E.3 DVT diagnosis (ultrasound)

In people with suspected DVT, what is the effectiveness of ultrasound in detecting deep vein thrombosis?

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Goodacre 2006 (HTA) [170] **Study design:** Systematic Review and meta-analysis **Duration of follow-up:**	**Patient group:** Patients with clinically suspected DVT **Exclusion criteria:** Prognostic studies (ie cohort studies that measured the risk of DVT developing after testing rather than the probability of VT being present at time of testing); Case-control studies (ie those selected on the basis of the results	**Assessment tool under investigation:** **Compression** **Colour Doppler** **Continuous wave Doppler** **Triplex** **Duplex** **Others** **Reference standard: Venography**	**Cohorts with clinically suspected DVT:** **Pooled Sensitivity for detecting any DVT:** **Pooled Sensitivity for detecting proximal DVT:** **Pooled Sensitivity for detecting distal DVT:** **Pooled Specificity (from all 98 studies):** **Pooled Specificity (from 53 studies reporting full data):** **PPV**	**Results of meta-analysis (95% CI, p-value):** 89.7% (88.8 to 90.5, p<0.001) 94.2% (93.2 to 95.0, p<0.001) 63.5% (59.8 to 67.0, p<0.001) 93.8% (93.1 to 94.4, p<0.001) 94.2% (93.4 to 95.0, p<0.001)	**Funding:** HTA programme **Limitations:** **Additional tests:** **Notes:**

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
	of their reference standard test); Studies with fewer than 10 patients; Studies published in languages other than English, French, Spanish or Italian; Studies of patients with suspected PE, except for the review of CT scanning, where such studies provide most of the available evidence; If the publication was an abstract or letter the authors were contacted for more details. If it was not possible to extract the necessary data from the published report they contacted the authors as long as it was published in the past 10 years.		**NPV** **Prevalence** **Positive LR (detecting any DVT and specificity from 98 studies):** **Negative LR (detecting any DVT and specificity from 98 studies):** **Positive LR (detecting proximal DVT from 98 studies):** **Negative LR (detecting proximal DVT from 98 studies):** **Positive LR (detecting distal DVT from 98 studies):** **Negative LR (detecting distal DVT from 98 studies):** **Positive LR (detecting any DVT and specificity from 53 studies):** **Negative LR (detecting any**	14.47 0.11 15.19 0.06 10.24 0.39 15.46	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
	<u>All patients</u> **N:** **Mean age (range):** **Drop outs:**		**DVT and specificity from 53 studies):** **Positive LR (detecting proximal DVT from 53 studies):** **Negative LR (detecting proximal DVT from 53 studies):** **Positive LR (detecting distal DVT from 53 studies):** **Negative LR (detecting distal DVT from 53 studies):**	0.11 16.24 0.06 10.9 0.39	
			Operator reported as radiologist: n=33 **Pooled Sensitivity for detecting any DVT:** **Pooled Sensitivity for detecting proximal DVT:** **Pooled Sensitivity for detecting distal DVT:**	 86.1% (83.8 to 88.3) 94.4% (92.3 to 96.1) 62.6% (55.4 to 69.4)	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Pooled Specificity:	92.4% (90.9 to 93.7)	
			PPV	11.33	
			NPV	0.076	
			Prevalence	12.42	
			Positive LR (detecting any DVT:	0.06	
			Negative LR (detecting any DVT :		
			Positive LR (detecting proximal DVT :	8.24	
			Negative LR (detecting proximal DVT :	0.40	
			Positive LR (detecting distal DVT:		
			Negative LR (detecting distal DVT:		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
				Compression only (n=22)	
			Pooled Sensitivity for detecting any DVT:	90.3% (88.4 to 92.0), p<0.001)	
			Pooled Sensitivity for detecting proximal DVT:	93.8% (92.0 to 95.3, p=0.005)	
			Pooled Sensitivity for detecting distal DVT:	56.8% (49.0 to 66.4, p<0.001)	
			Pooled Specificity	97.8% (97.0 to 98.4, p=0.01	
			PPV	41	
			NPV	0.10	
			Prevalence	42.6	
			Positive LR (detecting any DVT):	0.06	
			Negative LR (detecting any DVT):	25.8	
			Positive LR (detecting proximal DVT):		
			Negative LR (detecting proximal DVT):		
			Positive LR (detecting distal DVT):		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Negative LR (detecting distal DVT):	0.44	
				Colour Doppler only (n=5)	
			Pooled Sensitivity for detecting any DVT:	81.7% (77.4 to 85.5, p<0.001)	
			Pooled Sensitivity for detecting proximal DVT:	95.8% (85.7 to 99.5, p=0.427)	
			Pooled Sensitivity for detecting distal DVT:	4	
			Pooled Specificity:	3.5% (23.2 to 66.5, p=0.009)	
			PPV	92.7% (89.7 to 95.1, p=0.003)	
			NPV	11.19	
			Prevalence	0.197	
			Positive LR (detecting any DVT):		
			Negative LR (detecting any DVT):		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Positive LR (detecting proximal DVT):	13	
			Negative LR (detecting proximal DVT);	0.045	
			Positive LR (detecting distal DVT):	5.96	
			Negative LR (detecting distal DVT):	0.609	
				Continuous wave Doppler only n=16	
			Pooled Sensitivity for detecting any DVT:	81.1% (78.2 to 83.7, p<0.001)	
			Pooled Sensitivity for detecting proximal DVT:	87.8% (84.7 to 90.5, p<0.001)	
			Pooled Sensitivity for detecting distal DVT:		
			Pooled Specificity:		
			PPV	41.8% (32.5 to 51.6, p=0.015)	
			NPV	84.0% (81.4 to 86.3, p<0.001)	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Prevalence	5.068	
			Positive LR (detecting any DVT):	0.225	
			Negative LR (detecting any DVT):	5.487	
			Positive LR (detecting proximal DVT):	0.145	
			Negative LR (detecting proximal DVT);	2.61	
			Positive LR (detecting distal DVT):	0.69	
			Negative LR (detecting distal DVT):		
				Triplex n=25	
			Pooled Sensitivity for detecting any DVT:	91.1%(89.0 to 93.0, p<0.001)	
			Pooled Sensitivity for detecting proximal DVT:	96.4% (94.4 to 97.9, p<0.001)	
			Pooled Sensitivity for detecting distal DVT:		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Pooled Specificity:	75.2% (67.7 to 81.6, p<0.001)	
			PPV	94.3% (92.5 to 95.8, p<0.001)	
			NPV		
			Prevalence	15.98	
			Positive LR (detecting any DVT):	0.09	
			Negative LR (detecting any DVT):		
			Positive LR (detecting proximal DVT):	16.91	
			Negative LR (detecting proximal DVT);	0.038	
			Positive LR (detecting distal DVT):	13.19	
			Negative LR (detecting distal DVT):	0.26	
			Pooled Sensitivity for detecting any DVT:	Duplex n=25 92.1% (90.7 to 93.5, p<0.001)	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Pooled Sensitivity for detecting proximal DVT:	96.5% (95.1 to 97.6, p<0.001)	
			Pooled Sensitivity for detecting distal DVT:	71.2% (64.6 to 77.2, p<0.001)	
			Pooled Specificity:	94.0% (92.8 to 95.1, p<0.001)	
			PPV	15.35	
			NPV	0.08	
			Prevalence	16.08	
			Positive LR (detecting any DVT):	0.037	
			Negative LR (detecting any DVT):	11.86	
			Positive LR (detecting proximal DVT):	0.306	
			Negative LR (detecting proximal DVT);		
			Positive LR (detecting distal DVT):		
			Negative LR (detecting distal DVT):		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
				Others n=4	
			Pooled Sensitivity for detecting any DVT:	93.3% (88.8 to 96.4, p=0.338)	
			Pooled Sensitivity for detecting proximal DVT:		
			Pooled Sensitivity for detecting distal DVT:		
			Pooled Specificity:	96.0% (92.2 to 98.2, p<0.001)	
			PPV		
			NPV		
			Prevalence		
			Positive LR (detecting any DVT):	23.3	
			Negative LR (detecting any DVT):	0.07	
			Diagnostic performance of ultrasound stratified by Wells criteria n=1		
			Pooled Sensitivity for high Wells score:		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Pooled Specificity for high Wells score:	91% (81 to 96)	
			Pooled Sensitivity for intermediate Wells score:	100% (77 to 100)	
			Pooled Specificity for intermediate Wells score:	61% (46 to 74)	
			Pooled Sensitivity for low Wells score:	99% (94 to 100)	
			Pooled Specificity for low Wells score:		
			PPV	67% (42 to 85)	
			NPV		
			Prevalence	98% (95 to 99)	
			Positive LR (High Wells score):		
			Negative LR (High Wells score :		
			Positive LR (Intermediate Wells score):		
			Negative LR (Intermediate Wells Score :		
			Positive LR (Low Wells Score):		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Negative LR (Low Wells Score):		
			Asymptomatic cohorts **Pooled Sensitivity for detecting any DVT:** **Pooled Sensitivity for detecting proximal DVT:** **Pooled Sensitivity for detecting distal DVT:** **Pooled Specificity (from all 45 studies):** **Pooled Specificity (from 25 studies reporting full data):** **PPV** **NPV** **Prevalence** **Positive LR (detecting any DVT and specificity from 45 studies):**	**Results of meta-analysis** **50.7% (47.1 to 54.4, p<0.001)** **66.7% (61.9 to 71.3, p<0.001)** **39.0% (34.5 to 43.6, p<0.001)** **96.5% (95.9 to 97.1, p<0.001)** **97.0% (96.2 to 97.7, p<0.001)** **14.48** **0.51**	**Funding:** **Limitations:** **Additional tests:** **Notes:**

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Negative LR (detecting any DVT and specificity from 45 studies):	**19.057**	
			Positive LR (detecting proximal DVT from 45 studies):	**0.345**	
			Negative LR (detecting proximal DVT from 45 studies):	**11.14**	
			Positive LR (detecting distal DVT from 98 studies):	**0.63**	
			Negative LR (detecting distal DVT from 98 studies):		
			Positive LR (detecting any DVT and specificity from 25 studies):	**16.9**	
			Negative LR (detecting any DVT and specificity from 25 studies):	**0.508**	
			Positive LR (detecting proximal DVT from 25 studies):		
			Negative LR (detecting		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			proximal DVT from 25 studies):	22.23	
			Positive LR (detecting distal DVT from 25 studies):		
			Negative LR (detecting distal DVT from 25 studies):	0.34	
				13	
				0.628	
			Mixed cohorts		
			Pooled Sensitivity for detecting any DVT:	75.9% (66.7 to 83.6, p<0.01)	
			Pooled Sensitivity for detecting proximal DVT:		
			Pooled Sensitivity for detecting distal DVT:	93.2% (84.7 to 97.7, p=0.085)	
			Pooled Specificity (from all 5 studies):	55.8% (41.3 to 69.5, p=0.513)	
			PPV	97.9% (93.6 to 98.9, p=0.212)	
			NPV		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Prevalence **Positive LR (detecting any DVT:** **Negative LR (detecting any DVT :** **Positive LR (detecting proximal DVT :** **Negative LR (detecting proximal DVT :** **Positive LR (detecting distal DVT:** **Negative LR (detecting distal DVT:**	**36.14** **0.246** **44.38** **0.069** **26.57** **0.45**	
			Radiation	**Not reported**	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			3 month VTE rate	**Not reported**	
			Non diagnostic rate	**Not reported**	
			Severity of PE	**Not reported**	
			Mortality	**Not reported**	

Study details	Patients	Diagnostic tools	Outcome measures	Effect size	Comments
Tomkowski 2007[432] **Study design:** Diagnostic prospective study **Setting:** National Tuberculosis and Lung Disease Research Institute in Warsaw, Poland. **Duration of follow-up:** not reported	**Patient group:** Consecutive acutely ill medical patients who participated in a double blind prophylaxis study. **Inclusion criteria:** Acutely ill medical patients who were hospitalized due to congestive heart failure, or respiratory, infections or inflammatory diseases, or some combinations of these condtions. **Exclusion criteria:** Patients with VTE objectively documented at presentation. **<u>All patients</u>** **N:** 160 **Age (mean, (sd)): 70.5** (13) **Drop outs:** not reported.	**Assessment tool under investigation:** Compression ultrasound (CUS) (in the diagnosis of proximal and distal deep vein thrombosis (DVT) of the lower extremities); was performed prior to venography, on day 6-15 of the hospital stay at the end of the course of the blinded prophylaxis study drug. The primary criterion for diagnosing DVT was loss of venous compressibility. **Reference standard:** Venography (bilateral ascending); the examination was considered adequate when all required deep veins were demonstrated. An intra-luminal filling defect visualized in at	**CUS for proximal DVT**	**Venography** Positive Negative Total Positive 3 1 4 Negative 2 154 156 Total 5 155 160 **Sensitivity** 60% (23-88%) **Specificity** 99.4% (96-99%) **PPV** 75% (30-95%) **NPV** 98% (95-99%) **Prevalence** 5/160 (diagnosed by venography) **Positive LR** 100 **Negative LR** 0.40	**Funding:** Sanofi-Aventis, Registry Coordinating Center, S & H Medical Science Service, Red Respira, Instituto Carlos III (RedRespiral-ISCiii-RTIC-03/11). **Limitations:** 1) Relatively low DVT event rate 2) Venous compression was used as the only criterion for determining the presence of DVT. **Additional outcomes:** In all true positive cases identified by CUS, the site of DVT was the same as the site identified by
			CUS for distal DVT Positive Negative	**Venography** Positive Negative Total 2 2 4	

Study details	Patients	Diagnostic tools	Outcome measures	Effect size	Comments
		least two projections was considered as positive for detection of DVT.	Total	5 141 156 7 143 160	venography. **Notes:**
			Sensitivity	28.6% (8-64%)	
			Specificity	98.6% (95-99%)	
			PPV	50% (15-85%)	
			NPV	97% (92-98%)	
			Prevalence	7/160 (diagnosed by venography)	
			Positive LR	28.6	
			Negative LR	0/72	
			Radiation	Not reported.	
			3 month VTE rate	Not reported.	
			Non diagnostic rate	10/170 of patients had unsatisfactory venography readings.	
			Severity of PE	Not reported.	
			Mortality	Not reported.	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Shiver 2010[387] **Study design:** Diagnostic study **Setting:** Academic emergency department **Duration of follow-up:** 27 months (average (range 2-43 months)	**Patient group:** Patients undergoing workup for PE **Exclusion criteria:** Paediatric patients (<18 years); **All patients** **N:** 61. **Mean age (range):** 43 years. **Drop outs:** not reported.	**Assessment tool under investigation:** emergency physician-performed ultrasound (EPPU) (compression ultrasound). A Phillips HDI 4000 (Bothellk, WA) or a SonoSite MicroMaxx (Bothell, WA) machine using a broadband linear array 12-5 MHz transducer were used. The examination consisted of compression of 3 segments of the lower extremity venous system: the common femoral vein from superior to the saphenous vein to the bifurcation; the proximal superficial and deep femoral vein; popliteal vein to the trifurcation into the calf veins. DVT was excluded if the lumen could be obliterated with compression. **Reference standard:** CT venography (CTV). After lower extremity venous	**Venography** **EPPU** Positive Negative Total **Positive** 6 0 6 **Negative** 1 50 51 **Total** 7 50 57 (95% confidence interval) **Sensitivity** 86% (42% to 99%) **Specificity** 100% (91% to 100%) **PPV** 1 **NPV** 0.98 **Prevalence** 0.123 **Positive LR** 0 **Negative LR** 0.14 **Radiation** Not reported	**Funding:** Not reported. **Limitations:** convenience sample; small sample size. **Additional tests:** not reported. **Notes:** 20 patients reported a history of prior thromboembolic events. **Who performed test:** The decision to initiate a PE workup was left up to the attending physician who was blinded to the ultrasound results.

		ultrasound the patient underwent CTA of the chest and CTV of the lower extremities using a GD Lightspeed CT scanner. The CT examination used 5-mm thickness, 3-mm interval cuts using 100mL of Omnipaque 350 contrast. DVT diagnosed on CTV when a venous filling defect was noted.			
			3 month VTE rate	Not reported	
			Non diagnostic rate	Not reported	
			Severity of PE	Not reported	
			Mortality	Not reported	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Aywak 2007[38] **Study design:** Diagnostic study	**Patient group:** Patients referred to KNH for lower limb venography with clinically suspected DVT.	**Assessment tool under investigation:** 3 step venography including B-mode gray scale compression sonography, colour and colour Doppler sonography. Ultrasound examination was performed within 24 hours of the	**Whole limb** **Colour Doppler findings** Positive Negative	**Venography findings** With DVT Without DVT Total 16 (TP) 3 (FP) 19 2 (FN) 34 (TN) 36	**Funding:** Not reported. **Limitations:** Total sample size used is 55 limbs rather than no of participants (44).

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Setting: Kenyatta National Hospital, Nairobi **Duration of follow-up:** Not reported.	**Exclusion criteria:** Not reported. **<u>All patients</u>** **N:** 44 patients, 55 limbs. **Mean age (standard deviation:** Not reported. **Drop outs:** Not reported.	venography. Colour Doppler sonography at 5-7.5 MHz linear array probe with the patient in a supine position and the leg in slight external rotation, the common and superficial femoral veins were examined down to the level of the adductor canal in both the transverse and the longitudinal axis. Patient was then turned prone or in lateral decubitus position with knee slightly flexed at 30 degrees and assessment of the popliteal and proximal calf vessels performed. All venous segments were assessed for compressibility, colour flow and venous flow pattern both spontaneous and after distal calf compression. **Reference standard:** contrast venography – modification of Rabinov and Paulin. After applying a tourniquet to the ankle of the patient lying on a tilting flurooscopy table 100ml of non-	Total **Sensitivity** **Specificity** **PPV** **NPV** **Prevalence** **Accuracy** **Positive LR** **Negative LR**	18 37 55 88.9% 91.8% 84% 94.3% 0.327 90.9% 11 0.12	**Additional tests:** Not reported. **Who gave the test:** Both examinations were performed by different consultant radiologists. Almost every radiologist evaluating was blinded.
			DVT above the knee **Color Doppler findings** **Positive** **Negative**	**Venography findings** With DVT Without DVT Total 15 (TP) 1 (FP) 16 0 (FN) 34 (TN) 34	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
		ionic contrast injected into a dorsal foot veing slowly. Venous opacification was monitored fluoroscopically and 2 views of the calf and thigh were taken with the patient tilted at least 30 degrees in reverse Trendelenberg (head up) position. A single view of the upper thigh and pelivs was obtained with the patient supine.	**Total**	15 35 50	
			Sensitivity	100%	
			Specificity	97%	
			PPV	93%	
			NPV	100%	
			Prevalence	0.300	
			Positive LR	35	
			Negative LR	0	
			Radiation	Not reported.	
			3 month VTE rate	Not reported.	
			Non diagnostic rate		

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Severity of PE	Not reported.	
			Mortality	Not reported.	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Naz 2005[291] **Study design:** Diagnostic study **Setting:** Bolan	**Patient group:** Patients with suspected acute DVT of lower limb **Exclusion criteria:** Previous episodes of DVT, those already taking treatment and	**Assessment tool under investigation: C**olor Doppler ultrasonography. Color Doppler Toshiba Nemio 20 at 7.5MHz with linear probe. Where necessary power Doppler was used to visualise small veins. **Reference standard:** venography	**Colour Doppler ultrasound positive:** **negative:** **Sensitivity** **Specificity**	**Venography** **Positive** **Negative** 16 0 5 4 76.1% 100%	**Funding:** Not reported. **Limitations:** small sample size **Additional tests:** blood complete

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Medical Complex Hospital, Quetta **Duration of follow-up:**	on follow-up. **<u>All patients</u>** **N:** 25 **Mean age (standard deviation: 16-82 (+/- 20.33 years)** **Drop outs:**		**PPV** **NPV** **Accuracy** **Prevalence** **Positive LR** **Negative LR**	100% 44.45% 80% 0.840 0 0.239	picture, bleeding profile, blood sugar, urea, creatinine, urinalysis, x-ray chest. Optional – ultrasound of the abdomen (especially pelvis), CT scan and MRI. Results given for: left lower limb involvement, right lower limb involvement, both limbs involvement.
			Radiation	Not reported.	
			3 month VTE rate	Not reported.	
			Non diagnostic rate	Not reported.	
			Severity of PE	Not reported.	
			Mortality	Not reported.	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Ozbudak2006[309] **Study design:** Diagnostic study **Setting:** **Duration of follow-up:** 8 days?	**Patient group:** Patients with suspected lower extremity DVT who were clinically diagnosed with PE (according to PIOPED criteria) and confirmed by V/Q scintigraphy. **Exclusion criteria:** not reported. **<u>All patients</u>** **N:** 51 **Mean age (standard deviation):** 48.1 years **Drop outs:** none.	**Assessment tool under investigation:** Doppler ultrasonography (DUSG). **Reference standard:** venography The first DUSG examination was conducted using a 7.5Hz probe within 24 hours whether or not there were DVT symptoms. If patients had DVT on the first DUSG they then underwent venography; those with negative results had a repeat DUSG by the same radiologist on the 7th day of diagnosis. If the second DUSG was negative for DVT they underwent lower extremity venography within 24 hours. Lab results: D-dimer, Creactive	**Venography** **DVT positive** **DVT negative** **Total** **DUSG** **DVT positive** 19 0 19 **DVT negative** 6 26 32 **Total** 25 26 51 **Sensitivity** 76% **Specificity** 100% **PPV** 100% **NPV** 81% **Prevalence** 0.49 **Positive LR** 0 **Negative LR** 0.24 **Radiation** Not reported	**Funding:** Akdeniz University Scientific Project Unit. **Limitations:** no details of blinding **Additional tests:** D-dimer levels were elevated in 24 (75%) of 32 patients while they were normal in 8 (25%). Elevated D-dimer levels were found in 5 patients (83%) with DVT and 19 (73%) without DVT. **Notes:**

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
		protein , alanine transaminase and aspartate tranaminase levels were examined within 24 hours by ELISA method.			
			3 month VTE rate	Not reported	
			Non diagnostic rate	Not reported	
			Severity of PE	Not reported	
			Mortality	Not reported	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Ricci 2004[355]	**Patient group:**. Patients with clinically suspected DVT in the femoro-ilio-caval axis.	**Assessment tool under investigation:** Unenhanced US and US phlebography; all examinations were performed with HDI 5000	**Acute thrombosis** **Unenhanced US (Doppler)** **DVT positive**	**DVT positive DVT negative Total** 12 2 14	**Funding:** Not reported **Limitations:** The study

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study design: Diagnostic study **Setting:** University of Rome **Duration of follow-up:** Not reported	**Exclusion criteria:** not reported **All patients** **N:** 38 **Mean age (standard deviation):** 62 years (39 to 76) **Drop outs:** 3 patients were excluded from the analysis as it was not possible to cannulate a dorsal vein of foot and they underwent contrast enhanced US after injection of Levotist through an antecubital vein.	scanner with colour Doppler and duplex capabilities and with the appropriate 3.5-5 MHz convex and 7.5-10 MHz linear array transducers. Levotist which consists of galactose microparticles and a small admixture of palmitic acid (0.1%) was used as a microbubble contrast agent in all contrast enhanced US examinations. **Reference standard:** Ascending phlebography	**DVT negative** **Total** **Sensitivity** **Specificity** **PPV** **NPV** **Prevalence** **Positive LR** **Negative LR** **Chronic thrombosis** **DVT positive** **DVT negative** **Total** **Sensitivity** **Specificity** **PPV**	2 5 7 14 7 21 85.7% 71.4% 85.7% 71.4% 66.7% 3.0 0.20 **DVT positive DVT negative Total** 9 1 10 1 3 4 10 4 14 90% 75% 90%	did not provide detailed information on patients characteristics, duration of the study and exclusion criteria. **Additional tests:** **Notes:** No complications related to US phlebography were observed.

Study details	Patients	Diagnostic tools	Measure of Disorders	Results			Comments
			NPV	75%			
			Prevalence	71.4%			
			Positive LR	3.60			
			Negative LR	0.13			
			US phlebography				
			Acute thrombosis	**DVT positive**	**DVT negative**	**Total**	
			DVT positive	13	0	13	
			DVT negative	1	7	8	
			Total	14	7	21	
			Sensitivity	90%			
			Specificity	100%			
			PPV	100%			
			NPV	87.5%			
			Prevalence	66.7%			
			Positive LR	99999			
			Negative LR	0.07			

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Chronic thrombosis	**DVT positive DVT negative Total**	
			DVT positive	10 0 10	
			DVT negative	0 4 4	
			Total	14 4 14	
			Sensitivity	100%	
			Specificity	100%	
			PPV	100%	
			NPV	100%	
			Prevalence	71.4%	
			Positive LR	99999	
			Negative LR	0.00	
			Radiation	Not reported	
			3 month VTE rate	Not reported	
			Non diagnostic rate	Not reported	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
			Severity of PE	Not reported	
			Mortality	Not reported	

Subgroup: proximal versus whole leg ultrasound

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
Study name: Bernardi 2008[54] **Study design:** RCT (adequate randomisation (randomisation list available for each centre arranged by blocks of 10)	**Patient group:** Patients who had suspected symptomatic DVT of the lower extremities. **Inclusion criteria:** All consecutive outpatients who were referred by ED or gp	**Group 1** Details & duration of intervention: 2-point ultrasonography plus D-dimer. Those who had normal ultrasound findings at entry had D-dimer testing and those with normal D-dimer results were not further investigated or anticoagulated. A repeat ultrasonography was given to those with abnormal D-dimer results a week later or earlier if clinically indicated.	**Initial prevalence of DVT** **2-point strategy** **Whole leg strategy**	231/1045 (22.1%) 95% CI 19.6% to 24.6%. 278/1053 (26.4%) 95% CI 23.7 to 29.1%.	**Funding:** SISET (Scocieta Italiana per lo Studio dell'Emostasis e della Trombosi). AGEN Biomedical Ltd provided the D-dimer testing kits free-of-charge.
			Incidence of objectively proven symptomatic VTE occurring during a 3-month follow-up in patients with normal findings at the initial	**Group1:** 7/814 (0.9%), 95% CI 0.3% to 1.8%) **Group 2:** 9/775 (1.2%), 95% CI 0.5% to 2.2%.	**Limitations:** No details of blinding of clinicians to medical histories of participants. No ITT analysis.

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
good allocation concealment) **Setting:** 14 universities or civic hospitals in Italy **Duration of follow-up:** 3 months	to one of the centres with a first episode of suspected DVT. **Exclusion criteria:** Pregnancy, under 18 years of age, history of VTE, suspected PE, life expectancy less than 3 months, ongoing anticoagulation (>48 hours), mandatory indication for anticoagulation (eg atrial fibrillation), and geographic inaccessibility to follow-up. **All patients** **N:** 2098 **Age (mean):** **Drop outs:** 13/814 (eligible for 3 month follow-up) **Group 1** **N:** 1045	The transverse plane was examined with a linear probe (5-10MHz) from the common femoral at the groin and the popliteal vein down to where it branched into the calf deep veins at the popliteal fossa. Vein incompressibility was the only diagnostic criteria, defined as normal (compressible veins) or abnormal (noncompressible veins). A rapid whole-blood bedside D-dimer assay was used, which was based on red blood cells agglutination, defined as normal (no visible agglutination) or abnormal (visible agglutination or noninterpretable findings). **Group 2** Details & duration of intervention: Whole-leg color-coded doppler ultrasonography. Those patients who had normal utlrasound results did not have further investigation or anticoagulation. All veins were imaged continuously	diagnostic workup	**Relative risk:** 0.3% **95% CI:** -1.4% to 0.8% **p value:** Not significant	**Additional outcomes:** (list additional outcomes reported in paper but not recorded in this table) **Notes:** Those who had abnormal ultrasound were not eligible to continue with the study.
			Mortality	**Group1:** 9/814 (1.1%) **Group 2:** 7/75 (0.9%) **Relative risk:** **95% CI:** **p value:** (If no p-value: Sig/Not sig/NR)	

Study details	Patients	Interventions	Outcome measures	Effect size	Comments
	Age (mean): 63.7 (s.d 16.3) **Drop outs:** 12/775 (eligible for 3 month follow-up) **Group 2** **N:** 1053 **Age (mean):** 62.5 (s.d 16.2) **Drop outs:**	along their length, in the transverse plane, with a linear probe (5-10MHz). They examined the proximal deep veins first, including the femoral veins (common, superficial and deep) and the poipliteal vein down to its trifurcation. Only those with normal proximal findings had their calf veins evaluated, including the axial (perroneal and posterior tibial) and the muscular veins. The only diagnostic criterion for abnormal tsting of the proximal and axial calf veins was vein incompressibility. Adjunctive criteria for abnormal testing of the muscular veins was lack of spontaneous or reverse-flow intraluminal color-filing after augmentation maneuvers (ie manual squeezing of the calf).			

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: Kline 2008[227] **Study design:** Diagnostic study **Setting:** Carolinas Medical Centre, USA **Duration of follow-up:** 30 days telephone call follow-up	**Patient group:** Participants with suspected DVT. The participants were emergency department patients who self-referred themselves. **Inclusion criteria:** the clinical team had to place an order for a consultative ultrasonographic examination of one or both lower extremities to rule out DVT. **Exclusion criteria:** Consultative lower extremity ultrasonography performed in the radiology department in the last 48 hours;	**Assessment tool under investigation:** above-calf, 3-point compression ultrasonography of the lower extremity. (ECPU) **Reference standard:** whole-leg reference venous ultrasonography. All clinicians undertook a structed training course of 1-hour didactic lecture of the nomneclature and anatomy of the lower extremity venous system, the related functions of the ultrasonographic proble and machine, the technique for 3-point compression ultrasonography of the lower extremity venous system.	**ECPU**	**DVT(+) DVT(-) Total** **Positive** 19 17 36 **Negative** 8 139 147 **Total** 27 156 183 **Sensitivity** 70% (95% CI 50% to 86%) **Specificity** 89% (95% CI 83% to 94%) **PPV** 52% **NPV** 94% **Prevalence** 0.148 **Positive LR** 6.5 (95% CI 3.8 to 10.7) **Negative LR** 0.3 (95% CI 0.2 to 0.6) **Diagnostic accuracy** 85% (95% CI 79% to 90%)	**Funding:** Resident Research Award from the Emergency Medicine Foundation. One author received funding from National Institutes for Health. **Limitations:** The reference standard was established by agreement by two independent authors blinded to the US images and US interpretations. The adjudicators had to agree that 2 endpoints occurred within 30 days. **Additional tests:** Clinicains classified patients as low (<15%), moderate (15% to 40%) or high (>40%) pretest probability of DVT.
			Radiation	Not reported	
			3 month VTE rate	Not reported	

	consultative ultrasonography ordered to examine the arm or neck veins and not the leg veins; the presence of indwelling femoral vascular catheter or dialysis vascular shunts in the symptomatic leg; history of chronic DVT; an above-knee amputation in the symptomatic leg; inability to access all 3 landmarks for 3-point ultrasonography because of the presence of a cast, external fixed apparatus, or other obstacle; conditions preventing telephone follow-up eg homelessness or incarceration; they planned to exclude patients if the reference ultrasonography was not performed within 12 hours of enrolment.	Ultrasonic examinations by one of 2 machines available continuously in the ED. Ultrasonix CEP with 14.5MHZ linear-format broadband probles. Compressibility or coaptation of target veins evaluated in the transverse view (marker to right side of patient). Patient placed in reverse Trendelenburg position. The leg was placed in external rotation, with knee slightly flexed. All participants had a consultative radiology ultrasonographic examination of same, or both, lower extremity performed in the radiology dpeartment on a separate floor within the same hospital within 12 hours of enrolment. All US examinations were interpreted by a board-certified radiologist who was unaware that the patient was enrolled in a study of emergency clinicain-performed US.	**Non diagnostic rate**	Not reported	**Notes:** This study aimed to look at the accuracy of emergency clinician-performed US by a heterogenous group of emergency department clinicians.
			Severity of PE	Not reported	
			Mortality	8 patients died within 30 days of enrolling, including 2 who had complications arising from PE, both of whom were diagnosed with DVT at enrollemnt and both who had a positive emergency clinician-performed ultrasonographic result.	

	<u>All patients</u> **N:** 185 **Mean age (range): 51.6 (s.d 16.1)** **Drop outs:** 2 patients voluntarily withdrew after the US and reference US but before follow-up.				

Study details	Patients	Diagnostic tools	Outcome measures	Effect size	Comments
Tomkowski 2007[432] **Study design:** Diagnostic prospective study	**Patient group:** Consecutive acutely ill medical patients who participated in a double blind prophylaxis study. **Inclusion criteria:** Acutely ill	**Assessment tool under investigation:** Compression ultrasound (CUS) (in the diagnosis of proximal and distal deep vein thrombosis (DVT) of the lower extremities); was performed prior to venography, on day 6-15	**CUS for proximal DVT** Positive Negative Total	**Venography** Positive Negative Total 3 1 4 2 154 156 5 155 160	**Funding:** Sanofi-Aventis, Registry Coordinating Center, S & H Medical Science Service, Red Respira, Instituto Carlos III (RedRespiral-ISCiii-RTIC-03/11).

Study details	Patients	Diagnostic tools	Outcome measures	Effect size	Comments
Setting: National Tuberculosis and Lung Disease Research Institute in Warsaw, Poland. **Duration of follow-up:** not reported	medical patients who were hospitalized due to congestive heart failure, or respiratory, infections or inflammatory diseases, or some combinations of these condtions. **Exclusion criteria:** Patients with VTE objectively documented at presentation. **<u>All patients</u>** **N:** 160 **Age (mean, (sd)): 70.5** (13) **Drop outs:** not reported.	of the hospital stay at the end of the course of the blinded prophylaxis study drug. The primary criterion for diagnosing DVT was loss of venous compressibility. **Reference standard:** Venography (bilateral ascending); the examination was considered adequate when all required deep veins were demonstrated. An intra-luminal filling defect visualized in at least two projections was considered as positive for detection of DVT.	**Sensitivity** **Specificity** **PPV** **NPV** **Prevalence** **Positive LR** **Negative LR**	60% (23-88%) 99.4% (96-99%) 75% (30-95%) 98% (95-99%) 5/160 (diagnosed by venography) 100 0.40	**Limitations:** 1) Relatively low DVT event rate 2) Venous compression was used as the only criterion for determining the presence of DVT. **Additional outcomes:** In all true positive cases identified by CUS, the site of DVT was the same as the site identified by venography. **Notes:**
			CUS for distal DVT Positive Negative Total **Sensitivity** **Specificity** **PPV** **NPV**	**Venography** Positive Negative Total 2 2 4 5 141 156 7 143 160 28.6% (8-64%) 98.6% (95-99%) 50% (15-85%) 97% (92-98%)	

Study details	Patients	Diagnostic tools	Outcome measures	Effect size	Comments
			Prevalence **Positive LR** **Negative LR**	7/160 (diagnosed by venography) 28.6 0/72	
			Radiation	Not reported.	
			3 month VTE rate	Not reported.	
			Non diagnostic rate	10/170 of patients had unsatisfactory venography readings.	
			Severity of PE	Not reported.	
			Mortality	Not reported.	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
Study name: **Gibson (2009)** **Study design:** Diagnostic study **Duration of follow-up:** 3 months	**Patient group:** Patients with clinically suspected DVT **Exclusion criteria:** Previous episode of VTE, symptoms of PE, pregnant, received full-dose low molecular weight heparin (LMWH) for more than 24 hours, had a life expectancy of < 3 monhts, had symptoms lasting for longer than 4 weeks, had ongoing anticoagulant treatment for other reasons, were geographically inaccessible for follow-up or had anticipated low compliance, or if written informed consent could not be	**Assessment tool under investigation:** Rapid ultrasound. The common femoral vein and the popliteal vein, down to the branching of the calf veins, were examined in the transverse plane. Diagnosis of thrombosis was based on lack of compressibility of one or more of these venous segments. **Reference standard:** complete CUS examination. The entire deep venous system was imaged from the groin down to the distal system in the calf. They examined the proximal venous system first, iwth the patient lying supine. The femoral bifurcation, the great saphenous vein junction, the profunda femoris and the femoral vein down to the distal part of the thigh were scanned along their length in the transverse plane. Then the popliteal vein to its trifurcation, the paired posterior tibial veins, the paired peroneal veins, the	**Rapid CUS detected:** **Complete CUS detected:** **Proximal DVT** **Distal DVT** **3 month VTE rate (at follow-up):**	Incidence: 59/257(23%) 95% CI 18 to 28%. This result is after the repeat RCUS, at the first RCUS the result was 56/257 (95%) Incidence: 99/264 (38%) 95% CI 32 to 43%, p<0.001. Confirmed in 59/257 patients. **Baseline RCUS** / **Repeat RCUS** / **CCUS** 56 / 3 / 61 0 / 3 / 38	**Funding:** Netherlands Heart Foundation **Limitations:** study underpowered, it needed 840 in each arm. **Additional tests:** D-dimer tests were done to rule out those with a normal result. **Notes:** 5/257 in the RCUS group and 2/264 were lost to follow-up.

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
	obtained. **<u>All patients</u>** **N:** 1002 but 481 found to be normal after D-dimer testing and so excluded. N=521. **Mean age (range):** 58 (18-99) **Drop outs:** 2 lost to follow-up.	lesser saphenous vein junction and the muscular veins (gastrocnemial and soleal sinusoids) were evaluated with the patient in the sitting position. Diagnosis of DVT from finding one or more non-compressible venous segments. D-dimer testing was performed only in patients with an unlikely clinical probability of having DVT. This was a fully automated quantitative immunoturbidimetric D-dimer asasy (Tinaquant, Roche Diagnositics, Mannheim, GermanY). A D-dimer test result of <0.5 mg/L fibrinogen equivalent units was considered to be normal. In the case of a low clinical probability and a normal D-dimer test result, DVT was considered to be excluded, no anticoagulants prescrived and patients followed up for 3 months. Those with a	**Rapid CUS detected:** **Complete CUS detected:**	Incidence 2.0% (95% CI 0.6 to 5.1%) Incidence 1.2% (95% CI 0.2 to 4.3%) (p=0.69) Absolute difference 0.8% (1.8% to 3.4%) Confirmed in 99/264 patients Excluded in 165 patients (63%) with a normal complete CUS Inconclusive in 13 (4.9%)	
			Radiation	Not reported	
			Non diagnostic rate	Not reported	
			Severity of PE	Not reported	

Study details	Patients	Diagnostic tools	Measure of Disorders	Results	Comments
		likely clinical prbability and those with a low probabiliity and an abnormal D-dimer test results, were randomised to undergo either a rapid CUS examination or a complete CUS examination.	**Mortality**	1/481 (0.2%) (of those with an unlikely clinical probability of having DVT and a normal D-dimer level and not treated with anticoagulant) died but was not a result of fatal pulmonary embolism. 4 patients died in the RCUS group during follow-up, none had fatal pulmonary embolism as cause. 1 patient died in the CUS group due to fatal pulmonary embolism. Their first CUS test was inconclusive and they did not return for a repeat test.	