



NOVEL PARSIMONIOUS RECOMMENDATIONS BY DR. MADHU BADIREDDY FOR IDENTIFYING HOSPITALIZED PATIENTS WHO MAY DEVELOP PULMONARY EMBOLISM

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Venous thromboembolism (VTE) is one of most common diseases that affects inpatients in hospital. When the clots that form in the leg veins dislodge to the lungs, it causes pulmonary embolism (PE). Pulmonary embolism is common in a hospital setting and its complications contributes to 5 to 10 percent of deaths in admitted patients. It is a challenging health problem, especially for hospitalized patients. Health care providers in all clinical settings will be faced with managing patients with this illness. Risk factors for venous thrombosis are pulmonary embolism, elderly patients with immobility, surgery, trauma, malignancy, pregnancy, congestive heart failure and acquired defects in blood coagulation factors. These risks are cumulative, putting most hospitalized patients at greater risk of having a pulmonary embolism. DVT (Deep Vein Thrombosis) is defined as blood clots in the pelvic, leg, or major upper-extremity veins. These clots can break off from the veins, travel through the heart, and lodge in the lung arteries, causing potentially deadly PE.

Blood is brought back to the heart after circulating through various parts of the body. This flow is not passive, for example, blood from the legs have to work against gravity to come back to the heart. This is facilitated by the muscles of the leg, especially through the calf muscles which acts as peripheral pump or a peripheral heart. At other times, the properties of the blood may also change. The blood cells may be sticky. A common condition which makes the blood cells sticky is diabetes. So, imagine a person which is both overweight and diabetic and one who does not move around a lot will have clots formed within the blood vessels, despite no injury in the wall of the blood vessel.

Dr. Madhu Badireddy, an affiliate physician associated with Christus Santa Rosa Hospitals/Sound Physicians, San Antonio, Texas, United States, has been pioneering in educating about DVT and its prevention in a hospital setting, which can impact on improving patients suffering from chronic illnesses and lead to fast recovery path. Dr. Badireddy has a long commitment in prevention of development of this deadly disease for hospitalized patients, or for individuals in nursing homes with diminished abilities of movement and reduced activities of daily living. The greatest risk of pulmonary embolism occurs when a clot has formed in the thighs, calf muscles or pelvis. The blood flow from these areas leads directly to the lungs, where a detached clot can lodge in the pulmonary arteries. Clots in the veins of the calves or arms, may also be associated with pulmonary embolism. The gold standard for diagnosis of PE is CT pulmonary angiography CTPA, also called CECT (contrast enhanced CT scan). Risk assessment for patients with morbid clots is a complex clinical challenge.

If every patient admitted in the hospital and with potential risk factors for thrombosis were to be evaluated for pulmonary embolism, this would significantly contribute to hospital waste. Significant clinical judgemental skills are required to evaluate the at-risk patients. Furthermore, the use of X-rays in imaging and the use of toxic agents which can potentially harm the kidneys poses a significant challenge to precisely identify the at-risk patients. Frontline pioneering work was done for the first time in an original analysis by Dr. Badireddy and his team while serving his residency in Internal Medicine at St. Luke's Hospital in Bethlehem, Pennsylvania. This seminal study demonstrated for the first time that not all

patients who are admitted in the hospital and even at "significant" risk of development of DVT/PE may not need sophisticated imaging (1). In this innovative study of Dr. Badireddy, which was published in *The Journal of Community Hospital Internal Medicine Perspectives*, it has helped in establishing that computed tomographic pulmonary angiography (CTPA) was overemployed in the evaluation of hospitalized patients with suspected acute pulmonary embolism (PE) (1). This work is truly pioneering, and the results were that the concepts in evaluation of patients with suspected acute PE will reduce unnecessary CTPA examinations. This was the first original study which identified the algorithm for patient evaluation. In a recent study published in 2019, further evidence proved the importance of Dr. Badireddy's earlier findings. This new independent study completely replicated the earlier findings, attesting to the tremendously insightful data provided initially by Dr. Badireddy. The study involving cohorts of patients in the emergency room stated that 99 % of CTPA were negative (2). This has provided overwhelming evidence regarding the overutilization of the imaging methods and further validated the original clinical recommendations advocated by Dr. Badireddy.

Blood work may also be performed to assess the risk of DVT/PE. D-dimer blood assay, recommended in patients with low to moderate risk, is usually ordered in only one-third of patients. Much greater emphasis of current guidelines is needed to avoid inappropriate utilisation of resources without missing the diagnosis of even a single case of PE, given the very high mortality risk. The work of Dr. Badireddy has emphasized the medical community in thoroughly assessing DVT and PE, while at the same time use clinical finesse and not overdo the expensive and many-a-times unnecessary advanced imaging. The major aim of treatment is to resist PE by reducing the propagation of an existing clot or preventing a new clot from forming and embolizing. A patient with confirmed PE may receive anticoagulants or thrombolytics or may undergo surgery. PE remains the third commonest hospital related deaths in the US. Half a million people are affected every year. In the United States nearly 13.4 million hospital patients are at risk from VTE.

In another recent study, Dr. Badireddy continued his focus on prevention of DVT and keeping the medical community informed (3). His intensive review elaborated on the treatment and prognosis of DVT. He suggested that venous stasis (immobility and congestive heart failure), endothelial injury (Surgery and trauma), and hypercoagulability (cancer, thrombophilia) can increase the risk of DVT. PE is one of the most common, but preventable, causes of death in hospitalized patients. Only 50% of the hospitalized patients receive DVT prophylaxis. Prevention of DVT in hospitalized patients decreases the risk of DVT and PE, which in turn decreases mortality and morbidity. DVT prophylaxis may be primary or secondary. Primary prophylaxis is the preferred method with the use of medications and mechanical methods to prevent DVT. Secondary prophylaxis is a less commonly used method that includes early detection with screening methods and the treatment of subclinical DVT. A right balance needs to be created to prevent excesses of diagnosis but at the same time not miss even a single fatal case.

PE signs and symptoms can include shortness of breath, dry cough, sudden chest pain. More severe clinical findings can be hypotension, hypoxemia, and loss of consciousness. Usually, these

occur with a massive PE, multiple PE, or in situ clot propagation. Signs and symptoms of DVT in the leg include leg or calf pain, redness or discoloration and increased warmth and swelling in the affected leg. Early DVT diagnosis and management are crucial.

DVT can be prevented and the ways are people should avoid situations where blood clots might form, such as while staying in a fixed position in seat for a long duration in a plane or car. Travelers are advised to leave the car or walk around the plane every hour or two and to flex and relax their calf muscles to prevent blood stasis in veins. Hospitalized patients are also advised to get out of bed as soon as possible. Compression stockings are applied to regularly squeeze the veins in the calf muscles of patients who are unable to walk. Patients are treated with anticoagulants that inhibit one or more of the clotting factors. Although the potential side effects of these measures include bleeding, they have been shown to prevent thrombosis and save lives.

Awareness of DVT and PE can be the best way to prevent this condition. Medical professionals have recognized DVT for almost 2 centuries, but till recently, only about half of Americans were informed about the disease. Historically, many prominent public figures have been afflicted with DVT but received little attention. Lifestyle changes can avert the risk factors for venous thromboembolism. Problems are obesity, inactivity, and cigarette smoking. Nevertheless, most inquiries about DVT prevention come from patients who are in long haul air travel. Physician efforts, such as those advocated by Dr. Badireddy, are key to prevent morbidity arising out of this preventable condition.

Venous thromboembolism (VTE) can occur after major general surgery. Pulmonary embolism is recognized as the most common identifiable cause of death in hospitalized patients in the United States. The risk of deep venous thrombosis (DVT) and pulmonary embolism (PE) is higher in colorectal surgical procedures compared with general surgical procedures. Venous thromboembolism (VTE) prophylaxis consists of pharmacologic and nonpharmacologic measures to diminish the risk of deep vein thrombosis (DVT) and pulmonary embolism (PE). DVT prophylaxis is essential in the management of trauma patients. Currently, the optimal VTE prophylaxis strategy for trauma patients is unknown. Traditionally, pelvic and lower extremity fractures, head injury, and prolonged immobilization have been considered risk factors for VTE. However, it is unclear which combination of risk factors defines a high-risk group. Modalities available for trauma patient thromboprophylaxis are classified into pharmacologic anticoagulation, mechanical prophylaxis, and inferior vena cava (IVC) filters. The hospitalist needs to be equipped with all these strategies to avert mortality.

Guidelines for VTE prevention are numerous and do not always agree, and the complexity of the inpatient setting and the variability of patients make implementation of evidence-based guidelines challenging. Usually, a VTE prevention protocol includes a VTE risk assessment, a bleeding risk assessment, and clinical decision support on prophylactic choices based on the combination of VTE and bleeding risk factors. The VTE protocol must be available at crucial junctures of care, such as at admission to the hospital, at transfer to different levels of care, and postoperatively. Perhaps the greatest index of the importance of Dr. Badireddy's original study is highlighted by the fact that his key concepts have formed the basis for drafting a national level-based practice advisory of the American College of Emergency Physicians (*Clinical guidelines Committee of the American College of Physicians, Raja AS et.al, Annals of Internal Medicine, 2015, 163(9); 701-11*) (4). This VTE protocol guidance is most often embedded in order sets that are commonly used (or mandated for use) in these settings, essentially hard wiring the VTE risk assessment into the process. Risk assessment is essential, as there are harms, costs, and discomfort associated with prophylactic methods; for some inpatients, the risk of anticoagulant prophylaxis may outweigh the risk of HA-VTE. Though there is no perfect VTE risk assessment tool, Dr. Badireddy's work provides a reference of creating a right balance between identifying the patients with

highest risk and individuals with lesser risk of progressing to frank embolism.

The continued major significance of Dr. Badireddy's work is exemplified that in diverse settings, clinicians have been able to replicate and further validate the findings. For example, in a recent study involving the emergency department in East Lansing Hospital, the authors have found exactly similar findings of the relative lack of significance of CTPA in a clinical thrombotic situation (2). These validation of the work depicts the visionary nature of the study initially performed by Dr. Badireddy. At the societal levels, Dr. Badireddy's thoughtful contributions efficiently tackles the rising costs of healthcare. The sustenance of the findings of Dr. Badireddy over time and adoption of the recommendation into the clinical work flow can be inferred as truly practice changing, with Dr. Badireddy's contributions of prevention of medical overuse ascending to one at a level of trail blazing hospitalist. Dr. Badireddy's findings have now been widely adapted by global guidelines of conscientious medical care such as "Choosing Wisely". His emphasis on the use of clinical gestalt rather than piecemeal approach is significantly preventing overdiagnosis of low-risk PE. The relevance of Dr. Badireddy's findings are more significant than ever before in the backdrop of an "aging" America and the imminent need for high-value cost-efficient care for hospitalized patients.

Figure 1. Dr. Madhu Badireddy



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