Deep Vein Thrombosis and Pulmonary Embolism Considerations in Orthopedic Surgery

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KEYWORDS

• Deep vein thrombosis • Venous thromboembolism • Pulmonary embolism • Prophylaxis • Risk factors • Treatment • Perioperative clearance

KEY POINTS

- Deep vein thrombosis and pulmonary embolism are major complications of concern after surgical intervention.
- Older age and a history of venous thromboembolism are considered the main risk factors with strong evidence in the literature to increase the risk of venous thromboembolism.
- The current gold standard diagnostic instruments are venography for deep vein thrombosis and pulmonary angiography for pulmonary embolism. However, because these tests are invasive and expensive, alternative diagnostic tools include venous compression ultrasonography for deep vein thrombosis and ventilation-perfusion scan and computed tomographic pulmonary angiogram for pulmonary embolism.
- Multiple pharmacologic and nonpharmacologic interventions are available for the prevention and treatment of deep vein thrombosis and pulmonary embolism, and the risks associated with the use of each modality should be weighed against the benefits in its use on a case-based level.

INTRODUCTION

Both deep venous thrombosis (DVT) and pulmonary embolism (PE) are responsible for substantial patient morbidity and mortality, with PE ranking as the third most common acute cardiovascular disease.[1] Nearly 10,000 deaths were the result of PE or DVT in 2009 with PE having an estimated mortality rate of nearly 30%.[1,2] Because of the serious nature of venous thromboembolism (VTE) complications, health care providers allocate an abundance of resources to diagnose and treat this condition, resulting in an increased length of hospitalization and cost. DVT and PE account for more than 500,000 hospitalizations in the adult population and carry a large economic burden with a health care cost up to $33,200 per patient annually.[1] Orthopedic procedures, especially trauma and total joint arthroplasty, place patients at an increased risk for VTE. Complications of VTE may affect large numbers of patients, as the incidence of hospital-acquired DVT after major orthopedic surgery is 40% to 60%.[3,4] Therefore,

Funding Sources: No additional funding sources were used for this article.
Conflicts of Interest: No conflicts of interest are evident for authors of this article.
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Orthop Clin N Am 48 (2017) 127–135
http://dx.doi.org/10.1016/j.ocl.2016.12.003

having a better understanding for risk factors, diagnosis, and management of DVT and PE is essential in preventing and treating patients and may achieve substantial reduction in overall perioperative morbidity, mortality, and health care cost burden.

RISK FACTORS AND DIAGNOSIS

Risk Factors

In patients undergoing total hip arthroplasty (THA), total knee arthroplasty, or hip fracture surgery, 1% to 3% will go on to have a symptomatic DVT, whereas 0.2% to 1.1% will go on to have a PE within 35 days of surgery. The first postoperative week is the period of highest risk for symptomatic PE development.[5,6] In addition to identifying the period in which patients are at risk for VTE, identifying which patients' characteristics are associated with a higher risk is essential in guiding diagnostic and management efforts.

Certain patient characteristics, such as age and a history of a previous VTE, may pose primary risk factors for unprovoked VTE in the emergent setting.[2,7] In the ninth decade of life, the incidence of emergent PE is 1 in 200 patients, whereas in the third decade of life the incidence is only 1 in 10,000 patients.[2] Risk associated with age for emergent PE development is most significant after the age of 50 and increases until the age of 80 years.[2] A history of prior VTE is also a risk factor for emergent PE, causing a 2- to 3-fold increase in risk of future unprovoked VTE in men.[2] Surgery requiring intubation, immobility, and estrogen also transiently increase the risk of provoked PE.[2] In surgical patients, the risk of VTE extends for months and even potentially for a year.[5,8] Although sex, smoking, congestive heart failure, cancer, and obesity are commonly thought to be risk factors for DVT and PE, there is not enough evidence to consider these as primary risk factors.[2] With specific regard to risk factors for VTE in orthopedic patients, the American Academy of Orthopedic Surgeons (AAOS) guidelines report that, with the exception of a history of VTE, the current evidence is inconclusive as to whether other factors increase the risk of VTE in patients undergoing elective arthroplasty and, therefore, does not recommend routinely assessing patients for these factors.[9]

Diagnosis

When suspecting DVT and PE, and before conducting any further testing, it is important to initially establish a level of pretest probability.[10] The Wells clinical prediction criteria is used to establish whether a patient has a low, intermediate, or high pretest risk for PE development.[10] It considers the presence of certain risk factors, signs of DVT, and the likelihood of an alternative diagnosis.[10] A meta-analysis of 15 studies reported that patients with the highest pretest probability had a prevalence of DVT ranging from 17% to 85%, whereas those with a moderate pretest probability had a prevalence of 0% to 38%, and patients with the lowest pretest probability had a prevalence of 0% to 13%.[11] These results suggest that Wells clinical prediction rule is not definitive and should be only used to establish probability assessment and to guide further diagnostic and screening tests.

There are several imaging modalities currently used to confirm or rule out the diagnosis of DVT and PE. The current gold standard diagnostic techniques are venography and pulmonary angiography, respectively; however, because of exorbitant cost and the invasive nature of these tests, their role in diagnosis has become limited.[10] Therefore, less-invasive tests are sought after to play a more significant role in ruling in or out DVT and PE diagnoses.[12]

Currently, one of the most common noninvasive diagnostic tests for DVT is venous compression ultrasonography (CUS).[10,12] When attempting to diagnose proximal DVT, CUS has been reported to have a sensitivity and specificity of 97% and 98%, respectively.[11] Patients with low pretest probability combined with a negative CUS can be safely withheld from anticoagulant therapy.[10] CUS is not frequently used to detect distal DVT, as the sensitivity and specificity are much lower, and controversy exists as to whether to treat isolated distal DVT.[10]

Another safe and cost-effective way of evaluation is a D-dimer assay.[13] D-dimers are products of cross-linked fibrin breakdown by plasmin produced at the site of thrombosis.[11,14] Although no biomarker exists that is both 100% sensitive and specific for VTE, D-dimer is a very sensitive laboratory test, and a negative assay in combination with a low pretest probability of VTE is useful in ruling out the presence of DVT and PE.[14] However, studies have found that an elevated D-dimer is also seen in various clinical scenarios, including sepsis, pregnancy, malignancy, and after surgery, making the test nonspecific with limited use in ruling in DVT or PE in these settings.[2,10,14] The current AAOS guidelines therefore conclude that D-dimer is not a reliable marker to screen for DVT after arthroplasty.[10] In the event of an elevated D-dimer assay in which PE may not be ruled out,