombosed vein; Doppler findings included: decreased flow augmentation proximal to the occlusive thrombus, continuous flow distal to the affected vein and the absence or diminished Valsalva response. By color flow in non-occlusive thrombus the blood flow around the thrombus was analyzed; in vein occlusion the blood flow in the collateral tiny channels adjacent to the vein wall was searched (fig 1-5).

Ultrasonography of the lower extremity deep venous system was performed in supine position, with the head of the bed raised 20°–30°. The limb was externally rotated and slightly flexed at the knee. The transducer was placed transversely in the groin area to identify the common femoral vein and then was moved distally along the deep venous system, with a compression applied at 1-2

Table I. Wells score

Clinical situation	Points
Active cancer (treatment ongoing, or palliative within 6 months)	+1
Paralysis or recent plaster immobilization of the lower extremities	+1
Recently bedridden for >3 days or major surgery <4 week	+1
Localized tenderness along the distribution of the DV	+1
Entire leg swelling	+1
Calf swelling >3 cm compared to the asymptomatic leg	+1
Pitting edema in the symptomatic leg	+1
Previous deep venous thrombosis documented	+1
Collateral superficial veins (nonvaricose)	+1
Alternative diagnosis (at least as likely that of venous thrombosis)	-2

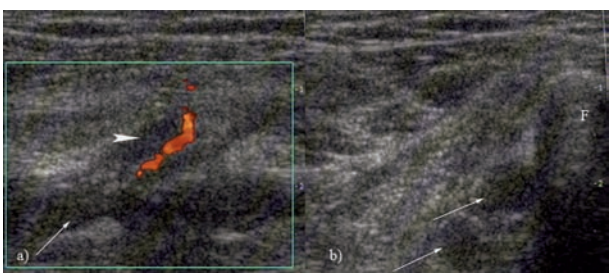


Fig 1. Longitudinal (a) and transverse (b) scan of the peroneal vein. Acute thrombosis of the both veins with extension in the peroneus muscle veins (arrowhead), F- fibula.

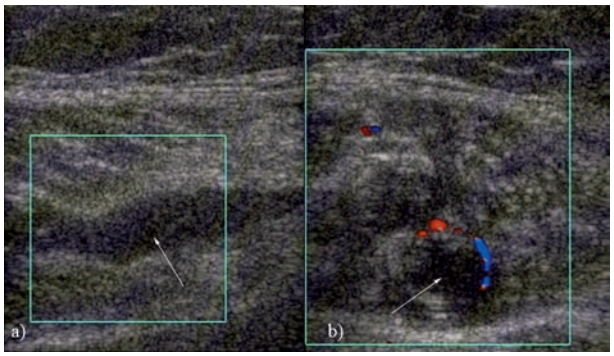


Fig 2. Acute and complete thrombosis of the gastrocnemian muscle vein (arrows)- longitudinal (a) and transverse (b) scan.

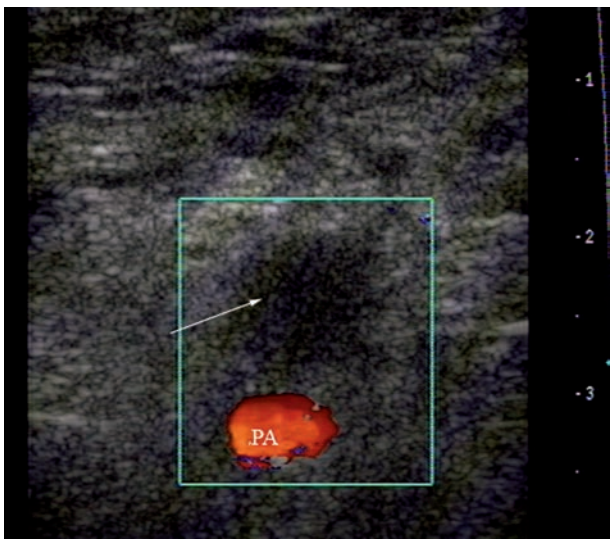


Fig 3. Transverse scan of the popliteal vein. Complete thrombosis (arrow). PA- popliteal artery.

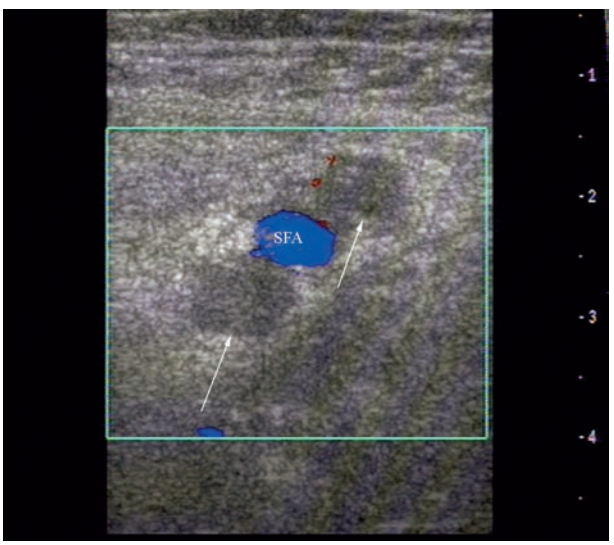


Fig 4. Transverse scan of the superficial femoral vein, at the middle of the thigh. Complete thrombosis of both veins (arrows). SFA – superficial femoral artery.

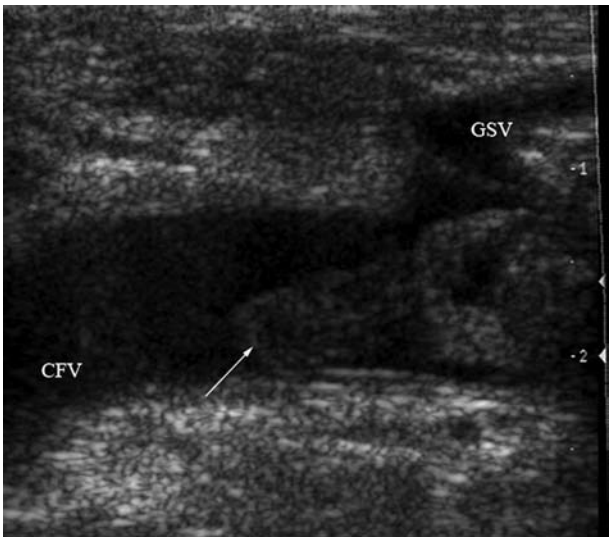


Fig 5. Longitudinal scan of the common femoral vein, at the inguinal level. Incomplete thrombosis at the great saphenous vein opening level (arrow); complete thrombosis in the proximal part of the vein. CFV- common femoral vein, GSV- great saphenous vein.

cm intervals. Compression of the veins within the adductor canal was sometimes difficult due to the deep course of the vein through the muscles. For the deep distal veins the examination was made with the patient in a sitting position with the affected leg hanging over the side of the bed.

The statistical methods used were chi-square test, Fisher test; $p<0.05$ was considered significant statistically.

Results

The mean age of the patients was 58.62 years old (standard deviation: 11.2); the sex distribution showed 242 men and 140 women, with a sex ratio male/female: 1.72:1. The distribution of the cases depending on the age decade is showen in fig 6.

Doppler ultrasound examination found DVT findings in 198 cases: proximal DVT in 102 cases and distal DVT in 96 patients.

DVT was overall diagnosed in 51.83% of cases: 70.58% (120 cases) from the group with high probability, respectively in 50.76% of cases with moderate probability (66 cases) and 14.63% of the patients with low probabilty (12 cases).

There was a significant difference regarding the DVT diagnosis between third group and the second group (p= 0.0005) and respectively, the first group (p=0.0001). There was also a significant difference between the second group and the first group (p= 0.0001).

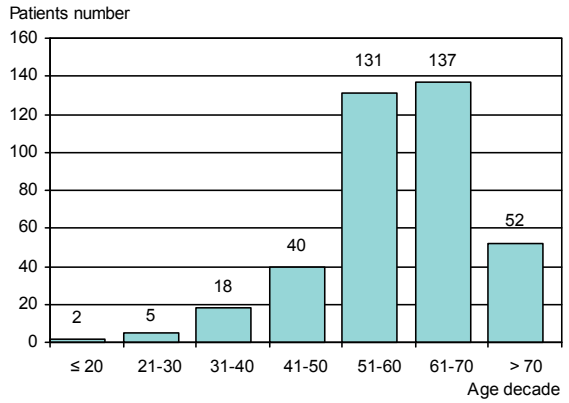


Fig 6. The distribution of the patients based upon age decade.

Discussions

Before 1995 the approach of DVT was to perform an ultrasound in any suspected DVT case and to repeat it in one week if the result was negative. However, studies showed that only 12-20% of the suspected cases presented DVT and thus this strategy proved to be ineffective. Wells score was published initially in 1988 and then was adapted. This clinical model enables physicians to assess the risk stratification, dividing cases in groups of low, moderate and high risk respectively, with impact in the future management of the case.

Thus, the recent guidelines [5] for DVT show that the measurement of D-dimers in cases with a low clinical probability of DVT represents the test of choice; a normal value of D-dimers rules out the diagnosis of DVT in these cases, whereas increased values require an ultrasound exam which confirm or not the diagnosis of DVT. Ultrasonography represents the test of choice in patients with a moderate or high risk probability of DVT. The measurement of D-dimers represents the next step in cases with a negative ultrasound result; if D-dimers present increased values, it is necessary to repeat the ultrasonography in one week whereas normal values rule out DVT in these cases (fig 7).

When the measurement of the D-dimers cannot be performed, Doppler ultrasound represents the test of choice for the confirmation of DVT diagnosis [1].

Several studies have reported a sensitivity of 95% and specificity of 98% of this method for the DVT diagnosis, especially for proximal thrombosis (2). The overall sensitivity of ultrasound is considered to be between 86-98% [6]. Ultrasound is less sensitive in patients with distal DVT; a negative ultrasound does not rule out the diagnosis of DVT at this level. Serial ultrasound or venography may be required for cases with suspected distal DVT and a negative ultrasound and for patients who have suspected proximal DVT and an equivocal ultrasound exam [1,5,7]. Serial ultrasound exams should be performed in cases with moderate and high risk probability based on Wells score, According to the guidelines, contrast venography is considered the test to rule out the diagnosis of DVT [1]. Venography or MRI could be performed when serial ultrasonography cannot be made.

In the absence of DVT, the veins collapse with a complete apposition of the vein walls during gentle compression. The loss of this property is the principal criterion for the diagnosis of DVT. Other changes include: the distention of the involved vein in acute thrombosis, the loss of the phasic respiratory venous flow pattern and a continuous flow wave.

Ultrasound direct changes showing DVT include the identification of the thrombus as an echoic mass within the vein; the diagnosis could be inconclusive in cases with fresh thrombus and/or artifacts [8,9]. Acute DVT is often anechoic but in time the clot became echoic.

According to several studies, patients with a high probability of DVT have over a 75% prevalence of DVT confirmed by tests whereas cases with a low pretest probability have a less than a 5% prevalence of DVT [10].

We obtained similar results in our study in cases with a high probability. However DVT was diagnosed on ultrasound in a higher percent in cases with a low probability, maybe due to the fact that we identified the distal thrombosis (with minor clinical signs) in almost 50% of the cases. However, another study showed that 12% of

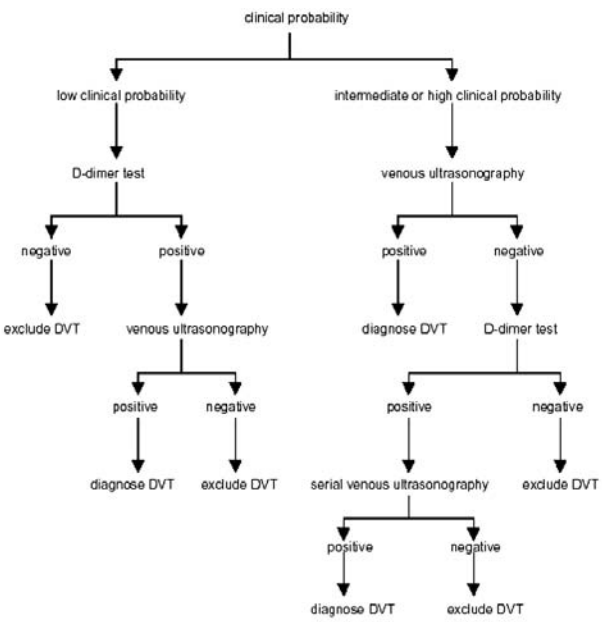


Fig 7. The assessment of DVT cases (adapted after [5]).

the patients with low clinical probability presented DVT [11]. The study shows that, a low clinical probability of DVT (a score of -1 or less) correlated with a confirmation in 14.63% of cases of DVT at ultrasound. The lack of correlation with d-dimer levels is the most important limit of our study.

Conclusions

There is a significant correlation between the clinical probability of DVT and the proportion of cases confirmed by ultrasound; ultrasound identified DVT in more than 50% of cases with a suspicion of DVT. In 70% of cases with a high probability of DVT this diagnosis was revealed by ultrasound; a moderate clinical probability of DVT correlated with 50.76% of confirmed diagnosis; a low clinical probability of DVT correlated with a confirmation in 14.63% of cases of DVT at ultrasound.

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