ECHOCOLOR DOPPLER LESSONS

The deep venous thrombosis of the lower limbs: ultrasound findings and differential diagnoses

Franco Accorsi
The deep venous thrombosis of the lower limbs.

Ultrasound findings and differential diagnoses.

INTRODUCTION

The echocolor Doppler is the current first-line tool for diagnosis of deep vein thrombosis (DVT) of the lower limbs because of its high sensitivity and specificity (when used by experienced sonographers) and because it is a non-invasive, inexpensive, repeatable test.

It is useful to distinguish:

1. between the proximal DVT and the isolated distal DVT (infra-popliteal deep veins alone). This distinction is important as embolic complications of clinical relevance occur, in the majority of cases, in proximal DVT.

2. between the anterograde DVT (centripetal extension) and the more rare retrograde DVT (centrifugal extension). This distinction may be important for diagnostic/therapeutic implications (the most frequent causes of the retrograde DVT are compressions, such as from neoplasm).

The ultrasound diagnosis is also important in patients with suspected DVT recurrence and in patients with conditions that mimic DVT.

In this lesson will be presented the echo-color-Doppler ultrasound findings in proximal and distal DVT and in the suspected DVT recurrence.
DVT OF THE LOWER LIMBS

1. acute DVT: ultrasound findings
2. old DVT: ultrasound findings
3. recurrent DVT
4. differential diagnoses
DVT OF THE LOWER LIMBS

1. acute DVT: ultrasound findings
2. old DVT: ultrasound findings
3. recurrent DVT
4. differential diagnoses
RECENT THROMBUS: ULTRASOUND FINDINGS

The recent thrombus is:

i. occlusive

ii. hypoechogenic

iii. voluminous (increases the venous diameter).
RECENT THROMBUS: ULTRASOUND FINDINGS

It is useful to distinguish between:

1. proximal DVT:
   i. inferior vena cava and the iliac veins
   ii. femoral veins (common, profundus and superficial)
   iii. popliteal vein

2. isolated distal DVT:
   i. infra-popliteal deep veins alone

This distinction is important as embolic complications of clinical relevance occur, in the majority of cases, in proximal DVT.
RECENT THROMBUS: ULTRASOUND FINDINGS

It is useful to distinguish between:

1. anterograde DVT (centripetal extension). DVT usually starts in the calf veins and then it may extend to the proximal veins

2. retrograde DVT (centrifugical extension: more rare). Possible causes:
   i. compression (neoplasms, aneurysm...)
   ii. trauma, surgery, iatrogenic
   iii. DVT extension from collateral veins

This distinction is important for diagnostic/therapeutic implications (the most frequent causes are compressions, such as from neoplasm)
THE DVT ULTRASOUND STUDY OF THE INFERIOR VENA CAVA AND VEINS OF THE LOWER LIMBS

two diagnostic strategies are possible:

1. simple compression ultrasound (s-CUS): CUS of the common femoral and popliteal veins

2. complete echocolor Doppler study of the caval, iliac, and lower limbs veins (with morphologic and functional assessment), or complete CUS (CUS of the proximal and distal veins)
ULTRASOUND FINDINGS

1. proximal DVT:
   i. inferior vena cava and the iliac veins
   ii. femoral veins (common, profundus and superficial)
   iii. popliteal vein

2. isolated distal DVT:
   i. DVT of the infra-popliteal deep veins alone
DVT OF THE LOWER LIMBS
ultrasound findings

DVT DIAGNOSIS

In case of suspected:

1. inferior vena cava DVT
2. iliac veins DVT

a. it is required the complete venous ultrasound investigation with the direct visualization of the thrombus
b. it is difficult/impossible the CUS diagnosis due to the anatomical position of the inferior vena cava and the iliac veins
US study of the inferior vena cava and the iliac veins: method

- The investigation is performed with probes 3.5-5 MHz.
- It is necessary the adjustments of the device, particularly the gain and the Pulse Repetition Frequency (PRF).
- A high PRF can lead to non-visualization of the flow (the venous flow is a low velocity flow).
- In the common femoral veins the lack of respiratory variations of the flow and the lack of variations of the waveform during the flow augmentation maneuvers, indicate proximal obstruction.
DVT OF THE LOWER LIMBS
ultrasound findings

proximal, anterograde DVT with centripetal extension

complete venous ultrasound investigation in anterograde DVT

- progressive, spontaneous, DVT of the Lt lower limb, Lt. iliac vein (a) and inferior caval vein (b: tranverse and longitudinal scan) in young girl
DVT OF THE LOWER LIMBS ultrasound findings

proximal, anterograde DVT with centripetal extension

---

complete venous ultrasound investigation in progressive postoperative DVT

- DVT of the lt lower limb, lt., of the common femoral vein (a: longitudinal and transverse scan), of the lt. iliac vein (b: longitudinal scan). The inferior caval vein is patent with regular flow (c: longitudinal scan)
DVT OF THE LOWER LIMBS ultrasound findings

rt. iliac vein, retrograde, DVT with centrifugal extension

*complete venous ultrasound investigation in retrograde DVT*
- longitudinal scans: DVT of the right external iliac vein (b) due to extrinsic compression of the inferior vena cava (a: abdominal neoplasia)
ICV retrograde DVT with centrifugal extension

Complete venous ultrasound investigation in retrograde DVT

Longitudinal scans: DVT of the inferior vena cava (a) due to extrinsic compression (abdominal neoplasia). The rt. and lt. external iliac veins (b) are patent with a very low flow.
**DVT OF THE LOWER LIMBS ultrasound findings**

iliac vein, retrograde, DVT with centrifugal extension

---

**complete venous ultrasound investigation in retrograde DVT**

- Longitudinal scans: Lt. common iliac vein (a) compressed by an aneurysm of the Lt. common iliac artery. The Lt. external iliac vein (b) and the Lt. common femoral vein (c) are patent and present a continuous, very poor, flow (with lack of variations of the waveform during the flow augmentation maneuvers)
DVT OF THE LOWER LIMBS ultrasound findings

iliac vein, retrograde, DVT with centrifugal extension

c) common fem. vein

a) ext. iliac vein

b) lymphoma

complete venous ultrasound investigation in retrograde DVT

- longitudinal scans: a) DVT of the external iliac vein, compressed by abdominal lymphoma (b). Downstream of the compression is present a low flow. c) the common femoral vein is still patent, with very slow flow (smoke-like echo due to blood stasis)
DVT OF THE LOWER LIMBS ultrasound findings

iliac vein and common femoral, retrograde, DVT with centrifugal extension

a) iliac and common fem. vein (transverse scan)

b) superficial fem. vein (longitudinal and transverse scan)

c) popliteal vein (transverse scan)

complete venous ultrasound investigation in retrograde DVT in abdominal neoplasia

a) DVT of the external iliac and common femoral vein. Downstream the veins are partially patent (b, superficial femoral vein) or patent (c, popliteal vein)
ULTRASOUND FINDINGS

1. proximal DVT:
   i. inferior vena cava and the iliac veins
   ii. femoral veins (common, profundus and superficial)
   iii. popliteal vein

2. isolated distal DVT:
   i. DVT of the infra-popliteal deep veins alone
US study of the veins of the lower limbs: method

- the investigation is performed, currently, with probes 7.5-10 MHz. (the veins are relatively superficial).
- it is necessary the study of the compressibility and the presence of venous flow
DVT OF THE LOWER LIMBS ultrasound findings

DVT DIAGNOSIS:

In case of suspected:
1. femoral DVT
2. popliteal DVT

Two possible diagnostic strategies are possible:

a. the CUS diagnosis

a. the complete echocolor Doppler study (complete venous ultrasound investigation)
DVT OF THE LOWER LIMBS ultrasound findings

proximal, anterograde DVT with centripetal extension
DVT usually starts in the calf veins and then it may extend to the proximal veins

gastrocnemius vein
popliteal vein
superficial femoral vein
common femoral vein

complete CUS in anterograde DVT
- transverse scans: DVT from gastrocnemius veins extended in popliteal vein, in superficial and common femoral vein. The end of the thrombus is mobile, in the common femoral vein.
DVT OF THE LOWER LIMBS
ultrasound findings

common femoral vein retrograde DVT with centrifugal extension

CUS diagnosis in retrograde DVT
- transverse scan: DVT of the common femoral vein (a) compressed by a common femoral artery aneurysm (b) with extensive mural heterogeneous thrombus (diam = 1.83 x 2.42 cm.)
DVT OF THE LOWER LIMBS ultrasound findings

proximal, anterograde DVT with centripetal extension

complete echocolor Doppler study in anterograde DVT

- transverse and longitudinal scans: DVT of the posterior tibial veins (a). In this case this distal DVT is a part of a diffuse pathology) extended in popliteal vein (b), in common femoral vein (c). The end of the thrombus is mobile, in the external iliac vein (d)
DVT of the lower limbs ultrasound findings

Proximal, anterograde DVT with centripetal extension

Complete echocolor Doppler study in anterograde DVT

DVT of the posterior tibial veins (a: transverse scan) extended in popliteal vein (b: longitudinal scan), in superficial (c: longitudinal scan), and common femoral vein (d: longitudinal scan: the end of the thrombus is mobile, in the common femoral vein and the greater saphenous vein is patent)
antegrade SVT with centripetal extension
(the saphenofemoral junction as source for DVT)

**complete echocolor Doppler study in antegrade DVT:**
- longitudinal scans: two SVT of greater saphenous veins extending into the deep venous system: free-floating" thrombi with a "tongue" extending into the common femoral veins. The saphenofemoral junctions are source for deep venous extension
DVT OF THE LOWER LIMBS ultrasound findings

anterograde SVT with centripetal extension
(the saphenofemoral junction as source for DVT)

complete echocolor Doppler study in anterograde DVT:
- longitudinal scans: SVT of the greater saphenous vein (a) extending into the deep venous system (b, c: "free-floating" thrombus extending into the common femoral vein). The saphenofemoral junction is source for deep venous extension
**DVT OF THE LOWER LIMBS ultrasound findings**

**complete echocolor Doppler study in anterograde DVT:**

a) Longitudinal scans: DVT of the common femoral vein with “free-floating” thrombus. The saphenofemoral junction is open with continuous flow, compensatory.

b) Transverse scan: the venous lumen is almost completely occupied by thrombus.
DVT OF THE LOWER LIMBS ultrasound findings

anterograde SVT with centripetal extension
(the saphenopopliteal junction as source for DVT)

complete echocolor Doppler study in anterograde DVT:
- Longitudinal scans: SVT of the short saphenous vein (a) extending into the popliteal vein (b) with the end of the “free-floating” thrombus in superficial femoral vein (c). The saphenopopliteal junction is source for deep venous extension.
DVT OF THE LOWER LIMBS
ultrasound findings

ULTRASOUND FINDINGS

1. proximal DVT:
   i. inferior vena cava and the iliac veins
   ii. femoral veins (common, profundus and superficial)
   iii. popliteal vein

2. isolated distal DVT:
   i. DVT of the infra-popliteal deep veins alone
DVT OF THE LOWER LIMBS ultrasound findings

proximal, anterograde DVT with centripetal extension

complete echocolor Doppler study in anterograde DVT
- DVT of the gastrocnemious veins (a, transverse scans) extended in popliteal vein (b, longitudinal and transverse scans). The end of the thrombus is mobile, in the popliteal vein
DVT OF THE LOWER LIMBS ultrasound findings

proximal, anterograde DVT with centripetal extension

a)

b)

complete echocolor Doppler study in anterograde DVT (longitudinal and transverse scans)

- DVT of one posterior tibial vein (a, transverse scan) extended in popliteal vein (b, longitudinal and transverse scan)
DVT OF THE LOWER LIMBS
ultrasound findings

proximal, retrograde DVT with centripetal extension

complete echocolor Doppler study in retrograde DVT

- retrograde iatrogenic (surgical) popliteal DVT (a, longitudinal scan: area with absence of color is visualized) extended to posterior tibial veins (b, transverse scan)
DVT OF THE LOWER LIMBS
ultrasound findings

ULTRASOUND FINDINGS

1. proximal DVT:
   i. inferior vena cava and the iliac veins
   ii. femoral veins (common, profundus and superficial)
   iii. popliteal vein

2. isolated distal DVT:
   i. DVT of the infra-popliteal deep veins alone
ANATOMICAL CONSIDERATIONS

The term "distal" means distal to the knee.

This includes:

A. the paired deep calf veins (the peroneal, posterior tibial and anterior tibial veins)

B. the calf muscle veins (the gastrocnemius and the soleus muscle veins)
DVT OF THE LOWER LIMBS ultrasound findings

A. DEEP CALF VEINS anatomical considerations

i. the peroneal veins (medially to the fibula)

ii. the posterior tibial veins (dorsal to the tibia)

iii. the anterior tibial veins (in the anterior compartment from the fibula to the tibia)

The confluent segments of the peroneal and of the posterior tibial veins unify in the popliteal vein, which at this point also collects the anterior confluent segment.
B. THE CALF MUSCLE VEINS
anatomical considerations

i. the gastrocnemius veins drain via
two stem veins (medial and lateral)
into the popliteal vein

ii. the soleus muscle veins (connect
to the posterior tibial or peroneal
veins)
DVT OF THE LOWER LIMBS ultrasound findings

**DEEP DISTAL VEINS AND COMPARTMENTS:**

1. anterior compartment (anterior tibial vein);
2. deep posterior compartment (peroneal and posterior tibial vein);
3. superficial posterior compartment (gastrocnemius and soleus muscle veins)
a. DEEP CALF DEEP VEINS: ANATOMICAL CONSIDERATIONS

DEEP CALF VEINS: COMPARTMENTS

i. the peroneal veins (medially to the fibula, in the deep posterior compartment)
ii. the posterior tibial veins (dorsal to the tibia, in the deep posterior compartment)
iii. the ant. tibial veins (in the ant. compartment from the fibula to the tibia)
CALF MUSCLE VEINS: ANATOMICAL CONSIDERATIONS

i. the gastrocnemius veins drain via two stem veins (medial and lateral) into the popliteal vein in the superficial posterior compartment

ii. the soleus muscle veins connect to the posterior tibial or peroneal veins, in the superficial posterior compartment
Anatomical considerations

Even if anatomy does not solve this nomenclature problem, the following terms should be used in clinical practice.

1. Isolated calf muscle vein thrombosis (ICMVT) is a thrombosis confined to the muscle veins only.

2. Deep calf vein thrombosis (DCVT) is a thrombosis present in the paired calf veins.

3. Isolated distal deep vein thrombosis (IDDVT) is the composite of ICMVT and DCVT – occurring either in isolation or in combination.

*Isolated distal deep vein thrombosis: what we know and what we are doing. G. PALARETI and S. SCHELLONG. J Thromb Haemost 2012*
ISOLATED DISTAL DEEP VEIN THROMBOSIS

- thromboses that are restricted to the infra-popliteal deep veins of the lower limbs (isolated distal deep vein thrombosis, IDDVT) are frequently diagnosed in subjects with suspected pulmonary embolism (PE; 7–10%) or DVT (4–15%), accounting for 31–56% of all diagnosed leg DVTs.
- despite their frequency, IDDVTs still remain one of the most debated issues in the field of venous thromboembolism (VTE).
- conflicting clinical results have resulted in differing opinions on the need to test for IDDVTs and how to treat them.
- due to discordant results, the real risk of IDDVT-associated PE is not well established.
- IDDVTs are associated with lower risk of recurrence when compared with other VTEs, and fewer late sequelae than proximal DVT.

Isolated distal deep vein thrombosis: what we know and what we are doing. G. PALARETI and S. SCHELLONG. J Thromb Haemost 2012
SYMPTOMATIC CALF DVT AND RISK OF EXTENSION

- the majority of symptomatic episodes of DVT also start in the calf veins; however, symptoms are uncommon until there is involvement of the proximal veins.

- there is also evidence that, in the absence of treatment, about one quarter to one third of episodes of symptomatic, isolated distal DVT extend to involve the proximal veins.

*Clive Kearon. Natural History of Venous Thromboembolism. Circulation 2003*
DVT of the lower limbs ultrasound findings

DVT diagnosis in case of suspected isolated distal DVT
Two possible US diagnostic strategies are possible:

a. the complete CUS diagnosis
b. the complete echocolor Doppler study (complete venous ultrasound investigation)

It is useful to examine the lower leg while hanging down or standing on a stool in order to provide sufficient distension of the veins.
ultrasound diagnosis in isolated distal DVT:
The ultrasound diagnosis of the below-the-knee thrombus is:
i. more operator-dependent
ii. less sensitive

than proximal vein ultrasound examination
DVT OF THE LOWER LIMBS ultrasound findings

isolated distal DVT

complete echocolor Doppler study in isolated distal DVT
- gastrocnemious veins thrombosis (longitudinal and transverse scans)
DVT OF THE LOWER LIMBS
ultrasound findings

isolated distal DVT

complete echocolor Doppler study in isolated distal DVT
- gastrocnemius veins thrombosis (longitudinal and transverse scans)
DVT OF THE LOWER LIMBS
ultrasound findings

isolated distal DVT

gastrocnemious thrombosis
gastrocnemious thrombosis

CUS diagnosis in isolated distal DVT
a. gastrocnemious DVT occlusive (transverse scan)
b. gastrocnemious DVT not occlusive (transverse scan)
DVT OF THE LOWER LIMBS
ultrasound findings

isolated distal DVT

complete echocolor Doppler study in isolated distal DVT
- soleal vein thrombosis (longitudinal and transverse scan)
DVT OF THE LOWER LIMBS ultrasound findings

isolated distal DVT

gastrocnemious vein thrombosis

complete echocolor Doppler study in isolated distal DVT
- gastrocnemious vein non occlusive thrombosis (longitudinal and transverse scans)
DVT OF THE LOWER LIMBS ultrasound findings

isolated distal DVT

posterior tibial veins thrombosis

complete echocolor Doppler study in isolated distal DVT
- post. tibial veins thrombosis (longitudinal and transverse scan)
DVT OF THE LOWER LIMBS
ultrasound findings

perforating veins as source for deep venous extension

posterior tibial veins and perforating vein thrombosis

perforating vein as site of involvement
- progressive thrombosis of perforating veins extending into the deep venous system (transverse scans)
SYMPTOMATIC CALF DVT AND RISK OF EXTENSION

- The majority of symptomatic episodes of DVT also start in the calf veins; however, symptoms are uncommon until there is involvement of the proximal veins.

- There is also evidence that, in the absence of treatment, about one quarter to one third of episodes of symptomatic, isolated distal DVT extend to involve the proximal veins.

DVT OF THE LOWER LIMBS
ultrasound findings

isolated distal DVT: popliteal extension

a)

gastrocnemius DVT extended in pop. vein

b)

complete echocolor Doppler study in anterograde DVT
DVT of the gastrocnemius veins extended in popliteal vein. Floating thrombus: longitudinal (a) and transverse (b) scans
DVT OF THE LOWER LIMBS
ultrasound findings

isolated distal DVT: popliteal extension

**complete venous US investigation:**

**gastrocnemius DVT and control after heparin therapy**

- **a)** acute phase: longitudinal scan of the gastrocnemius DVT (complete occlusion). It is possible to visualize directly the distal end of the DVT. The popliteal vein is open.
- **b)** control 8 days later: longitudinal and transverse scans. Partial recanalization of the gastrocnemius DVT, but popliteal extension of the DVT.
DVT OF THE LOWER LIMBS

1. acute DVT: ultrasound findings
2. old DVT: ultrasound findings
3. recurrent DVT
4. differential diagnoses
OLD THROMBUS: US CHARACTERISTICS

There are no safe criteria, but normally an old thrombus is:

i. hyperechogenic

ii. with signs of recanalization and pathological reflux

iii. the diameter of the vein can be smaller than the native vein (due to partial sclerosis of the vein).
DVT OF THE LOWER LIMBS
ultrasound findings

RECENT AND OLD THROMBUS: US CHARACTERISTICS

**recent thrombus: US findings**

i. occlusive
ii. hypoechogenic
iii. voluminous

**old thrombus: US findings**

i. hyperechogenic
ii. with signs of recanalization and pathological reflux
DVT OF THE LOWER LIMBS
ultrasound findings

VEIN RECANALIZATION AFTER A DVT IS POSSIBLE!

VEIN RECANALIZATION AFTER A DVT

- ultrasonographic assessment of the common femoral and popliteal veins was performed 3 months after acute DVT (313 consecutive symptomatic outpatients). Veins were considered recanalized if they were 2.0 mm or less in diameter on a single test or 3.0 mm or less in diameter on two consecutive tests.

- the cumulative incidence of normal results on ultrasonography was:

  i. 38.8% at 6 months
  ii. 58.1% at 12 months
  iii. 69.3% at 24 months
  iv. 73.8% at 36 months

DVT OF THE LOWER LIMBS ultrasound findings

vein recanalization after a DVT

**complete ECD study in popliteal retrograde DVT: follow up**

- a) acute phase (post traumatic DVT): transverse and longitudinal scans.
- b) after 10 days (transverse and longitudinal scans)
- c) after 6 months (transv. and longit. scans): CUS = 6,9 mm. (partial recanalization)
DVT OF THE LOWER LIMBS ultrasound findings

vein recanalization after a DVT

complete ECD study in popliteal anterograde DVT: follow up
a) acute phase: occlusive popliteal DVT (transverse and longitudinal scans).
b) controls after 6 months: partial recanalization (transverse and longitudinal scans).
DVT OF THE LOWER LIMBS ultrasound findings

vein recanalization after a DVT

outcome of previous popliteal DVT

a) color/Bmode: longitudinal scans: residual vein thrombus (partial recanalization) of the popliteal vein.

b) hemodynamic study: valvular insufficiency is present.
DVT OF THE LOWER LIMBS ultrasound findings

vein recanalization after a DVT

**echocolor Doppler study in gastrocnemius veins DVT: follow up**
- gastrocnemius veins DVT follow up (transverse and longitudinal scans):
  a) acute phase (complete occlusion)
  b) control two months later (partial recanalization)
DVT OF THE LOWER LIMBS
ultrasound findings

vein recanalization after a DVT

complete ECD study in posterior tibial veins DVT: follow up
- posterior tibial veins DVT follow up:
  a) acute phase (complete occlusion: transverse scan);
  b) control two months later (complete recanalization: trans. and long. scans)
cCUS in the chronic phase of DVT

- often there is the residual thrombus
- CUS evaluation of the residual vein thrombus is important for prognostic (it is a risk factor for DVT recurrence) and diagnostic purposes (it is useful in the diagnosis of relapse)
- in these phases the echocolor Doppler can visualize the recanalized lumen and evaluate the continence / incontinence of the vein valve
DVT OF THE LOWER LIMBS ultrasound findings

a) longitudinal scan: residual vein thrombus

b) CUS: residual lumen = 0.69 x 1.2 cm

outcome of previous popliteal DVT with residual vein thrombus

a) presence of residual vein thrombus (partial recanalization)
b) CUS confirms the presence of residual vein thrombus
DVT OF THE LOWER LIMBS ultrasound findings

a) **longitudinal scan:**
   residual vein thrombus and valvular insufficiency

b) **CUS:**
   residual lumen = 0.84 x 0.57 cm

**outcome of previous popliteal DVT with residual vein thrombus**

a) presence of residual vein thrombus. The hemodynamic study allows to assess the valve function (in this case, valvular insufficiency is present)
b) CUS: residual vein thrombus
DVT OF THE LOWER LIMBS

1. acute DVT: ultrasound findings
2. old DVT: ultrasound findings
3. recurrent DVT
4. differential diagnoses
SUSPECTED DVT RECURRENCE

RISK OF RECURRENT VENOUS THROMBOEMBOLISM (VTE)

- In patients with a first episode of VTE associated with a major transient risk factor, the risk of recurrence after anticoagulants are stopped is \( \approx 3\% \) per year.

- In those with a continuing risk factor such as an underlying malignancy, or those with idiopathic thrombosis, this risk is at least 10\% per year, and the risk is greatest shortly after stopping therapy.

- Compared with proximal DVT or PE, isolated distal (calf) DVTs are associated with a lower risk of recurrent VTE.

*Clive Kearon. Natural History of Venous Thromboembolism. Circulation. 2003*
the clinical diagnosis is inaccurate for distinguishing a new episode of DVT from other causes of edema or pain in the leg.

in the case of suspected DVT recurrence, it has been proven that two-thirds of patients do not have an acute venous thrombosis.

SUSPECTED DVT RECURRENCE

symptoms

- the symptoms of DVT recurrence appear in one-third of patients who have suffered from DVT
- in patients with suspected DVT recurrence it is very important to use a diagnostic tool because the clinical diagnosis is inaccurate for distinguishing a DVT recurrence from other causes of edema or pain in the leg
CUS with a consideration of venous diameter is highly sensitive in identifying DVT recurrence.

RESIDUAL VEIN THROMBOSIS AND SUSPECTED DVT RECURRENTE

when a comparison with a previous ultrasound examination is available, the proximal DVT recurrence is ruled out if the residual vein thrombus is increased less than 2 mm compared to the previous examination.

CUS AND SUSPECTED DVT RECURRENCE

- A new DVT can be diagnosed owing to the presence of a new non-compressible venous segment or to the increase of the residual thrombus ≥ 4 mm.
- If the residual thrombus has not increased or if its increase is ≤ 2 mm compared to the previous examination, the presence of proximal recurrence of DVT is ruled out.
- D-dimer can be useful in cases in which the US test is not diagnostic (increase of the residual thrombus between 2 and 4 mm): a negative d-dimer would rule out the recurrence of DVT.

popliteal DVT recurrence

a) longitudinal and transverse scans: echogenic material in the popliteal vein and incomplete compressibility of the vein (CUS = 0.37 mm.) due to the residual venous thrombosis

b) control one year later (patient with edema of the calf and pain). The residual vein thrombus (CUS = 0.67 mm.) is increased more than 2 mm. compared with the previous ultrasound examination: DVT recurrence
RESIDUAL VEIN THROMBOSIS
AND SUSPECTED DVT RECURRENCE

- pitfalls may result from a technical error in CUS or from interpreting chronic DVT as acute DVT
- however, the CUS with a consideration of venous diameter is highly sensitive in identifying DVT recurrence

DVT OF THE LOWER LIMBS

1. acute DVT: ultrasound findings
2. old DVT: ultrasound findings
3. recurrent DVT
4. differential diagnoses
DVT OF THE LOWER LIMBS differential diagnoses

DVT differential diagnoses

With ultrasound it is possible to detect conditions that mimic DVT, such as popliteal cyst (the most common mass in the popliteal fossa), muscular rupture, hematoma, lymphoedema or tumors.
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB LOCALIZATION

i. bilateral
ii. unilateral
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB

i. bilateral

ii. unilateral

POSSIBLE CAUSES

- hypoproteinemia (for example: cirrosis, nephrotic syndrome)
- heart failure
- iatrogenic
- obstruction of the inferior vena cava
- lymphedema
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
bilateral localization

BILATERAL EDEMA IN IVC THROMBOSIS
floating thrombus in the inferior vena cava
resulting in venous stasis of the lower limbs
BILATERAL EDEMA (RT. > LT.) IN HEART FAILURE AND RT. BAKER'S CYST

a) transverse scan: dilatation of the common femoral vein (= 2.11 cm.) due to heart failure

b) longitudinal scans: venous pulsatility, bilaterally (femoral and popliteal veins) due to heart failure. Cardiac arrhythmia

c) dilatation of the rt. popliteal vein and Baker's cyst. The Baker's cyst rupture causes diffusion of synovial fluid along the calf (which explains the edema rt. > lt.).
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
bilateral localization

BILATERAL EDEMA IN HEART FAILURE AND LT. SVT (SSV)
a) transverse scans: venous pulsatility, bilaterally (femoral and popliteal veins) due to heat failure
b) longitudinal scans: SVT of the small saphenous vein and collateral
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
i. bilateral
ii. unilateral

- DVT and SVT
- post-thrombotic syndrome
- chronic venous insufficiency
- infection, cellulitis and lymphedema
- fracture and muscle hematoma
- A-V fistulas
- Baker’s cyst
- torn gastrocnemius muscle
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
uniteral localization

BAKER'S CYST
the most common mass in the popliteal fossa

- fluid distention of the gastrocnemius-semimembranosus bursa. Often asymptomatic, its rupture can cause pain in the calf or popliteal fossa with diffusion of synovial fluid along the calf
- ultrasound: a complex, cystic mass in the medial popliteal fossa
DVT OF THE LOWER LIMBS 
differential diagnoses

SWELLING OF THE LOWER LIMB 
uniteral localization

BAKER'S CYST

- fluid distention of the gastrocnemius-semimembranosus bursa.
- ultrasound: cystic mass in the medial popliteal fossa. The popliteal vein is open: no DVT
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMP
uniteral localization

BAKER'S CYST
- Baker's cyst rupture with diffusion of synovial fluid along the calf, with (a) longitudinal and (b) transverse scan
DVT OF THE LOWER LIMBS differential diagnoses

SWELLING OF THE LOWER LIMB uniteral localization

MUSCLE TEAR

- ultrasound: anechoic fluid collection in the rectus femoris muscle (longitudinal and tranverse scan: a, b)
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
uniteral localization

MUSCLE TEAR
- ultrasound: anechoic fluid collection in the gastrocnemius muscle
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
unilateral localization

HEMATOMA
soleus/gastrocnemius hematoma

- longitudinal and transverse scans: anechoic fluid collection between soleus/gastrocnemius muscles
DVT OF THE LOWER LIMBS differential diagnoses

SWELLING OF THE LOWER LIMB uniteral localization

SOLEUS MUSCLE CONTUSION WITH EDEMA OF THE CALF

a) longitudinal scans: soleus contusion
b) longitudinal and transverse scans: the popliteal, gastrocnemius and soleus veins are open
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
uniteral localization

GASTROCNEMIUS DVT AND HEMATOMA
- simultaneous presence of gastrocnemius DVT and hematoma
- longitudinal scan: anechoic fluid collection in the muscle and DVT of two gastrocnemius veins
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
unilateral localization

LYMPHEDEMA
- tissue fluid accumulation as a consequence of impaired lymphatic drainage
- ultrasound: thickening of the cutaneous, epifascial and subfascial compartments (a, b)
DVT OF THE LOWER LIMBS differential diagnoses

SWELLING OF THE LOWER LIMB uniteral localization

A-V FISTULA
- abnormal communication between an artery and vein
- ultrasound:
  a. visible connection between the artery and vein with spreading of color pixels into the extraluminal soft tissues
  b. high-velocity arterialized waveform in the draining vein
DVT OF THE LOWER LIMBS
differential diagnoses

SWELLING OF THE LOWER LIMB
uniteral localization

SOFT-TISSUE NEOPLASMS

- ultrasound: muscle mass with heterogeneous echo texture and indistinct margins. Ultrasound is nonspecific in the evaluation of a soft-tissue mass (hemorrhage and hemorrhagic or necrotic neoplasm may appear similar)
a DVT of the same district may result different symptoms
A DVT of the same district but with:

i. a different extend of thrombosis
ii. a different severity of associated vascular occlusion
iii. a different adequacy of collateral vessels

involves different signs and symptoms
DVT OF THE LOWER LIMBS
ultrasound findings

common femoral DVT: ultrasound findings

*a DVT of the same district may result different symptoms*

common femoral DVT with different symptoms

i. for the different localization of the head of the thrombus

ii. for the activation of collateral veins *(a significant edema occurs when thrombosis involves a main collector and becomes occlusive)*
DVT OF THE LOWER LIMBS ultrasound findings

common femoral DVT: ultrasound findings

*a DVT of the same district may result different symptoms*

common femoral DVT with different symptoms:

a) is involved the saphenofemoral crosse resulting in severe venous stasis
b) the internal saphenous vein is patent and acts as collateral circulation (resulting a lower obstacle to the flow)
DVT OF THE LOWER LIMBS
ultrasound findings

superficial femoral DVT: ultrasound findings

*a DVT of the same district may result different symptoms*

superficial femoral DVT with different symptoms
(in superficial femoral vein duplication)

a) in this case DVT of two superficial femoral veins
b) in this case DVT of only one superficial femoral vein
DVT OF THE LOWER LIMBS
ultrasound findings

popliteal DVT: ultrasound findings

a DVT of the same district may result in different symptoms

popliteal DVT with different symptoms:

a) popliteal vein not occlusive resulting in severe venous stasis
b) popliteal vein not occlusive resulting in a lower obstacle to the flow
short videos and playlists on echocolor Doppler physics are available on
https://www.facebook.com/francoaccorsiecodoppler/ and my youtube channel:
http://www.youtube.com/channel/UCij561sX0bQoEjXIWKhPnKg