University Heart Journal
Vol. 5, No. 2, July 2009

Venous Thromboembolism In Intensive Care Unit

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Abstract

Venous thromoboembolism (VTE) represents a spectrum of disease which includes deep vein thrombosis (DVT) and pulmonary embolism (PE), a common complication in critically ill patients. VTE is difficult to diagnose, expensive to treat and occasionally lethal despite therapy. Therefore preventive measures are paramount. DVT and PE contribute significantly to morbidity and mortality associated with critical illness.[1-3] But VTE remains an underestimated problem in ICU patients, despite the findings of many randomized controlled trials performed in the fields of DVT prophylaxis during the past few decades.[4,5] This article reviews the risk of VTE in critical care patients, thromboprophylaxis and suggests strategies to reduce the burden of thrombo-embloic disease in critical care unit.

Key words : Venous thromoboembolism, Intensive Care Unit.

Introduction

Venous Thromboembolism Deserves Attention Venous Thromboembolism is highly prevalent in critically ill patients. who deserves our attention. Objectively confimed DVT rates varies from 13 to 31%. Among patients who died while in ICU, PE has been reported in 7 to 27% (mean 13%) of postmortem examination and PE was thought to have caused or contributed to death in 0 to 12% [6-12]. DVT is considered to be the most important causative factor for PE Approximately 90% of pulmonary emboli are thought to originate in lower extremity deep venous system The overall incidence of DVT in ICU population ranges from 0 to33%.

VTE in the Critical Care Unit : Risks:

a) Thromboembolic risk factors that may be acquired during ICU stay include:

Immobilization, sepsis,mechanical ventillation[14], vasopressor use,haemodialysis, pharmacological paralysis [14], central venous line, insertion of femoral venous catheter [14,20,21], surgical procedures & failure to use thromboprophylaxis [14].

b) Thromboembolic Risk factors that predate the ICU admission includes:

Advanced age[16], serious medical illnesses, prolonged pre-ICU hospital stay [17], previous VTE[17], recent surgery, sepsis, malignancy [18], burn , major trauma[19], cardiac and respiratory failure AMI, immobilization & paralysis**.**

Although the clinical consequences of asymptomatic DVT detected by routine screening are uncertain, a recent study[18] showed that patient documented to have DVT by Doppler ultrasound had a significantly greater frequency of subsequent PE during their hospitalization(11.5% vs 0%, p=.01). Furthermore even small PE may be poorly tolerated by critically ill patients, many of whom have reduced cardio-respiratory reserve [22,23].

Risk categories [24-27] shown in Table 1

Low risks	Minor surgery (< 30 min) Major surgery (> 30 min with age less than 40). Medical illness (except MI, stroke)	<1%	<.1%
Moderate risks	Major surgery +age >40. Minor Sx +hx of DVT or PE Major trauma or burns Acute MI or stroke	1-10%	.1-1%
High risk	Major surgery or traum +hx of DVT or PE. Cancer surgery (abd/pelvis). Hip or knee replacement Hip or pelvic fx Lower limb paralysis.	10-30	1-10

Wells and colleagues *have developed a rapid seven question bedside assessment that is useful [24-27](Table 2).*

- *They designated a score of 4 or lower as pulmonary embolism unlikely.*
- *Wells Criteria: stratifies probabiity : High prob >6.0; Moderate prob 2.0-6.0; Low prob <2.0*

Wells Clinical Bedside Scoring System for Suspected Pulmonary Embolism Table -2

Parameter	Score
Clinical sign and symptoms of DVT (minimum leg swelling and pain with palpation of deep veins)	3
An alternative is less likely than PE	3
Heart rate greater than 100	1.5
Immobilization or surgery in the previous 4 weeks	1.5
Previous DVT/PE	1.5
Haemoptysis	1
Malignancy (on treatment in last 6 month or palliative	1

Most Common Symptoms and Signs among the 2454 Patients in the International Coopearative Pulmonry Embolism registry (ICOPER) (Table 3) [31]

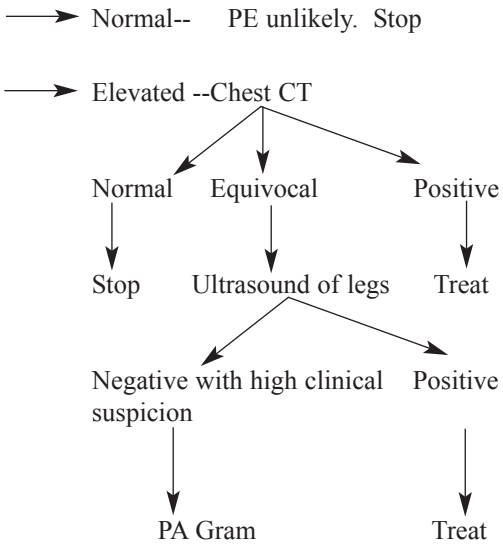
Symptoms and Signs	Percent
Dyspnoea	82
Respiratory rate >20 per min	60
Heart rate >100 bpm	40
Chest pain	49
Cough	20
Syncope	14
Haemoptysis	07

The Geneva Point Score to Assess Pulmonary Embolism Prognosis (Table 4) [31]

Variable	Point score
Cancer	+ 2
Hypotension	+2
Prior DVT	+1
Hear failure	+1
Hypoxaemia	+1
DVT on ultrasound	+1

Overall strategy: An Integrated Diagnostic Approach

- *The initial assessment includes history, physical examination, and ECG,*
- *With special attention to patients clinical milieu and risk factor for venous thromboembolism*
- *The wells bedside assessment score is used to semiquantitate the cinical likelihood of PE.*
- *As a part of differential diagnostic workup an ECG and X-ray chest are needed.*
- *A rapid D dimer is needed as a screening test Rapid D dimer --- as screening test*



***VTE In ICU* A Difficult Diagnosis**

- *VTE in ICU patients has unusual charcteristics that makes its clinical diagnosis difficult.*
- *Because of body wall oedema or surgical dressings-- signs and symptoms of DVT are often masked making a clinical diagnosis problematic.*
- *Physical examination is rarely helpful because DVT is generally asymtomatic.*
- *Moreover diagnosis is not always easy to confirm.*
- *DVT may not be suspected in ICU patient untill the patient manifest sign symtoms of PE.*
- *Even when a pulmonary embolism leads to death, diagnosis is often difficult to confirm in a patient who has already been treated and ventilated for a pulmonary condition.*
- *The insensitivity of Doppler utrasound and major difficulty in performing venography in ICU patient genarally lead to blind anticoagulant prophylaxis.*
- *Neither D dimer levels nor tests of hypercoagulability (activated protein C resistance ratio, prothrombin 20210A gene mutation, levels of protein C, protein S, or antithrombin, anticardiolipin antibody titre and lupus anticoagulant) had any predictive value for DVT in critically ill patients.*

Prevention of VTE in Critical Care

Mechanical Thromboprophylaxis in Critically Ill patients

- Classified as either static and dynamic.
- Consists of graduated compression stockings and pneumatic compression devices. [28]
- Should systematically be used alone or in combination with pharmacological prophylaxis in ICU patients.

Potential benefits--

- Useful as an interim alternative measure untill pharmacological prophylaxis can be safely introduced[28].

- Act in a synergistic manner and provide additional protective benefit when combined with mainstay pharmacological prophylaxis[29].

Pharmacological prophylaxis options includes: BRAUN WALD

- Unfractionated Heparin
- LMWH
- Fondaparinux
- Warfarin
- Aspirin confers a slight benefit.
- The oral direct thrombin inhibitor Ximelagarten appears promising when compared with enoxaparin or warfarin

Inferior Vena Caval Filter (IVCF)

IVC filter prevents PE not DVT.

Indications

✓*Major haemorrhage that precludes anticoagulation.*

✓*Recurrent pulmonary embolism despite well documented anticoagulation.*

General approach to thromboprophylaxis in high risk patient[30]

Routine thromboprophylaxis should be provided to critical patients based on an individual assessment of their bleeding and thrombosis risk.

Major trauma, spinal cord injury , critical care unit admission High risk of bleeding

Active bleeding, frank intracranial bleeding

Primary haemostasis not yet established

Yes

Mechanical thromboprophylaxis

IPC, GCS or IPC and GCS

Observe daily for bleeding risk

No

Pharmacological prophylaxis

Moderate TE risk: LMWH or LDH

High TE risk : LMWH or LMWH& Mechanical

High Risk of bleeding resolves

Yes No

Pharmacological prophylaxis

Continue mechanical thromboprophylaxis

Consider screening with DUS day 4-7

Start pharmacological prophylaxis ASAP

Reassess daily for bleeding and thrombosis risk

After 1-2 weeks

If VTE risk continues, patient haemodynamically stable, consider warfarin (INR 2-3) for longer term prophylaxis in acute care and rehabilitation

Management strategy for acute PE based on risk stratification[31]

Acute pulmonary embolism

Risk stratification

Clinical evaluation

Anatomical aspect of PE

Troponin, pro BNP, BNP

Right ventricular function

High risk	Low risk
Thrombolysis or embolectomy plus anticoagulation	Anticoagulation alone

Thrombolytics : *tPA 100 mg as a continuous infusion over 2 hrs within 2 wks of onset of symptoms and sign.*

LMWH*: Enoxaparin treatment.1 mg/kg SC bid,1 mg/kg qd for CrCl <30).*

Heparin*: Bolus of 5000 to 10000 units of intravenous UFH,* followed by a continuous intravenous infusion using nomogram based on weight. *Most patients require at least 30,000 units/hrs*

Intra venous unfractionated heparin "Raschke Nomogram"Table 5

Variable	Action
Initial heparin bolus	80 unit/kg bolus, then 18u/kg/hr
PTT<35, (<1.2X control)	80 unit/kg bolus, then increase by 4 unit/kg/hr
PTT 35-45 sec, (1.2-1.5X control)	40 unit/kg bolus, then increase by 2 unit/kg/hr
PTT 46-70sec (1.5-2.3X control)	No change
PTT 71-90 sec. 2.3-3X3 control	Decrease infusion rate by 2unit/kg/hr.
PTT >90 sec (>3Xcontrol)	Hold infusion for 1 hr then decrease infusion rate by 3 unit/kg/hr

Outpatient anticoagulation*:*

Warfarin: Initiated in hospital and transitioned to outpatient maintainance (3-4 days): Goal INR 2-3.

Length of therapy: DOTAVK study

✓*3 month for DVT with PE*

✓*6 months or longer for high risk of recurrence*

✓*6 weeks for isolated DVT*

Optimal Duration And Intensity Of Anticoagulation [31]

✓*Therefore 6 months of full- intensity anticoagulation (INR 2-3) followed by indefinite-duration low intensity (INR 1.5-2) anticoagulation is recommended for all suitable patients with idiopathic PE or DVT.*

Complication and management

- *Haemorrhage*

Heparin
protamine sulphate (1mg/100 units of heparin slowly, 50 mg over 10 to 30 min).
WARFARIN SODIUM
Fresh frogen plasma,Human recombinant factor VIIa concentrate,Vit K parenterally
Cryoprecipitate

- *Heparin induced thrombocytopenia*

On Need of A Policy for Thromboprophylaxis

Following principles summarize our views about thromboprophylaxis in critical care patients.

- ✓ *An essential component of the assessment of all ICU admissions should be a review of thromboembolic risks and consideration of thrombopropylaxis.*
- ✓ *With few exceptions, some form of thromboprophylaxis should be used in all ICU patients and should be commenced as soon as possible*
- ✓ *Decisions regarding the initiation of prophylaxis and selection of specific method of prophylaxis should be individualized and based on each patients risk for bleeding and thrombosis.*
- ✓ *In general anticoagulant based prophylaxis with LDH or LMWH is recommended.*
- ✓ *LDH is appropriate for patient at low to moderate thrombosis risks, while LMWH is recommended for high-risk patients.*
- ✓ *Sequential prophylaxis, with the use of mechanical devices during initial high bleeding risks phase followed by anticoagulant prophylaxis should be considered in relevant critical care patients.*
- ✓ *Prophylaxis should be reviewed daily and changed, if necessary, taking into consideration each patients overall clinical status on that particular day.*
- ✓ *Prophylaxis should generally not be interrupted for procedures or surgery unless there is a particularly high bleeding risk.*
- ✓ *Routine screening of patient for asymptomatic DVT is not recommended since this strategy is neither effective, nor cost effective.*
- ✓ *However for selected high-risk patients who have not received adequate prophylaxis either before or during ICU admission, a single proximal Doppler ultrasound examination will identify patients who require a therapeutic intervention (ultrasound positive), or prophylaxis (ultrasound negative).*
- ✓ *At the time of dischsrge from critical care unit, further thromboprophylaxis recommendation should be included in transfer order.*
- ✓ *Each critical care unit should have a written prophylaxis policy that is updated periodically as new evidence emerges.*

Conclusion

Venous thromboembolism is a common, potentially lethal complication of hospitalization for major trauma, SCI and other critical illnesses. Despite the availability of evidence-based prophylaxis recommendations for these groups, the use of this important patient safety interventions is frequently sub-optimal. Effective strategies to ensure that high-risk patient receive appropriate thromboprophylaxis include the creation of local written prophylaxis policy, and the use of preprinted orders or computer decision support system with mandatory fields addressing prophylaxis.

References

1. Hoyt D.B, Swegle J.R. Deep venous thrombosis in the surgical intensive care unit. Surg Clin North Am 1991;71:811-30.
2. Jain M, Schmidt G.A Venous thromboembolism:prevention and prophylaxis. Semin Respire Crit Care Med 1997;18: 79-90.
3. Davidson B.L. Risk assessment and prophylaxis of venous thrombo-embolism in acutely and /or critically ill patients. Haemostasis 2000;30(suppl 2):77-81.
4. Planes A, Vochelle N, Mazas F and et al. Prevention of post operative venous thrombosis: a randomized trial comparing unfractionated heparin with low molecular heparin in patients undergoing total hip replacement.Thromb Haemost 1988; 60: 407-10.
5. Leizorovicz A, Haugh M.C, Chapuis F.R and et al. Low molecular weight heparin in the prevention of peri-operative thrombosis..BMJ 1992; 305:913-20.
6. Moser K.M,LeMoine, J.R, Natchtewey F.J and et al. Deep venous thrombosis and pulmonary embolism; frequency in a respiratory intensive care unit. JAMA 1981;246:1422-24.
7. Pingeleton S.K, Bone R.C, Pingeleton, W.W and et al. Prevention of pulmonary emboli in respiratory intensive care unit. efficacy of low-dose heparin. Chest 1981;79:647-50.
8. Cullen D.J, Nemeskal A.R. The autopsy incidence of acute pulmonary embolism in critically ill surgical patients. Intensive Care Med 1986;12:399-403.
9. Blosser S.A, Zimmerman H.E, StaufferJ.L. Do autopsies of critically ill patients reveal important findings that were clinically undetected? Crit Care Med 1998;26: 1332-36.
10. Mort T.C, Yeseton N.S. The relationship of pre-mortem diagnoses and postmortem findings in a surgical intensive care unit. Crit Care Med 1999;27:299-03.
11. Dimopoulos G, Paignerelli M, Berre J and et al. Post mortem examination rate in ICU: is it still useful (abstract*)?* Crit Care Med 2000;28(suppl):78.
12. Willemsen H.W, Wester J.P, Hattum A.H and et al. The incidence of pulmonary embolism in a surgical intensive care unit (abstract). Crit Care Med 2000;26(suppl 3): S242.

13. Keane M.G, Ingenito E.P, Goldhaber S.Z.Utilization of venous thrombo-embolism prophylaxis in medical intensive care unit. Chest 1994;106:13-14.
14. Cook D, Attia J, Weaver B and et al. Venous thrombo-embolic disease: an observational study in medical-surgical intensive care unit patients. J Crit Care 2000;15:127-32.
15. Selby R, Geerts W.H. Venous thrombo-embolism: risk factors and prophylaxis. Semin Respire Crit Care Med 2000;21:493-501.
16. Harris L.M, Curl G.R, Booth F.V and et al. Screening for asymptomatic deep vein thrombosis in Surgical intensive care unit patients. J Vasc Surg 1997;26:764-69.
17. Hirsch D.R, Ingenito E.P,Goldhaber S.Z. Prevalence of deep venous thrombosis among patients in medical intensive care. JAMA 1995;274:335-37.
18. Ibrahim E.H, Iregui M , Prentice D and et al. Deep vein thrombosis during prolonged mechanical ventilation despite prophylaxis. Crit Care Med 2002;274:335-37.
19. Geerts W.H, Code K.I, Jay R.M and et al. A prospective study of venous thromboembolism after major trauma. N Engl J Med 1994;331:1601-06.
20. Trottier S.J, Veremarkis C.O, Brien J and et al. Femoral deep vein thrombosis associated with central venous catheterization: results from a prospective randomized trial.. Crit Care Med 1995;23: 52-59.
21. Joynt G.M, Kew J, Gomersall C.D and et al. Deep venous thrombosis caused by femoral venous catheters in critically ill adult patients. Chest 2000 ;117; 178-83.
22. Baum G.L, Fisher F.D. The relationship of fatal pulmonary insufficiency with cor-pulmonale, right sided mural thrombi and pulmonary emboli. a preliminary report. AM J Med Sci 1960;240:609-12
23. Greene R, Zapol W.M, Snider M.T. Early bedside detection of pulmonary vascular occlusion during acute respiratory failure. Am Rev Respire Dis 1981;124: 593-601.
24. Clagett P.G . Prevention of venous thromboembolism. Chest. 1999;116(1):257-9
25. Pinde L. Comparison of 3 and 6 months of oral anticoagulant therapy after a first episode of proximal deep vein thrombosis or pulmonary embolism and comparism of 6 and 13 weeks of therapy after isolated calf deep vein thrombosis (DOTAVK study).Circulation, 2001;103:2453-60.
26. Rudoni R.R . Use of 2D echocardiography for the diagnosis of pulmonary embolus. J Emerg Med.1998; 16(1):5-8
27. Stratton M.A. Prevention of venous thromboembolism. Archieves of Internal Medicine 2000; 160(3):334-45.
28. Agu O, Hamilton G, Baker D. Graduated compression stockings in the prevention of venous thromboembolism. Br J Surg. 1999;86:992-04.
29. Williams M.T, Aravindan N, Wallace M.Jand et al. Venous thromboembolism in intensive care unit. Crit Care Clin. 2003;19:185-207.
30. Geerts W.H. Prevention of venous thromboembolism in high- risk patients.American Society of Haematology 2006;19:462-66.
31. Little, W.C. 2001, 'Assessment of normal and abnormal cardiac function', in *Heart disease,* 6th edition, eds. Braunwald E., Zipes, D.P., & Libby, P., W.B. Saunders Company, Philadelphia, p.481.