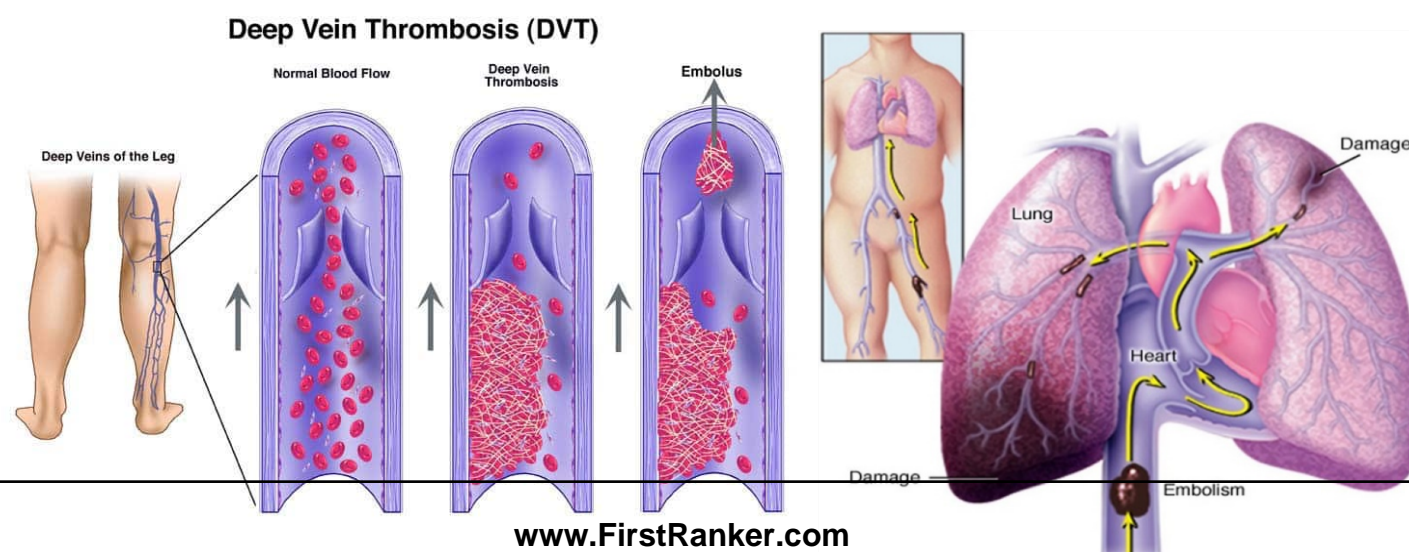


DVT Prophylaxis in Neuro ICU

What is DVT?

- ▶ VTE= DVT+PE
- ▶ Deep vein thrombosis is the formation of a blood clot in one of the deep veins of the body, usually in the leg



Pulmonary Embolism



History

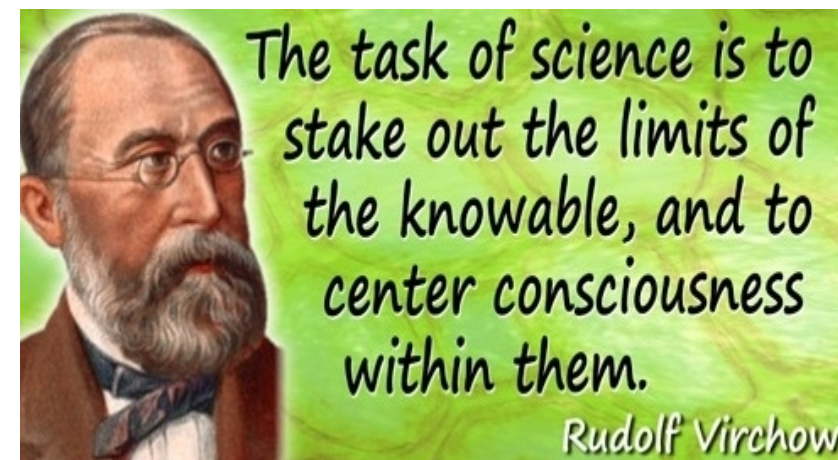
- ▶ Susruta (Ayurveda physician and surgeon, 600-1000B.C), Patients with a "swollen and painful leg that was difficult to treat"
- ▶ First description of pulmonary embolism by Giovanni Battista Morgagni in 1761, described large blood clots in the pulmonary vessels of patients who died suddenly



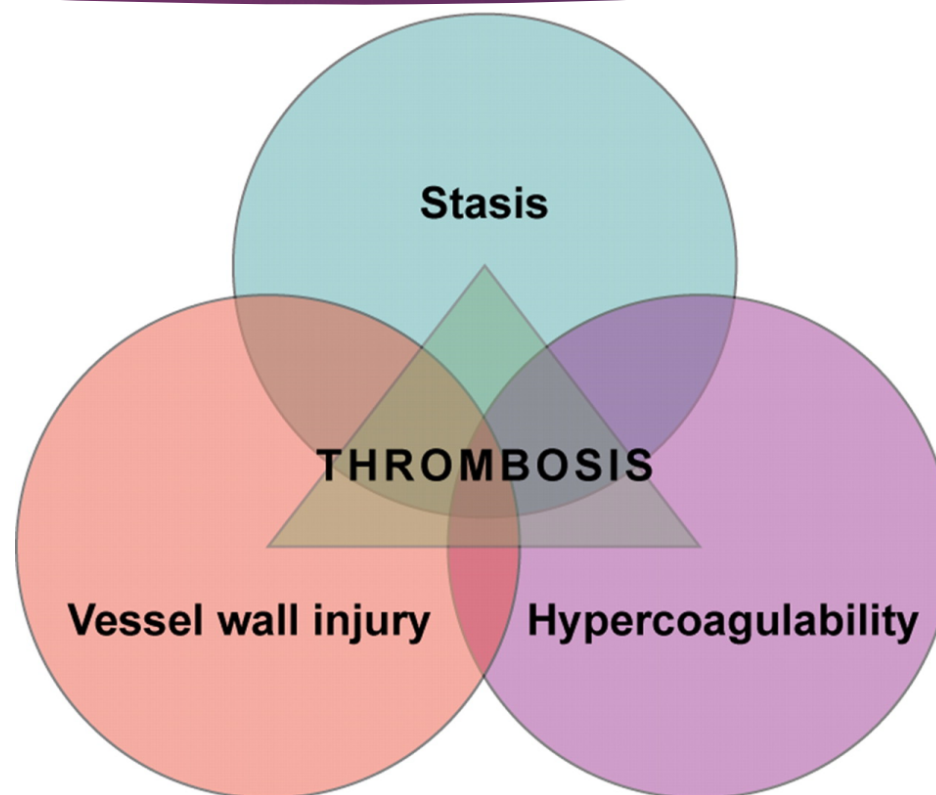
History

"Discovered" PE in 1846 – "the detachment of larger or smaller fragments from the end of a softening thrombus which are carried along the current of blood and driven into remote vessels. This gives rise to the very frequent process on which I have bestowed the name Embolia"

- ▶ In 1856, Rudolf Virchow published a collection titled "Collective Treatises on Scientific Medicine," which contained his detailed studies of embolization following venous thrombosis.



Virchow's triad



Neurologically impaired patients- moderate to high risk for VTE

- ▶ Paresis/Paralysis
 - ▶ Prolonged duration of depressed consciousness/coma
 - ▶ Brain neoplasm/Rheumatological/inflammatory disorders
 - ▶ Prolonged duration of surgery
 - ▶ Aneurysmal SAH – Vessel injury/ Endothelial activation
- } Venous stasis
- } Hypercoagulability

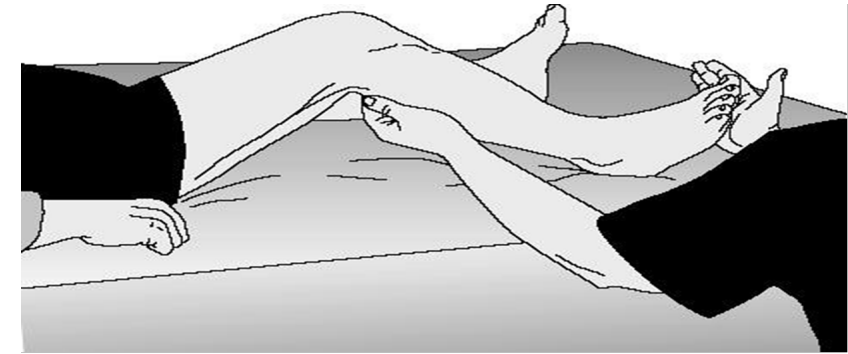
DVT in neurologically impaired patients

- ▶ Large variation in the statistics- overall incidence of DVT
- ▶ Incidence of DVT ranges from 21-34%- among pts who underwent cranial or spinal surgeries without any DVT prophylaxis
- ▶ Higher incidence seen (~50%)- in pts with spinal cord injury and ischemic stroke
- ▶ Incidence of DVT in aneurysmal SAH is 1.5-24%

Symptomatic deep vein thrombosis is
"tip of the iceberg"



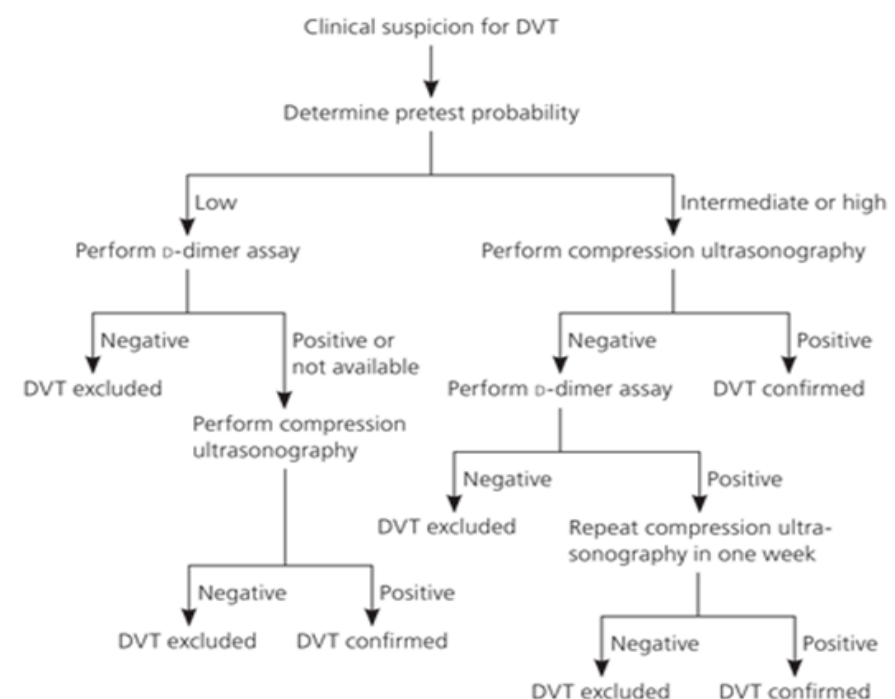
- ▶ The presence or absence of clinical symptoms of DVT is as unreliable marker
- ▶ **Signs and symptoms of DVT**
 - ▶ Pain or tenderness in the leg
 - ▶ Swelling of the leg or along a vein in the leg
 - ▶ Red or discoloured skin on the leg
 - ▶ Increased warmth in the area of the leg that's swollen or is in pain
 - ▶ **Homan;s sign**- pain in posterior calf with forced dorsiflexion of foot
 - ▶ **Moses sign**- gentle squeezing of the lower part of calf from side to side causes severe pain



Diagnosis of DVT

- ▶ D- Dimer Assay
- ▶ 125-labelled fibrinogen test
- ▶ Impedance plethysmography
- ▶ Doppler ultrasound of femoral veins
- ▶ Venography

Diagnosis of Deep Venous Thrombosis



DVT risk assessment score

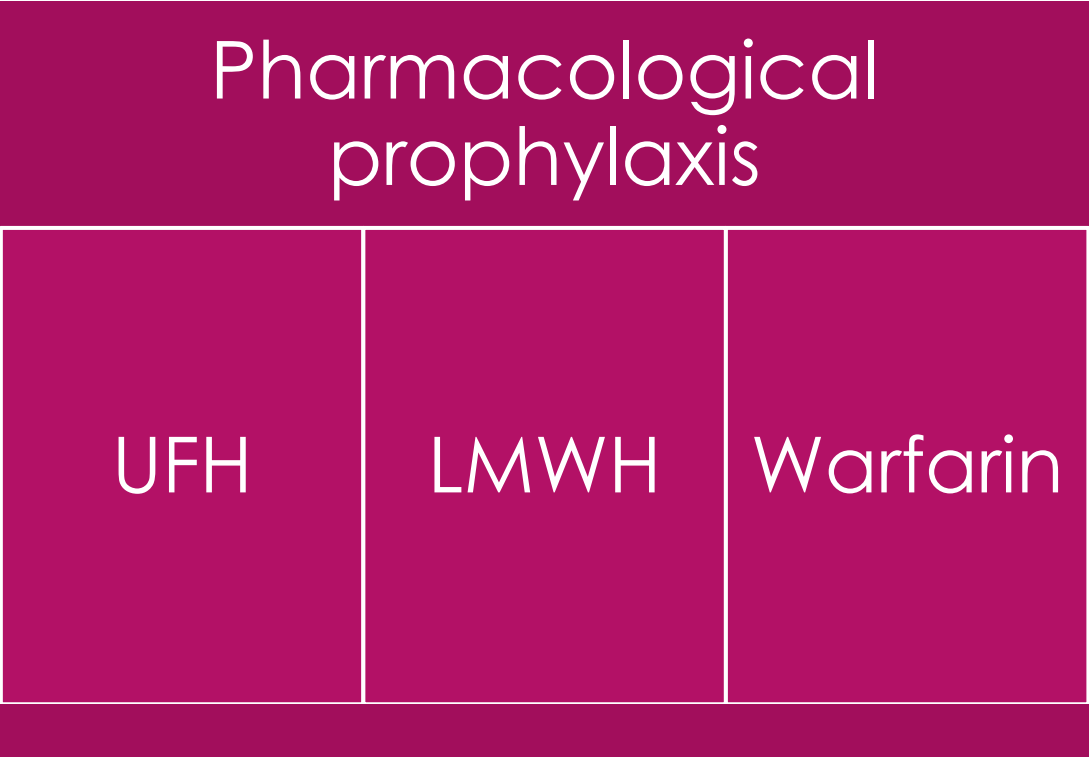
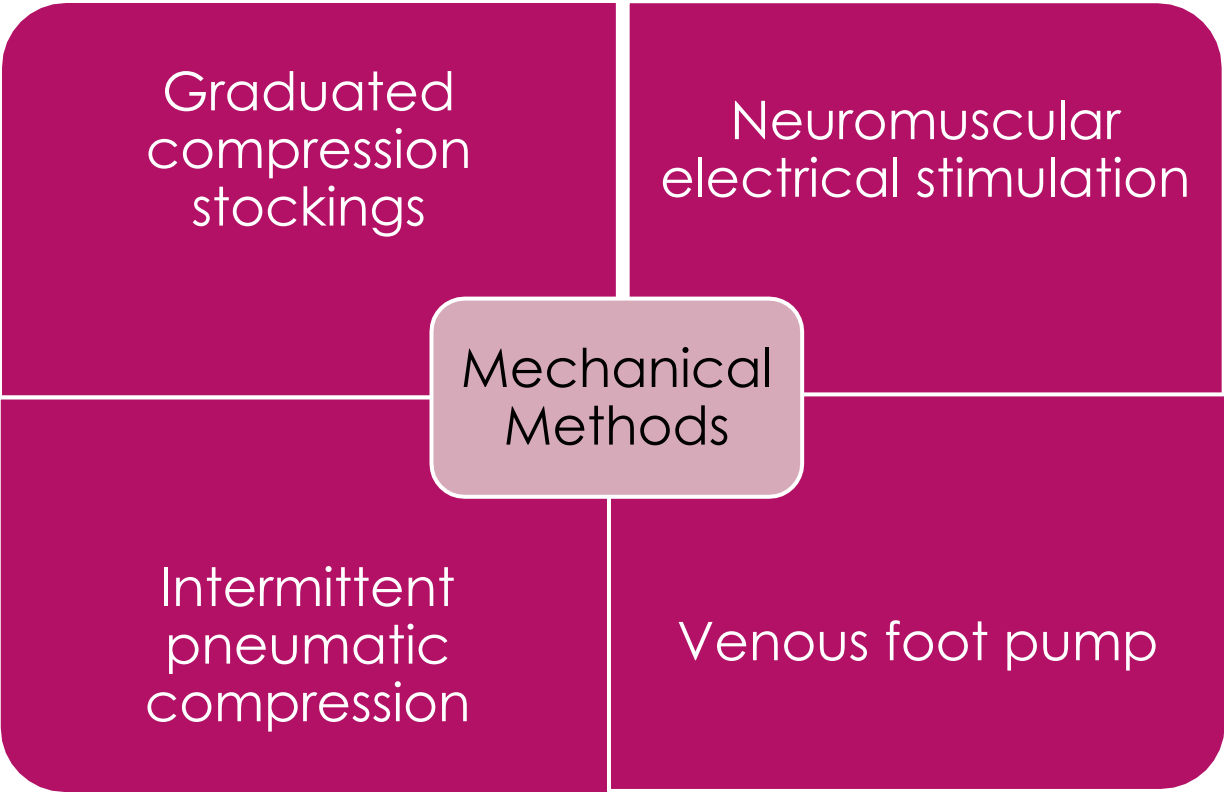
Name: Unit No: Ward:	Age: Type of admission: Diagnosis:
AGE SPECIFIC GROUP (years)	score
10-30	0
31-40	1
41-50	2
51-60	3
61-70	4
71+	5
MOBILITY	score
Ambulant	0
Limited (uses aids, self)	1
Very limited (needs helps)	2
Chairbound	3
Complete bedrest	4
TRAUMA RISK CATEGORY	score
Score item(s) <i>only preoperative</i>	score
Head injury	1
Chest injury	1
Spinal injury	2
Pelvic injury	3
Lower limb injury	4
CURRENT HIGH RISK DISEASES: Score the appropriate item(s)	score
Ulcerative colitis	1
Polycythaemia	2
Varicose veins	3
Chronic heart disease	3
Acute myocardial infarction	4
Malignancy (active cancer)	5
Cerebrovascular accident	6
Previous DVT	7
ASSESSMENT PROTOCOL	
Score range	Risk categories
≤ 10	Low risk
11-14	Moderate risk
15 ≥	High risk
Please record any other clinical observations that may supplement this DVT risk assessment.	
VENOUS THROMBOPROPHYLAXIS	
Low risk: Ambulation+ Graduated Compression Stockings.	
Moderate risk: Graduated Compression stockings+ Heparin + Intermittent Pneumatic Compression Stockings.	
High risk: Graduated Compression Stockings+ Heparin+ Intermittent Pneumatic Compression.	
International Consensus Group recommendation, 2001.	
© R Autar 2002	

New (2002) Autar DVT risk assessment scale.

Two-Level Deep Vein Thrombosis (DVT) Wells Criteria Score^a

Clinical Feature	Points
Active cancer (treatment ongoing, within 6 mo, or palliative)	1
Paralysis, paresis, or recent plaster immobilization of the lower extremities	1
Recently bedridden for 3 d or longer or major surgery within 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 asymptomatic side	1
Pitting edema confined to the symptomatic leg	1
Collateral superficial veins (nonvaricose)	1
Previously documented DVT	1
Alternative diagnosis at least as likely as DVT	-2
Clinical probability simplified score	
DVT likely	2 points or more
DVT unlikely	Less than 2 points

DVT prophylaxis methods



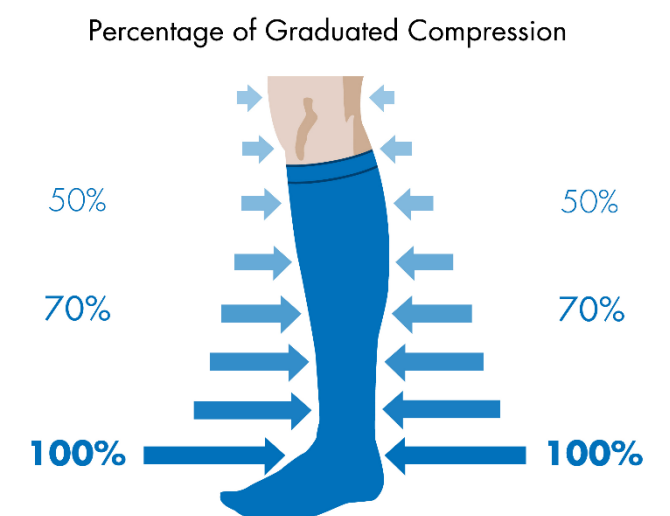
DVT prophylaxis methods

- ▶ **Early and frequent ambulation-** historically used to prevent DVT
- ▶ Not feasible for critically ill, neurologically impaired patients
- ▶ Largest no. of thromboembolic events occurred after pts started to ambulate
- ▶ Ambulation –counteracts only one component of Virchow;s triad- venous stasis



Mechanical methods

- ▶ **Graduated compression stockings:**
- ▶ Graded circumferential pressure from distal to periphery
- ▶ Greatest degree of compression at the ankle, with the level of compression gradually decreasing up the garment
- ▶ Pressure gradient ensures, blood moves from limb towards heart
- ▶ Reduces diameter of veins
- ▶ Improves venous flow velocity
- ▶ Avoid venous stasis
- ▶ Less efficacious in immobile patients



- In CLOTS trial 1, symptomatic and asymptomatic deep vein thrombosis occurred in 126 (10.0%) patients wearing graduated compression stockings and in 133 (10.5%) not wearing them, for a nonsignificant absolute reduction in risk of 0.5% (95% confidence interval [CI] -1.9% to 2.9%).

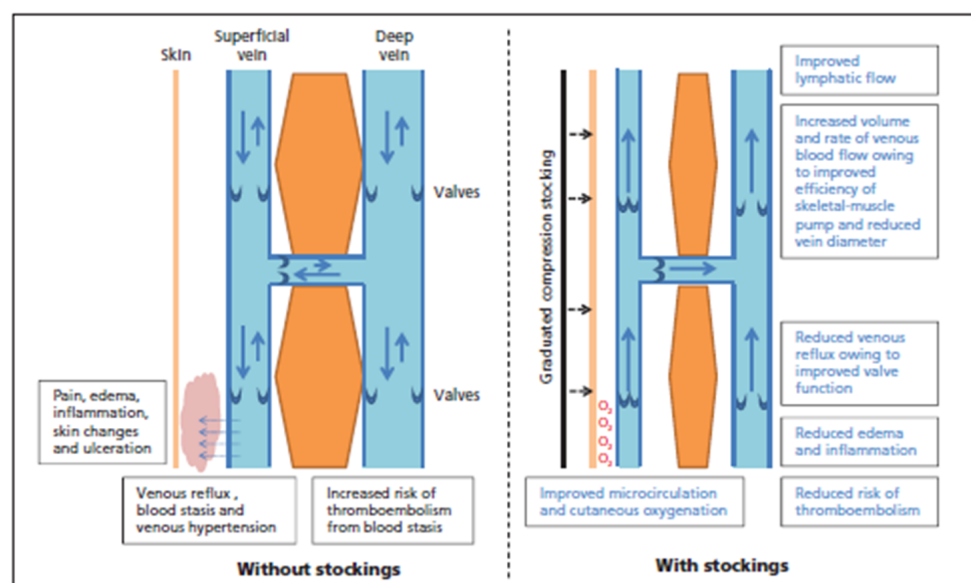
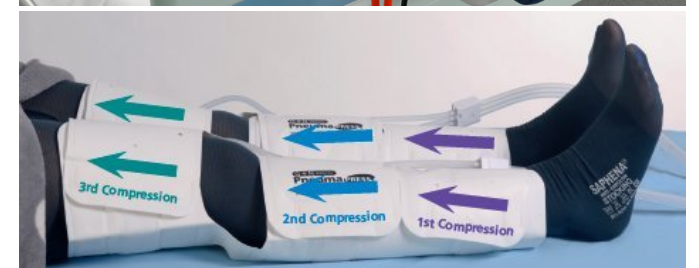


Figure 2: The mechanisms of action of graduated compression stockings.



► Intermittent pneumatic compression:

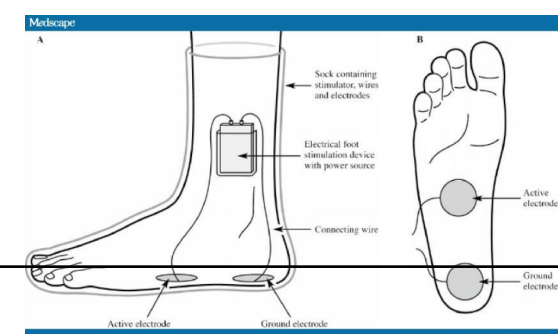
- Cycles of compression and relaxation of pumped air
- Inflates first at ankle with higher pressure
- Inflates last at thigh at lower pressure
- Deep veins are compressed and displaces blood proximally
- Vein refill from distal flow when cuff deflates
- Simulating pulsatile blood flow
- Useful as a solo measure in neurosurgical patients where anticoagulants are to be avoided
- LIMITATIONS: Improper fitting/neurovascular compression/iatrogenic DVT



- ▶ CLOTS-3 trial, concluded that with the use of thigh length sequential IPC, in patients with acute stroke leads to significant reduction in the development of DVT.



- ▶ **Venous foot pump:**
- ▶ An alternate to IPC/compression stockings
- ▶ Higher compression force
- ▶ **Neuromuscular electrical stimulation:**
- ▶ Muscle contractions → decrease stasis → improve venous return
- ▶ Comatose/neurologically impaired patient → unable to contract muscle
- ▶ Deliver pulses of electric current, via electrode on skin over selected muscle groups or nerves to induce involuntary contractions

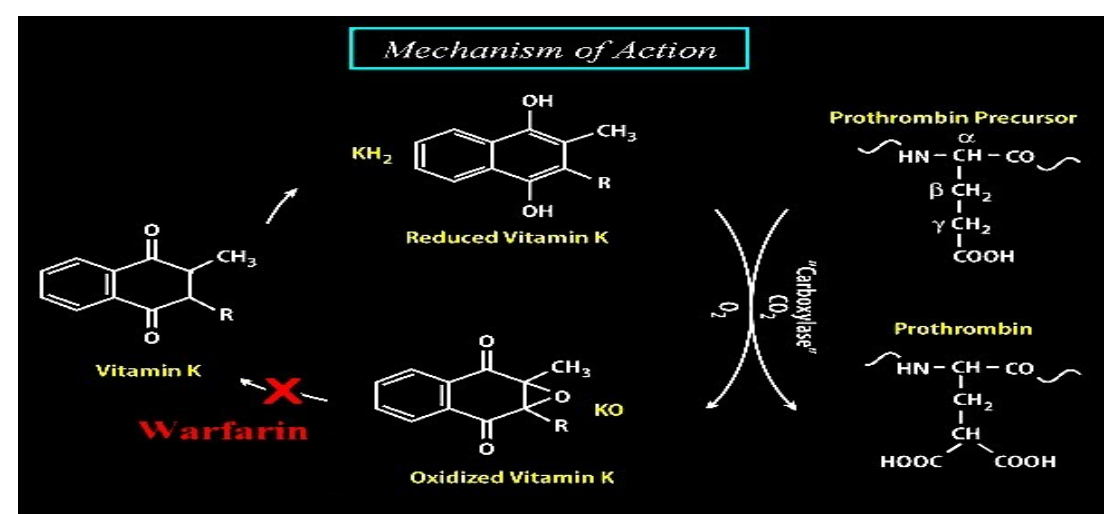
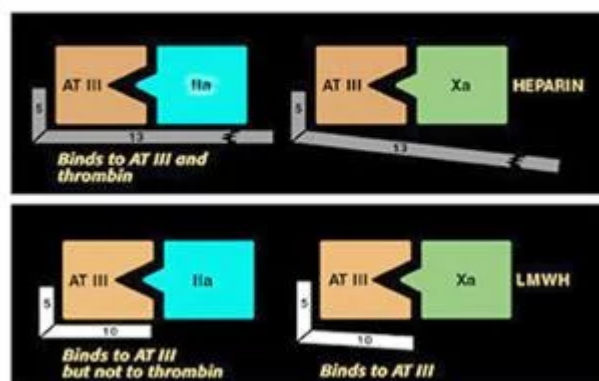


Pharmacological methods



- ▶ Low dose unfractionated heparin (LDUH)- S/C heparin 5,000 IU 8 Hourly (high risk) or 12 hourly (moderate risk)
- ▶ Low molecular weight heparin (LMWH)- e.g. S/C enoxaparin 40mg daily when creatinine clearance > 30ml/min or 30mg daily when creatinine clearance < 30ml/min
- ▶ Warfarin- high risk patient to keep INR between 2-3

Differential Effects of UFH and LMWH on Factor Xa and Thrombin



Newer antithrombotic drugs

Agent	MOA/RA	Duration of action
fondaparinaux	Factor Xa inhibitor /S.C	36-48hr
Rivaroxaban	Direct factor Xa inhibitor/oral	2-3 day
Apixaban	Direct factor Xa inhibitor/oral	2-3 day
Edoxaban	Direct factor Xa inhibitor/oral	One day
Dabigatran	Direct thrombin factor/oral	2-3 day
Desirudin	Direct thrombin factor/oral	7-9 hrs

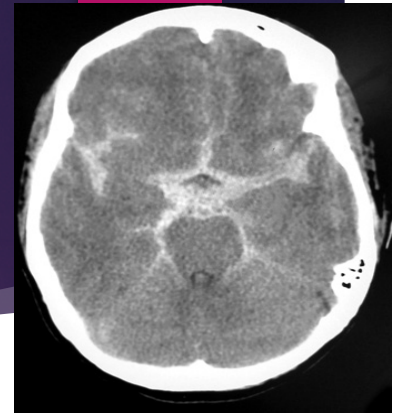
VTE prophylaxis for the patient who underwent craniotomy

- ▶ ACS-NSQIP data (2011-2012)- 10477craniotomy patients- VTE-3.2%
- ▶ Smith et al-1148 patient who underwent craniotomy for brain neoplasm, incidence of DVT- 14% and PE 3%
- ▶ Risk factors for postoperative venous thromboembolism in neurosurgery

Positive risk factors	Inconsistent or uncertain risk factors
Neoplasm – primary or metastatic	Previous VTE
Perioperative immobility/motor weakness	Obesity
Age	Steroid use
Duration of surgery	Mobility
Lack of thromboprophylaxis	Infection

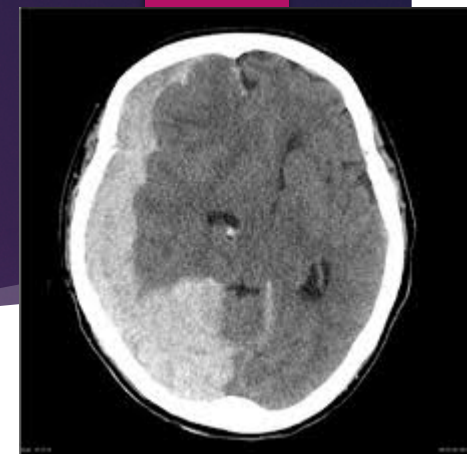
- ▶ Its recommended to use IPC+LMWH or IPC+UFH after 24-48 hr following craniotomy to minimize risk of VTE
- ▶ Intracranial bleeding occurs in approximately 1-1.5% of craniotomy patients who do not receive anticoagulant prophylaxis
- ▶ The use of anticoagulant thromboprophylaxis may be associated with a small increase in the risk of intracranial; haemorrhage
- ▶ The timing of initiation of anticoagulant thromboprophylaxis appears to influence postoperative bleeding risk
- ▶ Bleeding risk higher in the patients where prophylaxis given prior or soon after the craniotomy as compared to when administered after 24 hrs
- ▶ Decision should be made based on patient's bleeding and thrombosis risk

VTE prophylaxis for patients with aneurysmal SAH



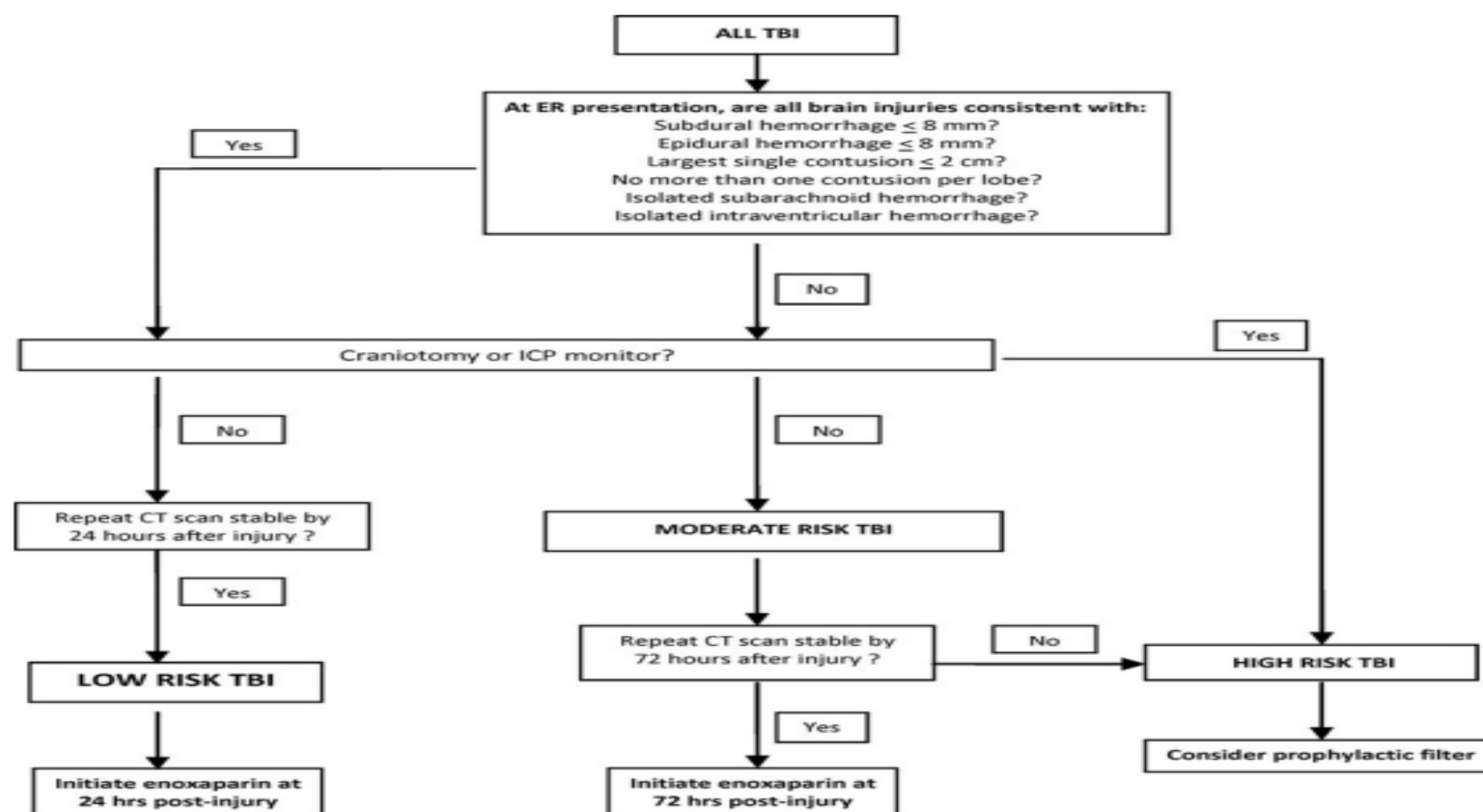
- ▶ Patients with a SAH are at increased risk of developing VTE,
- ▶ Incidence of DVT ranges from 1.5 to 24% and the incidence of PE 1.2-2.0%
- ▶ Worse clinical status at presentation, longer hospital stay and blood transfusion are associated with higher risk of VTE in this patient population
- ▶ Determining appropriate VTE pharmacoprophylaxis is challenging in presence acute bleed
- ▶ Initiating IPC as VTE prophylaxis as soon as patient with aSAH is admitted
- ▶ Initiating VTE prophylaxis with UFH at least after 24 hr after aneurysm has been clipped or coiled.
- ▶ LMWH has shown higher risk of bleeding in this patient group

VTE prophylaxis for patients with traumatic brain injury (TBI)



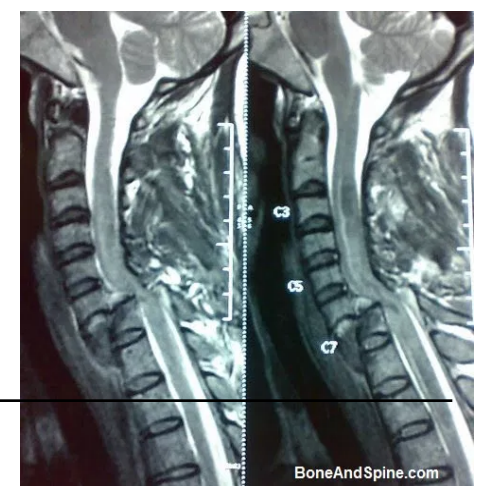
- ▶ Incidence of DVT in severe TBI patient ranges 13 to 17%
- ▶ Initiating IPC within 24hrs of presentation of TBI or completion of craniotomy
- ▶ Initiating LMWH or UFH after 24-48 hr of presentation with TBI and ICH
- ▶ LMWH OR LDUH in combination of mechanical prophylaxis may be used however there is increased risk of expansion of intracranial hemorrhage (Level-III evidence, BTF 2016)

Parkland's protocol



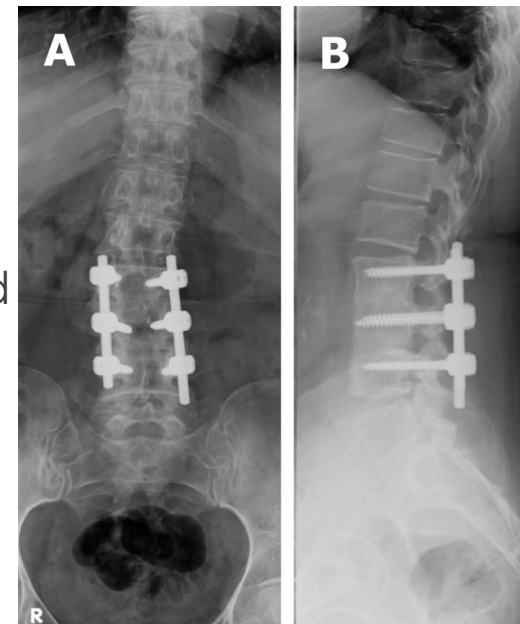
VTE prophylaxis for patient with spinal cord injury

- ▶ Spinal cord injury- independent risk factor for DVT
- ▶ Reported incidences of DVT in paralytic spinal cord injuries ranges from 18 % to 100% within first 12 weeks of injury
- ▶ Risk of DVT highest during first 2 weeks post injury
- ▶ Initiating VTE prophylaxis as early as possible within 72hrs of injury or once bleeding is controlled
- ▶ Mechanical prophylaxis alone is not enough
- ▶ LMWH or LDUH with or without IPC is recommended



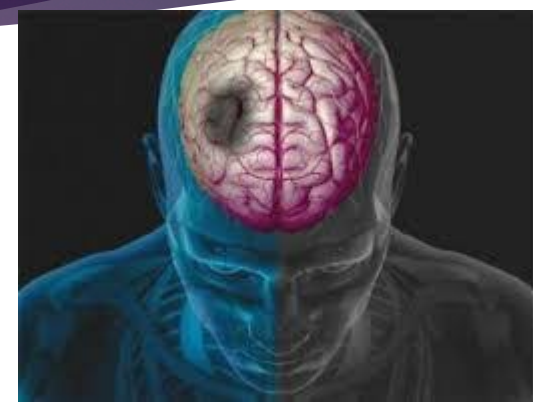
VTE prophylaxis for the patient who underwent spinal surgeries

- ▶ Generally at lower risk for VTE
- ▶ Incidence ranges from 0.4% to 1.1%
- ▶ Higher risk seen in patient with associated carcinoma, limited preoperative/postoperative mobility, complex or multilevel and prolonged procedure and advanced age
- ▶ Almost 50% of thromboembolic events in spinal surgery occur after hospital discharge
- ▶ Early mobilization
- ▶ Inhospital thromboprophylaxis starting with IPC followed by delayed use of LMWH (after 24 hr)
- ▶ Reported rates of epidural hematoma associated with thromboprophylaxis is very low (~0.2%)



VTE prophylaxis in critically ill patients with ischemic stroke

- ▶ Pulmonary embolism accounts for 10% of deaths in AIS patients
- ▶ With thromboprophylaxis there is concern of haemorrhagic transformation of ischemic stroke
- ▶ Various randomised trials and metaanalysis are in favour pharmacological thromboprophylaxis
- ▶ VTE prophylaxis should be started as soon as possible
- ▶ Patients with AIS with restricted mobility, LMWH in combination with IPC
- ▶ Stroke patients who undergo hemicraniotomy or endovascular procedure, UFH/LMWH and/or IPC should be used in the immediate postsurgical epoch, except when r TPA is administered, in that case it should be delayed for 24hr



VTE prophylaxis in critically ill patient with intracranial haemorrhage



- ▶ In few prospective studies incidence of DVT detected by venous ultrasonography was 20-40%
- ▶ Risk of VTE in patients with ICH has been estimated 2-4 times as high as patients with AIS
- ▶ Its recommended to use IPC/GCS over no prophylaxis at the time of hospital admission
- ▶ Using LDUH/LMWH to prevent VTE in patients with stable hematoma without ongoing coagulopathy, after 48 h of admission
- ▶ Mechanical prophylaxis can be continued once pharmacological prophylaxis started

VTE prophylaxis in critically ill patients with neuromuscular disease

- ▶ Patients who are critically ill with neuromuscular diseases like GBS, MG are at high risk of VTE
- ▶ VTE prophylaxis is the key element of the care of these patients
- ▶ LMWH or LDUH or Fondaparinaux as the preferred method of VTE prophylaxis
- ▶ Mechanical prophylaxis where risk of bleeding is significant
- ▶ VTE prophylaxis should be continued for extended period, at a minimum for the duration of acute hospitalization or until the ability to ambulate returns

Conclusion



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