

Getting Rid of Homans: Screening for Deep Venous Thrombosis (DVT's) with Clinical Guidelines

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ATSU

Discussion

- ▶ **1. What techniques did you learn in PT school to evaluate possible DVTs?**
- ▶ **2. What do you currently use, have been taught or teach your students regarding approaches to DVTs?**

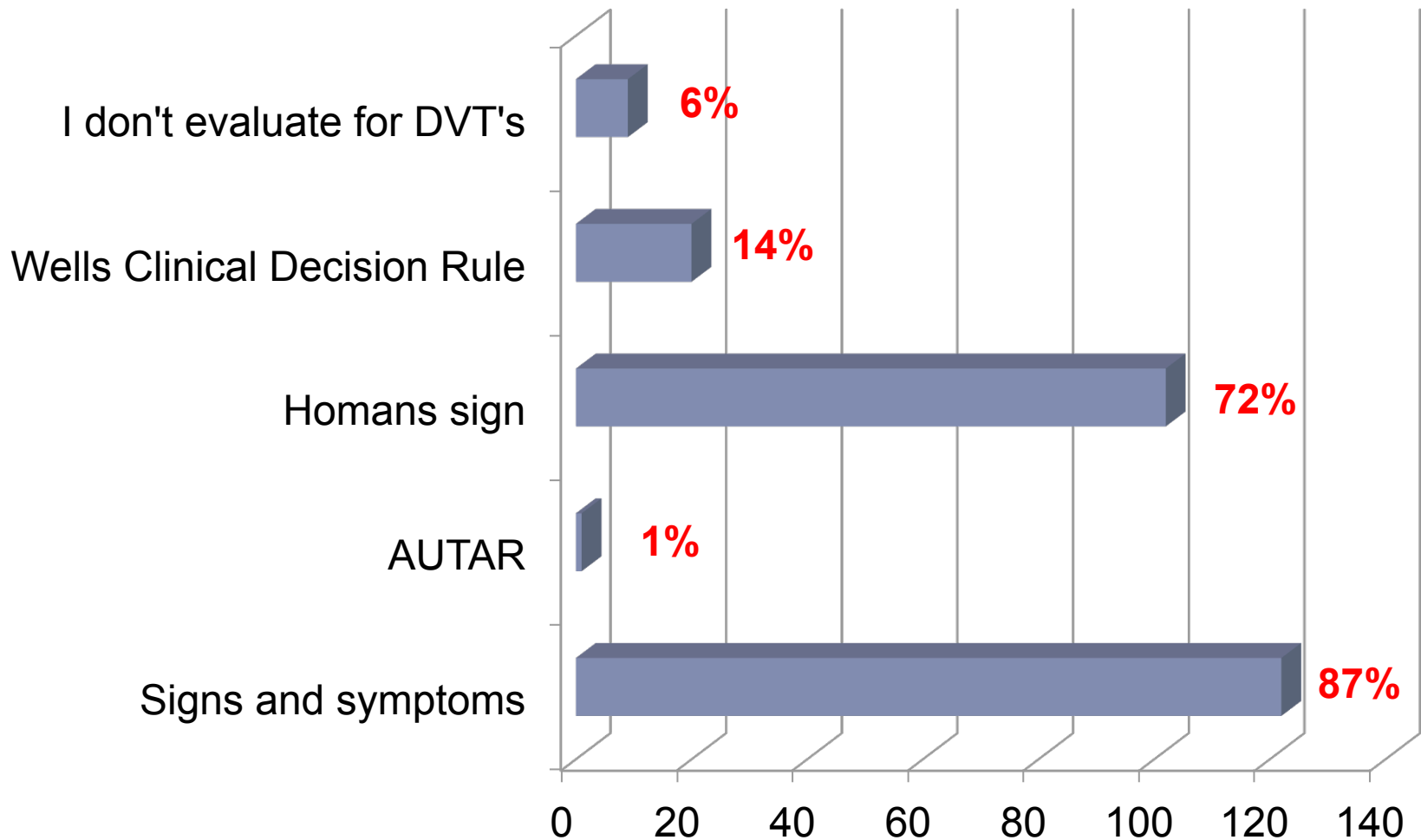


What techniques or methods were you taught during your entry-level professional education to evaluate a patient for a DVT?

- ▶ **Homans sign** 109 responses
 - ▶ **Signs and symptoms** 17 responses
 - ▶ **Warm to touch** 13 responses
 - ▶ **Swelling /edema** 14 responses
 - ▶ **Observation/appearance** 12 responses
 - ▶ **Palpation** 22 responses
 - ▶ **Wells/CDR** 3 responses
 - ▶ **Others**
-



What techniques or methods do you routinely use to evaluate a patient that you suspect has a DVT?



Introduction

- ▶ **According to the CDC, an estimated 18 million individuals undergo surgery each year in the United States. (Kirkland et al., 1999)**
- ▶ **Venous thromboembolism (VTE) is one of the more common complications seen in patients following surgery or with cancer, trauma, or prolonged immobilization. (Geerts et al., 2001)**



Introduction

- ▶ **VTE refers to all forms of thrombosis in the venous circulation and manifests in 2 ways: deep vein thrombosis (DVT) and pulmonary embolism (PE).**
- ▶ **DVTs affect ~ 2 million Americans per year, is the 3rd most common cardiovascular disease after CAD and stroke, and PE are responsible for 10% of hospital deaths.** Anand et al 1998; Autar, 1996



Intro: DVT incidence trends

- ▶ **From 1989-2006, hospital DVT increased 3.1 times from 35 to 107/100,000 population.** Stein 2010
- ▶ **From 1992-2006, the incidence of PE in hospitalized patients increased 2.5 times from 33 to 83/100,000 population.** Stein 2010
 - ▶ The incidence of a secondary diagnosis of PE increased at a lower rate.
- ▶ **Stein concluded that “Efforts to prevent DVT in high-risk hospitalized patients appear to be inadequate. Therapy of DVT, however, appears to be effective.”**



Intro: DVT trends—Stein 2010

- ▶ **The proportion of hospitalized patients with DVT has decreased as a result of early discharge home.**
 - ▶ **The incidence of PE increases exponentially with age, but no age group is immune.**
 - ▶ **Asians and Native Americans have a lower incidence of PE than whites or African Americans.**
 - ▶ **Epidemiologic data and new information on risk factors provide insight into making an informed clinical assessment and evaluation for antithrombotic prophylaxis.**
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Initiation of a DVT

▶ **Platelet aggregation**

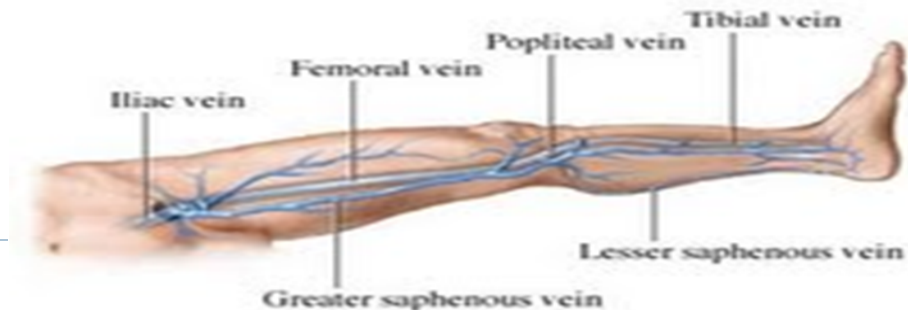
- ▶ **Damaged vessel wall exposes the subendothelium**
 - ▶ **Inflammatory response leads to thrombogenesis with adhesion, activation & aggregation of platelets and coagulation.**
 - ▶ **Can occur with direct venous damage**
 - ▶ **hip or knee surgery, or varicose vein stripping, severe burns, or lower-limb trauma.**
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- ▶ **Can occur in chronic inflammatory states.**

DVT (VTE)

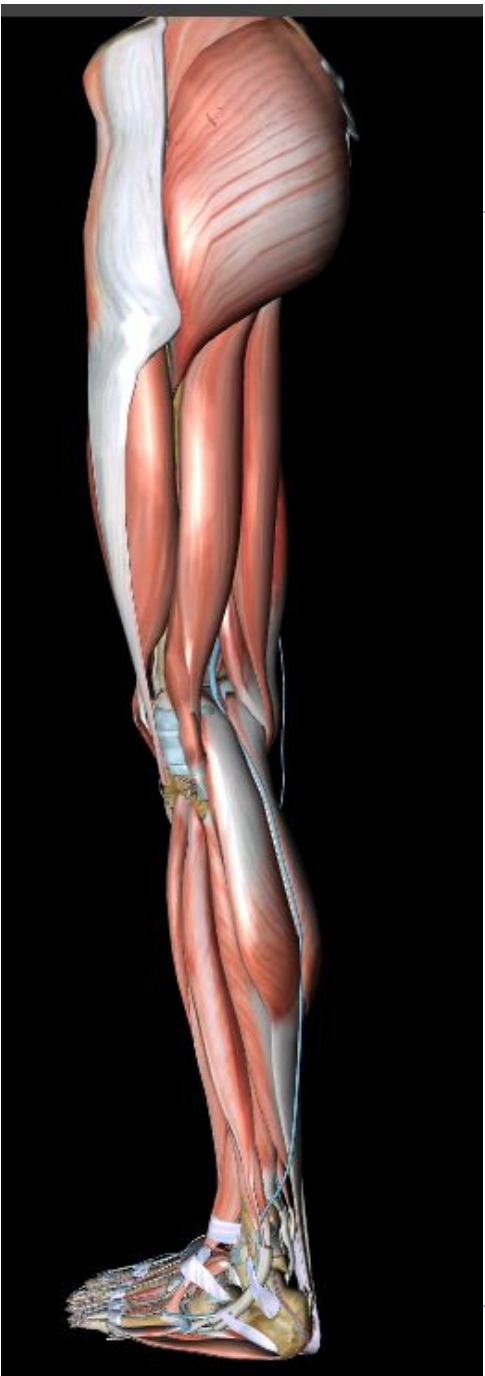
- ▶ **Proximal DVTs involve the popliteal, femoral, or iliac venous system and are commonly complicated by PE.**
- ▶ **Approximately 20% of untreated silent calf vein thrombi and 20% to 30% of untreated symptomatic calf vein thrombi extend into the popliteal vein.**
- ▶ **When the DVT extends and is untreated, it is associated with a 40% to 50% risk of clinically detectable PE.** Anderson FA

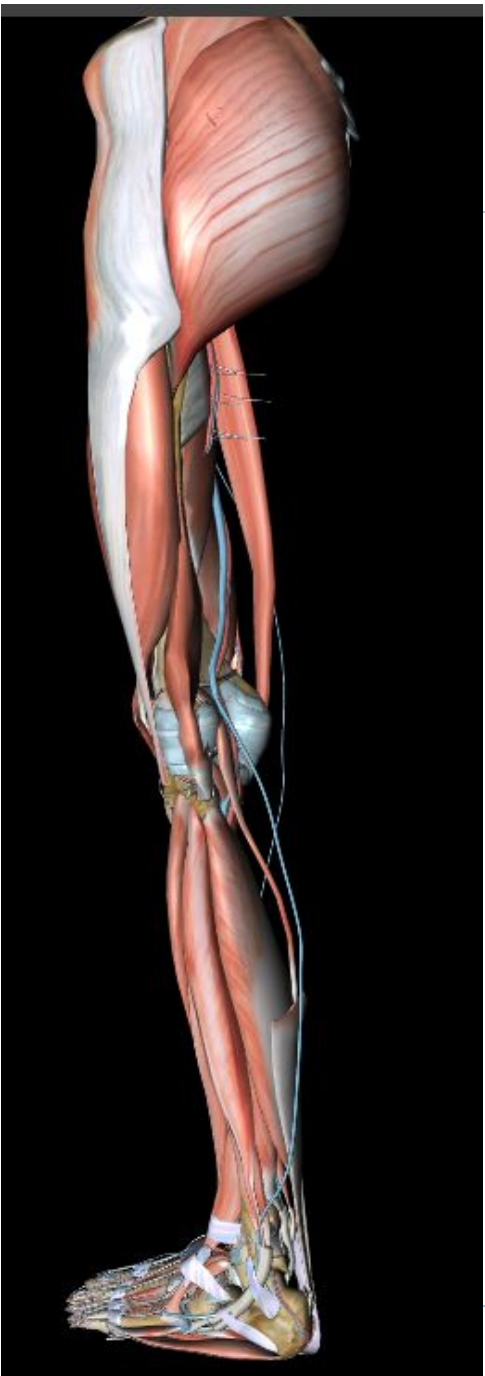
DVT (VTE)

- ▶ **Proximal deep vein thrombosis (PDVT) is the more dangerous form of lower-extremity DVT because it is more likely to cause life-threatening PE and may result in a greater risk of postthrombotic syndrome.** Riddle & Wells 2004
- ▶ **Calf DVT, although less serious than PDVT, must be considered because the thrombus extends proximally in approximately 30% of cases.** Riddle & Wells 2004









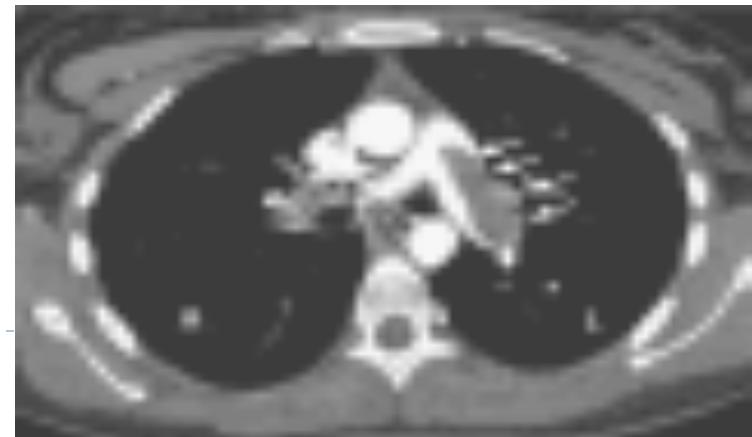
PE

- ▶ **~ 10% of all patients with acute PE die during the first 1 to 3 months after diagnosis.**
- ▶ **Overall, 1% of all patients admitted to hospitals die of acute PE, and 10% of all hospital deaths are related to a PE.**



PE Clinical manifestations

- ▶ **Dyspnea is the most frequently reported symptom.**
- ▶ **Chest pain is common.**
- ▶ **Syncope is usually associated with a massive PE and caused by a reduction in cardiac output. Results in hypotension and impairment of cerebral blood flow.**



Conditions and Settings

DVT Risks

Inpatient vs outpatient

- ▶ **In many cases, PDVT does not appear until after a patient has been discharged from the hospital and is being managed as an outpatient.**
- ▶ **If outpatients with PDVT can be identified earlier rather than later, the risk for severe morbidity and mortality potentially can be lessened.**

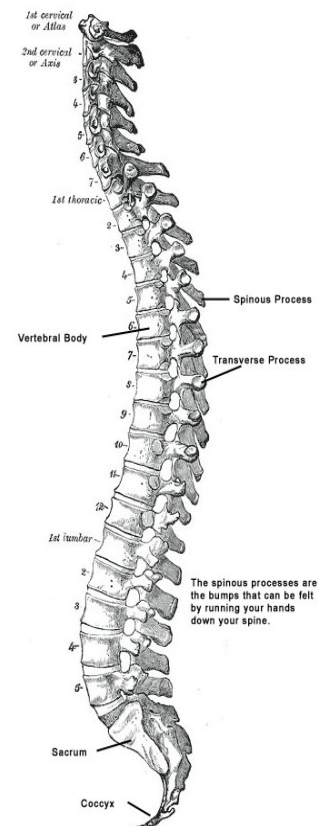
Prevalence of VTE after Spinal surgery

- ▶ Yoshioka looked at 73 patients who underwent spinal surgery between Sept. 2007 and March 2008.

- ▶ Concluded: The prevalence of VTE after spine surgery was 8.3%.

No patients with clinical signs of DVT.
5 had a DVT and 3 had a PE

Lateral View of the Vertebral Column



After D/C from the Hospital

- ▶ **Venographic studies suggest that ~ 1 of 5 (20%) patients undergoing elective orthopedic surgery who receive standard antithrombotic prophylaxis will have asymptomatic DVT found by venography at the time of hospital discharge.**
- ▶ **3 months after hospital discharge, symptomatic nonfatal VTE occurs in ~ 1 of 42 (2.4%) patients, and fatal PE occurs in approximately 1 of 1250 (0.08%) patients.**



Lower Extremity Post Operation

- ▶ **Kume examined 48 patients that underwent a total Knee Arthroplasty.**
- ▶ **Kume noted that 23 of the 48 patients had DVT postoperatively, and 8 had an asymptomatic PE.**
- ▶ **PDVT is reported to be the most common complication following hip or knee arthroplasty and traumatic orthopedic injuries.**

Riddle & Wells 2004



Post operation

- ▶ **Orthopedic procedures may carry a high risk for VTE due to the destruction of bone marrow causing intravasation of marrow cells and cell fragments and elevations of plasma tissue factor.**
- ▶ **Tissue factor is a potent trigger of blood clotting and is found in high concentration in bone marrow and the adventitia surrounding the major blood vessels and the brain, putting neurosurgical patients at great risk for development of VTE.**

Neuro surgery

- ▶ **After neurosurgery, the incidence of VTE has been reported to be as high as 50%.**
- ▶ **Risk factors that increase the rates of VTE in neurosurgery patients include intracranial surgery, malignant tumors, duration of the surgery, and presence of paresis or paralysis of the lower limbs.**
- ▶ **Patients can remain in this postsurgical hypercoagulable state for weeks after surgery.**

Cancer and VTE

- ▶ **Kanz examined 705 patients with recently diagnosed Cancer or progressive Cancer after remission to study their prognostic significance for VTE and survival.**
- ▶ **VTE occurred in 43 (6.1%) patients and 413 (58.6%) died. The cumulative probability of VTE was 6.6% after one year.**



Patients with COPD and DVT incidence

- ▶ **Duan examined 520 patients with COPD**
 - ▶ Considered to be at moderate risk for the development of VTE.
- ▶ **DVT was found in 46 cases (9.7%)**
 - ▶ In patients with DVT, the duration of hospitalization was longer and the mechanical ventilation requirement increased.
- ▶ **Conclusion:**
 - ▶ Patients with COPD, who were immobilized for over 3 days, complicated by pneumonia and had respiratory failure type II, had a higher risk of DVT.



Elderly

- ▶ **Siccama (2010) systematic review of 9 articles**
 - ▶ Diagnostic accuracy of CDRs for VTE in elderly.
- ▶ **Conclusions:**
 - ▶ An increase of prevalence of PE with age
 - ▶ 5 fold increase over 75 y/o
 - ▶ Safety and sensitivity of the CDRs for VTE in elderly remained high
 - ▶ A strong decrease of specificity and efficiency for CDRs of VTE in older patients.
 - ▶ “Although the safety of CDRs for VTE is high, adapting (CDR’s) for elderly is much needed to make them more efficient for aged patients.”



Signs & symptoms

DVT

Signs & Symptoms

- ▶ **The classic signs and symptoms of DVT are localized pain, tenderness, swelling, and discoloration.**
- ▶ **Other symptoms may include lower extremity edema, fever, extremity warmth, and pain.**
 - ▶ Symptoms can serve only as a trigger for further diagnostic inquiry; they cannot, by themselves, rule a DVT in or out.
- ▶ **Like symptoms, physical examination findings are not sensitive or specific; in more than 50% of the instances in which there was a verified DVT, there was a normal physical examination.**

Signs & Symptoms

- ▶ **Most clinicians attempt to identify outpatients suspected of having PDVT by considering the patients' signs and symptoms and associated risk factors. For example, patients with symptomatic PDVT tend to complain of lower extremity pain, calf tenderness, and lower extremity swelling.**
- ▶ **However, approximately 75% of all patients who are suspected of having PDVT are found not to have PDVT when formal diagnostic testing is completed.**



Homans' History



Appearance in the Literature

- ▶ **1943 (Annals of Surgery) – article: “Thrombosis and Embolism: review of 202 patients treated by femoral vein interruption” by Allen, Linton, & Gordon from the Surgical Department at MGH (Allen et al., 1943)**
 - ▶ “Homans’ sign is a term used in our clinic. Dr John Homans calls it the dorsiflexion sign.”
 - ▶ 42% of extremities examined (+) for Homans’ sign
 - ▶ “59% of cases had leg signs or symptoms as the first indication of trouble, while 41% had chest pain first.”



The article usually referenced

- ▶ **1944 (NEJM) – article: “Diseases of the Veins” (Homans, 1944)**
 - ▶ **Refers back to Allen et al. their use of “Homans’s sign”**
 - ▶ **States:**
 - ▶ **“I prefer to call it the dorsiflexion sign”**
 - ▶ **“I regard the dorsiflexion sign as having a greater degree of importance than would be judged from (Allen et al.’s) analysis.”**
 - ▶ **“if one looks on the dorsiflexion sign as evidence of even the faintest irritability of the posterior muscles, ... the sign will probably be found present more frequently than either tenderness or swelling.”**



Homans' Sign Evaluated (McLachlin et al., 1962)

	True Positives		False Positives	
	Incidence	%	Incidence	%
Swelling at ankle	10/12	83	1/18	6
Local Tenderness	5/12	41	2/18	11
Skin-Temperature Changes	6/12	41	0/18	0
Homans' dorsiflexion sign	1/12	8	1/18	6
Venous dilatation	3/12	25	2/18	11

“... surprised to find that one of the clinical signs in popular use (Homans') was elicited in only 8% of the cases with thrombi ... (Homans') was positive in only 1 of 5 cases in which thrombosis in the calf veins was proved at autopsy.”

▶ (McLachlin et al., 1962)

Homans' Sign Evaluated (Urbano, 2001 - review)

- ▶ **Homans' sign present in 33% pts with thrombosis, also present in 21% without**
- ▶ **Estimates of accuracy of Homans'**
 - ▶ positive in 8% to 56% of proven DVT cases, positive in 50% of symptomatic pts without proven DVT
 - ▶ More common in pts clinically suspected of DVT with negative venogram than in clinically suspected with positive venogram
- ▶ **“This has led nearly all authors to declare that Homans' sign is unreliable, insensitive, and nonspecific in the diagnosis of DVT.”**

(Urbano, FL.. Homans' sign in the diagnosis of deep vein thrombosis. Hospital Physician. March 2001, pp. 22-24)

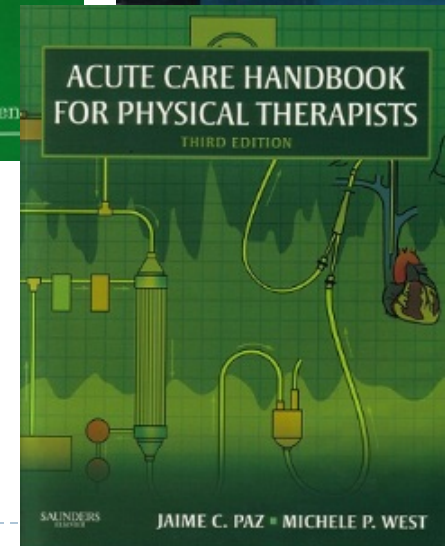
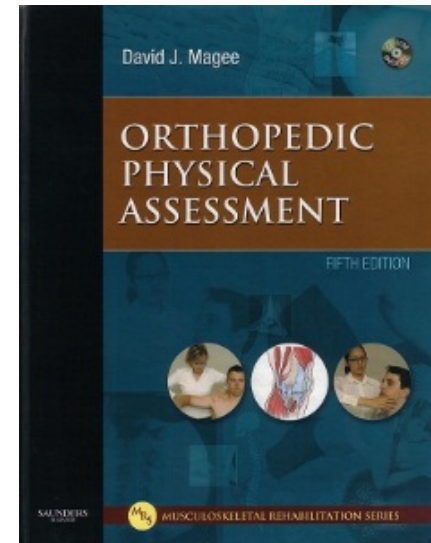
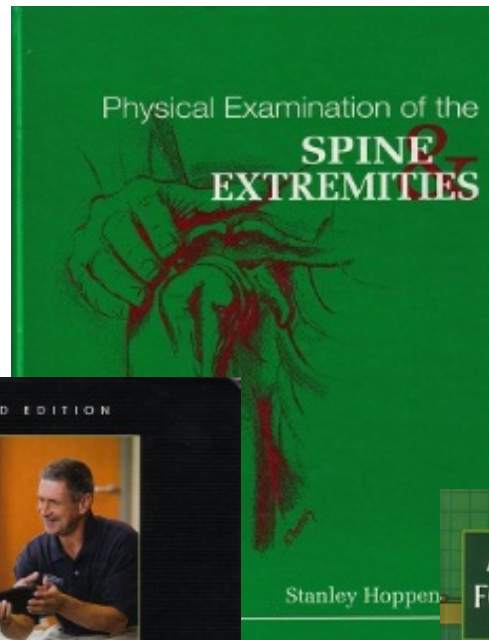
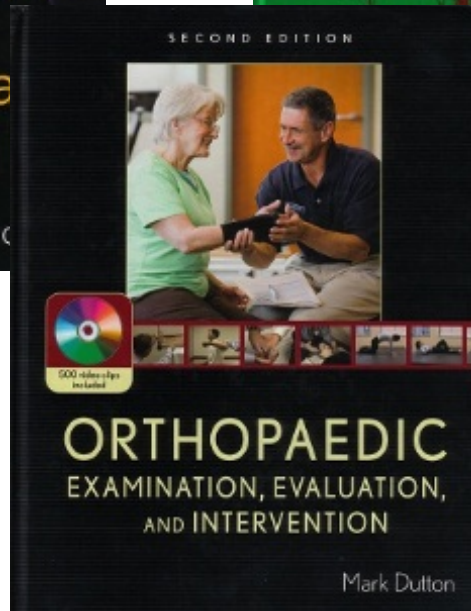
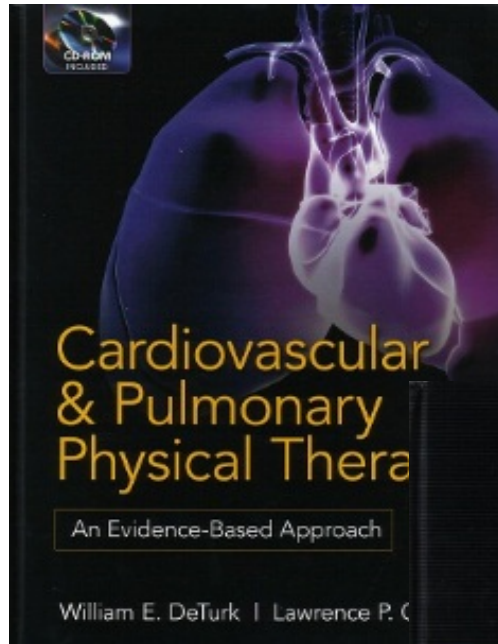
Homans' Sign Evaluated

(Riddle & Wells, *Physical Therapy*, 2004)

- ▶ **“Studies have demonstrated that the Homans sign has essentially no diagnostic value with sensitivities on the order of 50%”**
- ▶ **“... therapists need a method for determining when (a pt with DVT) should be referred for a diagnostic workup.”**
- ▶ **Authors recommend use of clinical decision rules by therapists – and describe Wells CDR.**



In Our Current & “Classic” Texts



Clinical Decision Rules

Current practice evolving

- ▶ **Current practice is to refer all patients presenting with complaints suspected of a DVT, to specialized diagnostic services for objective testing.**
- **Studies have revealed that 80–90% of these referred patients do not have a DVT.**
- ▶ **Rapid point-of-care D-dimer assays combined with a specific CDR makes it possible to realize a diagnostic work-up in a primary care setting.**

Other DVT Assessment Tools

- ▶ **Kahn (4 component scale)**
 - ▶ Found not to be effective in hospitalized patients
- ▶ **Oudega (9 component scale)**
 - ▶ Primary Care
- ▶ **St. Andre (6 component scale to identify proximal & distal DVTs)**
 - ▶ Hospitalized patients
- ▶ **Ambulatory (Constans et al. 6 component scale)**
 - ▶ Outpatients



Variables	Wells	Oudega
Male sex	--	1
Oral contraceptive use	--	1
Active malignancy	1	1
Immobilization of LE's	1	--
Major surgery (3 months)	1	1
Absence of leg trauma	--	1
Localized tenderness	1	--
Dilated collateral veins	1	1
Swelling (whole leg)	1	--
Calf swelling > 3cm	1	2
Pitting edema	1	--
Previously documented DVT	1	--
Alternative diagnosis	-- 2	--
Positive D-dimer result	--	6
Cutoff scores for considering DVT is absent	< 3	< 6

DVT Assessment Tools (CDR)

- ▶ **Wells**
- ▶ **AUTAR 1998**
- ▶ **Developed to separate risk into no risk, low, moderate and high risk categories.**
- ▶ **7 categories of risk factors.**
- ▶ **100% sensitivity, 81% specificity and a correlation coefficient of 0.98**
- ▶ **Designed to allow application in diverse clinical specialties.**



Wells CDR

- ▶ **“The diagnosis of DVT relies heavily on the use of objective tests because symptoms and signs are not thought to be specific.”**
- ▶ **“It has been our impression that clinical features can be used to classify symptomatic patients with suspected DVT as having a high or low probability for DVT before diagnostic testing.”**
- ▶ **Original study published in 1995...addition**



Since 1995...

Sensitivity

Specificity

▶ Sohne 2005	100%	45%
▶ Aguillar 2006	100%	30%
▶ Schutgens 2006	100%	35%
▶ Carrier 2008	96%	70%



Wells 1997

- ▶ **593 patients:**
- ▶ **329 low-risk, 10 (3%) had DVT diagnosed.**
 - ▶ Thus implying that low-risk patients with normal US results do not need further testing.
- ▶ **193 moderate-risk, 32 (16.6%) proved to have DVT.**
- ▶ **71 high-risk, 53 (75%) had DVT diagnosed.**
 - ▶ *In high risk patients with a negative ultrasound, further tests should be considered.*



Clinical Decision Rule Developed by Wells and Colleagues (*Lancet*. 1997;350:1795-1798)

Clinical Finding	Score ^a
Active cancer (within 6 months of diagnosis or palliative care)	1
Paralysis, paresis, or recent plaster immobilization of lower extremity	1
Recently bedridden >3 days or major surgery within 4 weeks of application of clinical decision rule	1
Localized tenderness along distribution of the deep venous system ^b	1
Entire lower-extremity swelling	1
Calf swelling by >3 cm compared with asymptomatic lower extremity ^c	1
Pitting edema (greater in the symptomatic lower extremity)	1
Collateral superficial veins (nonvaricose)	1
Alternative diagnosis as likely or greater than that of deep vein thrombosis ^d	- 2



Clinical Pretest Probability: Wells DVT Score

High DVT Risk = 3+

Moderate DVT Risk = 1-2

Low DVT Risk = < 1

(If both legs are symptomatic, score the more severe leg)

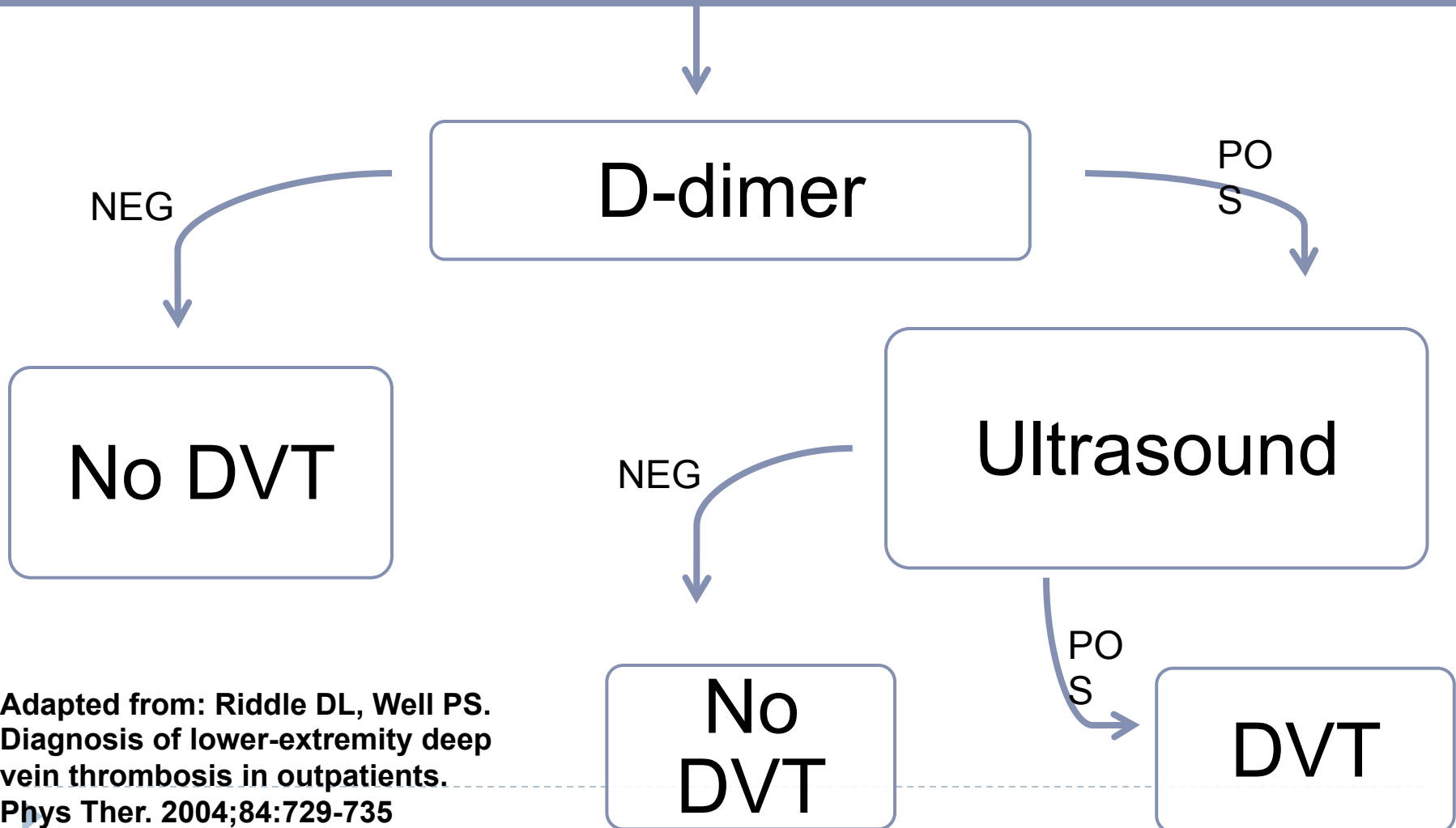


Algorithm for Diagnosing Deep Vein Thrombosis (DVT) in Outpatients

Adapted from: Riddle DL, Well PS.
Diagnosis of lower-extremity deep vein
thrombosis in outpatients. *Phys Ther.*
2004;84:729-735.

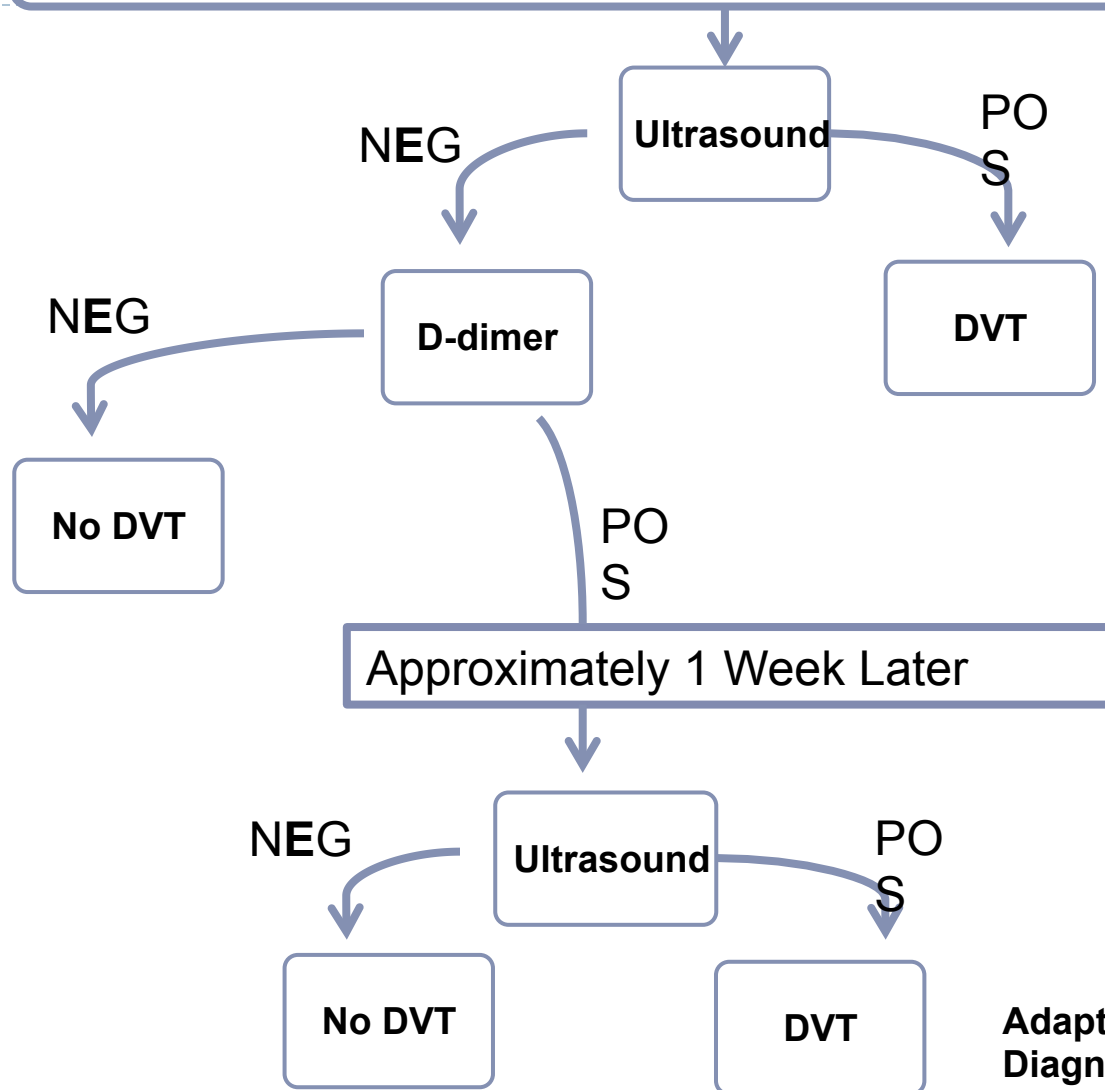


Low Pretest Probability (Score of 0 or less)



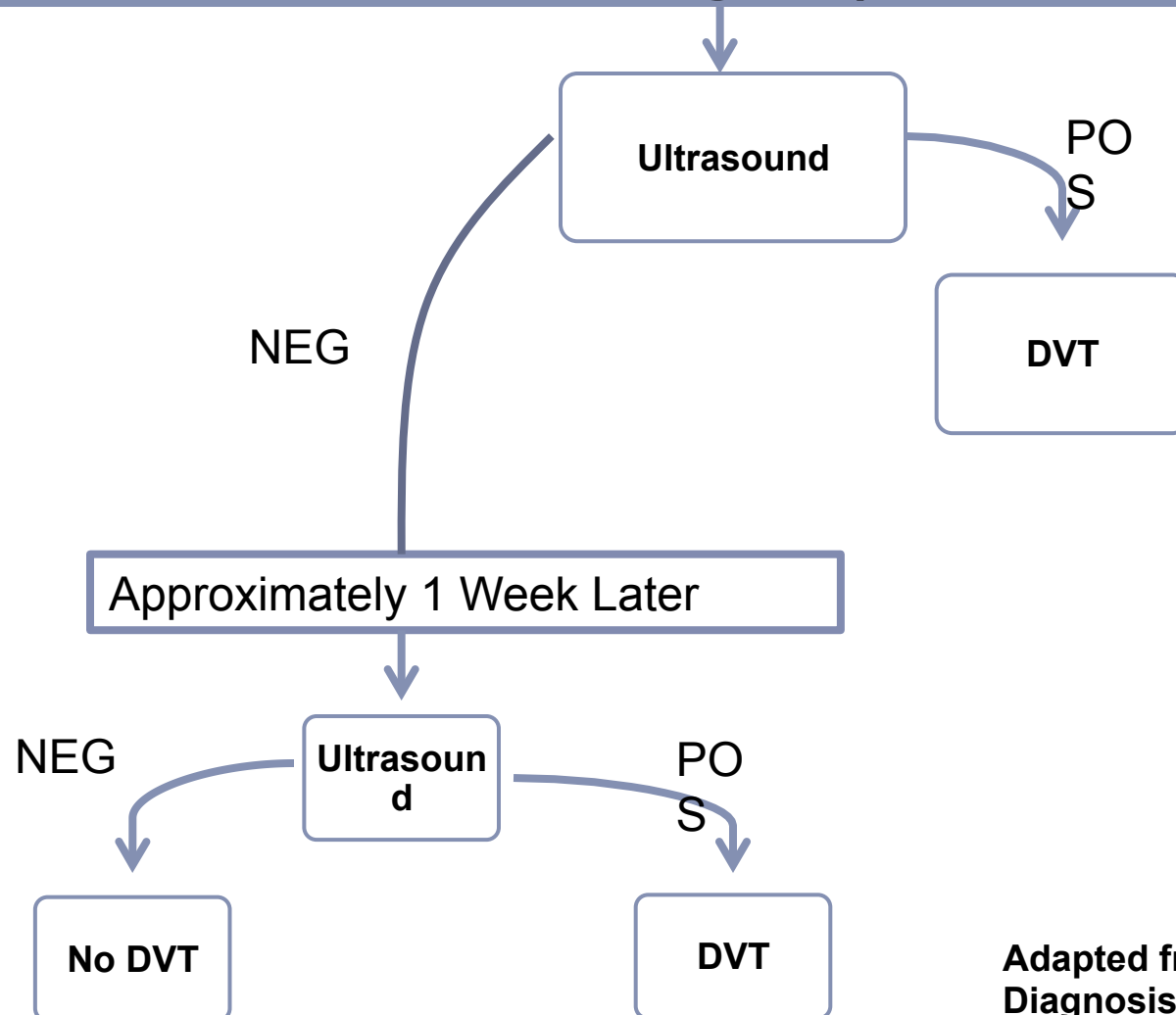
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Phys Ther. 2004;84:729-735

Moderate Pretest Probability (score of 1 or 2)



Adapted from: Riddle DL, Well PS.
Diagnosis of lower-extremity deep
vein thrombosis in outpatients.
Phys Ther. 2004;84:729-735

High Pretest Probability (score of 3 or higher)



Adapted from: Riddle DL, Well PS.
Diagnosis of lower-extremity deep
vein thrombosis in outpatients.
Phys Ther. 2004;84:729-735

Limitations of the Clinical Decision Rules

- ▶ To date, research has shown that Clinical decision rules are not as effective of a screening tool for:
 - ▶ Elderly patients
 - ▶ Patients with Cancer
- ▶ More research needs to be done for specific settings
 - ▶ Acute/med surg
 - ▶ Hospitalized patients→identifying the best CDR to use!



When can the patient with DVT start ambulation?

▶ Historical Evidence:

- ▶ 2002. Ciccone; Evidence in Practice article, one patient.
 - ▶ physician: “ambulate as soon as possible”
 - ▶ Ciccone’s clinical decision: wait 48 hours (risk of PE) after initiation of anticoagulant therapy and ensure continuous use of compression stockings
- ▶ 2004. Aldrich & Hunt; *PTJ* Update article. Review of Lit.
 - ▶ Data limited but Walking Within the First 24 hours of beginning medical treatment for DVT (anticoagulant with compression stockings)
 - ▶ Careful consideration for patients with DVT and known PE



When can the patient with DVT start ambulation?

▶ Current Evidence

- ▶ 2009. Anderson et al; Systematic Review w/ meta-analyses
 - ▶ NO DIFFERENCE IN RISK btwn ambulation & bed rest for:
 - Developing of PE
 - Development of a new DVT
 - Progression of an existing DVT
 - ▶ “clinicians should be confident that that ambulating patients with DVT does not appear to increase the risk (of 3 bullets above).”
 - ▶ Article based on meta-analysis of 4 RCTs from 1999-2006 and 4 other studies from 2001-2008.



Patient example

A 68-year-old man was referred to your outpatient clinic following a cemented right hip arthroplasty procedure 3 weeks before your examination. He reports that he has had pain in his right calf and thigh since being discharged from the hospital and that these symptoms limit his ability to ambulate. He also reports difficulty getting in and out of bed. You find that he has a swollen right lower extremity and that he complains of pain when you palpate his right posterior calf and knee. You suspect that he may have a deep vein thrombosis (DVT), but you also consider that it is likely that the lower-extremity symptoms are attributable to the recent surgical procedure. Do you contact the patient's physician?

Answer (from Riddle & Wells)

If we now return to our hypothetical patient, we can see that the **patient would have a score of 1** on the CDR because he had **recent major surgery (+ 1 on the CDR)**, **swelling throughout the lower extremity (+ 1 on the CDR)**, and **tenderness to palpation in the posterior calf and knee (+ 1 on the CDR)**, along with an **alternative diagnosis at least as likely as PDVT (postoperative pain and swelling for a score of —2 on the CDR)**. The probability that this patient has PDVT is approximately 17%. Given the potentially serious consequences associated with missing a PDVT, referral to a physician would appear to be appropriate. Because this patient has a moderate probability of PDVT, evidence suggests that the patient should have a compression ultrasound test.

Case study

- ▶ **52 y/o woman who c/o 1 week history of right calf pain. She underwent a L5 discectomy for LBP & R LE pain 2 months ago. She did not take anticoagulants after the surgery. Pt reports R calf pain for a few days that is different than her previous R LE pain. She has been gradually walking longer distances & does not remember hurting her calf. Her leg is mildly swollen w/ pitting edema in the calf. Homans sign is – and she has tenderness in her calf region.**
- ▶ **She is otherwise healthy and has never had a DVT.**

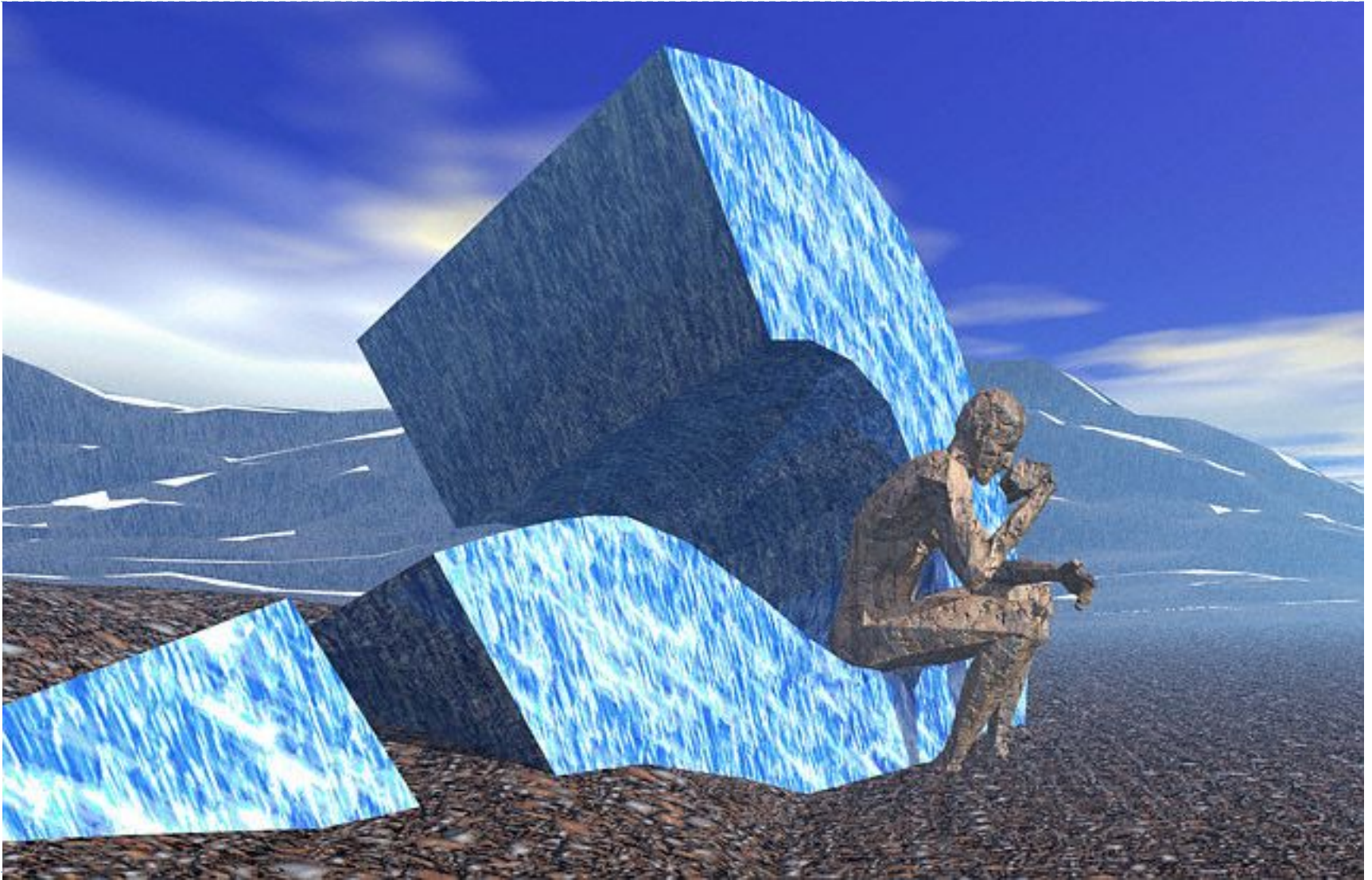
Case study

- ▶ **63 y/o retired man d/c'd from hospital for a surgically repaired supracondylar fracture of the humerus 1 month earlier. He did not take anticoagulants after the surgery. Currently, in addition to his shoulder pain, he c/o moderate L calf pain & swelling during the past week. He is ambulatory & has no history of DVT, leg trauma, or unusual physical activity. He denies chest pain, SOB or dizziness, although he does have CHF controlled by meds. The L calf measures 2 cm larger than the R & there is slight swelling in the thigh. No evidence of pitting edema was found. Homans sign –**
-



Discussion

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Clinical Decision Rule Developed by Wells and Colleagues (*Lancet*. 1997;350(9094): 1795-1798)

Clinical Finding	Score ^a
Active cancer (within 6 months of diagnosis or palliative care)	1
Paralysis, paresis, or recent plaster immobilization of lower extremity	1
Recently bedridden >3 days or major surgery within 4 weeks of application of clinical decision rule	1
Localized tenderness along distribution of the deep venous system ^b	1
Entire lower-extremity swelling	1
Calf swelling by >3 cm compared with asymptomatic lower extremity ^c	1
Pitting edema (greater in the symptomatic lower extremity)	- 2
Collateral superficial veins (nonvaricose)	
Alternative diagnosis as likely or greater than that of deep vein thrombosis ^d	

^aScore interpretation: ≤0=probability of proximal lower-extremity deep vein thrombosis (PDVT) of 3% (95% confidence interval [CI] = 1.7%-5.9%), 1=probability of PDVT of 17% (95% CI= 12%-23%), ≥3=probability of PDVT of 75% (95% CI = 63%-84%).

^bTenderness along the deep venous system is assessed by firm palpation in the center of the posterior calf, the popliteal space, and along the area of the femoral vein in the anterior thigh and groin.

^cMeasured 10 cm below tibial tuberosity.

^dMost common alternative diagnoses are cellulitis, calf strain, and postoperative swelling.