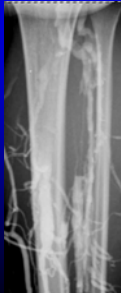
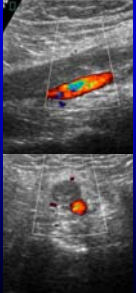


DVT Diagnosis




Ulf Nyman
 Associate Professor
 Lund University
 Department of Radiology
 East Division
 (Kristianstad, Hässleholm
 Trelleborg, Ystad)
 Sweden



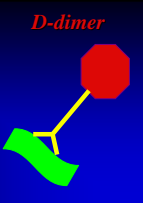
Diagnosis of 1st time symptomatic DVT

Scientific evidence

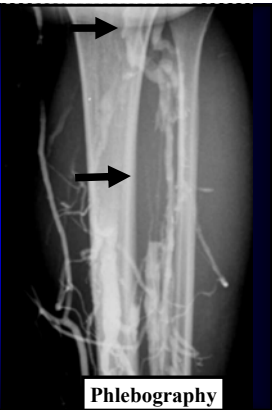
- SBU-report 158/2002 – a systematic review
 - Swedish Council on Health Technology Assessment
- National guidelines 2004
 - Socialstyrelsen, The National Board of Health and Welfare
- Studies and systematic reviews after 2002




Clinical probability



D-dimer



Phlebography



US = Ultrasonography

Reference methods

- Phlebography
- Management (follow-up) studies of
 - patients with a negative test and w/o anticoagulation f/u regarding episodes of symptomatic VTE diagnosed with imaging during ≥ 3 months
 - Evaluates the risk of false-negative DVT requiring treatment (“clinically relevant”) DVT
 - Upper 95 CI $\leq 4\%$ acceptable

Whole leg Ultrasonography

SBU-report 158/2002

- 9 studies, 1987-1998
- Diagnostic technique
 - B-mode n=1, duplex n=3, colour duplex n=5
- 1807 in- & outpatients; incidence DVT 44%

Meta-analysis	95% CI	
• Sensitivity	96%	94-97%
• Specificity	93%	90-94%

Predictive values

Prevalence (%): 44

Test	Disease		
	Yes	No	
Pos	327	30	357
Neg	14	403	416
∩	340	433	773
	96	93	
	Sens (%) Spec (%)		

92 PPV (%)

97 NPV (%)

Whole leg Ultrasonography

SBU:s conclusions/National guidelines

- Whole leg ultrasonography has a diagnostic accuracy comparable with phlebography (1*)
- US should replace phlebography

* 1= strong scientific support

Whole leg ultrasonography

Advantages

- No needles
- No contrast media complications
- Differential diagnoses
 - Baker's cyst, hemorrhage, aneurysm

Whole leg Ultrasonography

Meta-analysis of negative examinations

- 1970-2009, 7 studies, 4 731 patients
- Active cancer 14%, recent surgery 15%
- Follow-up at least 3 months
- VTE rate at f/u 0.6% (95% CI 0.3-0.9%)

Johnson Meta-analysis JAMA 2010;303:438-45.

Whole leg US - Predictive values

Prevalence (%): 25

Test	Disease		
	Yes	No	
Pos	186	41	226 82 PPV (%)
Neg	8	539	547 99 NPV (%)
	193	580	773
	96	93	
	Sens (%)	Spec (%)	

Whole leg ultrasonography

Drawbacks

- Time consuming
- Special training
- False-positives
- Overtreatment of calf vein thrombosis?

Proximal vein ultrasonography

- Two-point compression test
 - Common femoral + popliteal vein
- Proximal femoral veins + popliteal vein to confluence of calf veins
- Proximal US + symptomatic area
 - Baker's cyst, bleeding, aneurysm

Safety to exclude DVT?

SBU-report 158/2002 and later studies

- Low-moderate clinical probability + neg D-dimer
- Negative proximal US combined with (Two point test of femoral and popliteal veins)
 - Low clinical probability – Wells score <2 points OR
 - Negative D-dimer OR
 - Negative repeated US after 1 week

Table 1. Clinical Model for Predicting the Pretest Probability of Deep-Vein Thrombosis.*
Wells et al. NEJM 2003;349:1227-35

Clinical Characteristic	Score
Active cancer (patient receiving treatment for cancer within the previous 6 mo or currently receiving palliative treatment)	1
Paralysis, paresis, or recent plaster immobilization of the lower extremities	1
Recently bedridden for 3 days or more, or major surgery within the previous 12 wk requiring general or regional anesthesia	1
Localized tenderness along the distribution of the deep venous system	1
Entire leg swollen	1
Calf swelling at least 3 cm larger than that on the asymptomatic side (measured 10 cm below tibial tuberosity)	1
Pitting edema confined to the symptomatic leg	1
Collateral superficial veins (nonvaricose)	1
Previously documented deep-vein thrombosis	1
Alternative diagnosis at least as likely as deep-vein thrombosis	-2

Wells scoring system

- | | <i>Points</i> |
|------------------------|---------------|
| • Low probability | ≤0 |
| • Moderate probability | 1-2 |
| • High probability | ≥3 |
| • DVT unlikely | <2 (≤2) |
| • DVT likely | ≥2 (>2) |

1. Clinical probability + Negative D-dimer test

N=8239	Clinical Probability Estimate†		
	Low	Moderate	High
Point estimate for deep vein thrombosis likelihood	5	17	53
Probability for positive D-dimer after testing (high sensitivity)	11	25	63
Negative high-sensitivity D-dimer	0.5	1	8.6
Probability for positive D-dimer after testing (moderate sensitivity)	17	34	67
Negative moderate sensitivity D-dimer	0.9	4.4	19

*Probability after testing from application of Bayes Theorem.
†Posttest odds = pretest odds × likelihood ratio; pretest odds derived from pretest probability as follows: pretest odds = pretest probability/(1 - pretest probability). Similarly posttest probability derived from posttest odds by posttest odds/(1 + posttest odds). For example using a negative result with a high-sensitivity D-dimer if patient is low pretest probability then pretest odds = 0.05/0.95 = 0.052. Next posttest odds = 0.052 X 0.10 (from Table 5) = 0.0052. Convert to posttest probability by 0.052/1.0052 = 0.052 or 0.5%.

Wells et al. Metaanalysis JAMA 2006;295:199-207

2. Low clinical probability & one normal proximal US

3 months f/u neg US	N	DVT %	VTE %	Upper 95% CI
• Wells 1997	318	16	0.3	≤ 1.9
• Tick 2002	250	41	2.0	≤ 5.0
• Kraaijenhagen 2002	834	22	1.6	≤ 2.6
• Wells 2003	267	16	1.5	≤ 3.8
• Pooled data	1669	23	1.4%	≤ 2.0%

3. Negative D-dimer & one normal proximal US

3 months f/u neg US	N	DVT %	VTE %	Upper 95% CI
• Bernardi 1998 • Snabb-ELISA	592	28	0,2	≤ 0.9
• Tick et al 2002 • SimpliRED	148	41	0	≤ 3.0
• Kraaijenhagen 2002 • SimpliRED	828	22	0,7	≤ 1.6
• Pooled data	1568	28	0,4	≤ 0.8

4. Negative serial proximal US

- Four studies (n=2715)
 - Sluzewski 1991 (d1,2,7), Heijboer 1993 (day 1,2,8), Cogo 1998 (day 1,7), Birdwell 1998 (day 1,7)
- DVT frequency 23%
 - 1st examination (proximal DVT) 96%
 - 2nd examination (distal ⇒ prox DVT) 4%
- Follow-up 3-6 months of negative US 2 068
- VTE during follow-up (n=18) 0.9%
- One episode of fatal LE (day 5) 0.05%
 - 1 of 2 121 w. normal us after US day 1 *SBU-report 158/2002*

Distal deep vein thrombosis

Are they clinically relevant?
 Comparison between whole leg and serial proximal (day 1 & 7) ultrasonography

Proximal vs. Whole leg US

- Righini 2006 Meta-analysis
 - meta-analysis, 1983-205
- Bernardi 2008 RCT
 - serial prox US + D-dimer vs. whole leg US
- Gibson 2009 RCT
 - serial prox US vs. whole leg US if clinically likely DVT or pos D-dimer

Righini Thromb Haemost 2006 Bernardi JAMA 2008, Gibson J Thromb Haemostat 2009

Distal DVT of all DVT

Outpatients	Whole leg	Serial proximal*
• Righini	49%	3%
• inpatients	20%	
• Bernardi	23%	6%
• Gibson	38%	5%

*Distal ⇒ proximal DVT at 2nd examination

Righini Thromb Haemost 2006 Bernardi JAMA 2008, Gibson J Thromb Haemostat 2009

Negative US - VTE at 3-mo f/u

Percent (upper 95% CI)	Whole leg	Serial prox
• Righini	0.4 (≤0.6)	0.6 (≤ 0.9)
• meta-analysis		
• Bernardi	1.2 (≤2.2)	0.9 (≤ 1.8)
• including prox US + neg D-dimer		
• Gibson	1.2 (≤4.3)	2.0 (≤5.1)

Righini Thromb Haemost 2006 Bernardi JAMA 2008, Gibson J Thromb Haemostat 2009

No. of repeat examinations

	Serial proximal US
• Bernardi	24%
• Gibson	20%

Bernardi JAMA 2008, Gibson et al. J Thromb Haemostat 2009

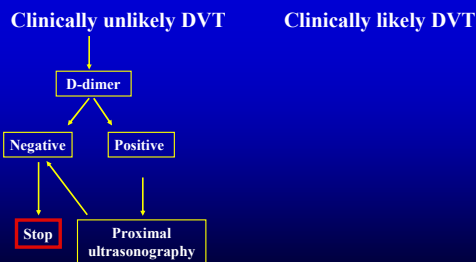
Whole leg examinations

- Detecting calf DVT may deleterious
- It does not reduce 3-month thromboembolic risk
- Significant false-positive findings
- Unnecessary anticoagulation with its risks

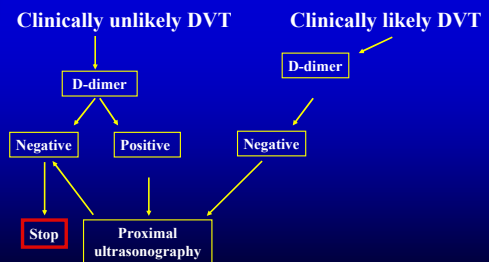
Proximal ultrasonography

The drawback of 20-25% repeat US examinations may still be more cost effective than whole leg US considering its risk of false positive diagnoses and overtreatment of calf vein thrombosis with its known complications

DVT – diagnostic algorithm



DVT – diagnostic algorithm



DVT – diagnostic algorithm

