

Nursing Assessment of Deep Vein Thrombosis

Maureen Anthony

Deep vein thrombosis (DVT) is a commonly occurring condition with potentially serious complications. According to the Centers for Disease Control and Prevention (CDC, 2012), some 200,000-400,000 people in the United States develop DVT each year. It most often occurs in the deep veins of the leg, but also can be found in any deep vein of the body (Emanuele, 2008). Prolonged immobilization related to surgery or hospitalization, trauma, malignancy, hormone therapy, pregnancy, advancing age, and dehydration have been associated with the development of DVT (Collins, 2009). In addition, 5%-8% of those affected are known to have inherited disorders of blood clotting. The most serious complication of DVT is pulmonary embolism (PE), which occurs in up to 50% of cases and has a mortality rate of up to 30%. Post-thrombotic syndrome is another complication that affects up to one-third of persons with DVT. It is characterized by persistent pain, swelling, and discoloration of the affected extremity (CDC, 2012).

The morbidity and mortality associated with DVT make early, accurate diagnosis of key importance. Traditionally, nurses have been taught to observe for clinical signs and symptoms of DVT, such as swelling, warmth, erythema, and pain of the affected extremity. Unfortunately, these symptoms are found in many conditions and are not exclusive to DVT. A simple, noninvasive test known as the Homan's sign also has been used to screen for DVT, but it is positive in 50% or fewer of persons with possible DVT (Swartz, 2010). An ideal clinical test has high speci-

The seriousness of deep vein thrombosis (DVT) and its accompanying morbidity and mortality make early and accurate diagnosis of key importance. Best clinical practice is supported by the use of a clinical decision model that determines risk based on predisposing factors and certain clinical signs and symptoms.

ficity and high sensitivity (Tovey & Wyatt, 2003). *Sensitivity* refers to the number of cases of a condition that will be detected with the test. Sensitive tests typically are used for screening purposes. *Specificity* refers to how accurate the test is without giving false positives. Tests with high specificity are used to confirm the presence of the condition. For decades, authors have asserted the Homan's test lacks both sensitivity and specificity, and thus is of no clinical value (Cranley, Canos, & Sull, 1976; Haeger, 1969; McLachlin, Richards, & Paterson, 1962; Tovey & Wyatt, 2003; Urbano, 2001; Vaccaro, Van Aman, Miller, Fachman, & Smead, 1986). Despite evidence Homan's sign is not useful in screening for DVT, it continues to appear in health assessment textbooks for nurses and evidence suggests its continued use by some practitioners (Watkins, 2009).

Screening and detection of DVT must be as accurate as possible. Failing to diagnose a DVT can contribute to a fatal pulmonary embolism, while false-positive screening can result in costly diagnostics or the patient's unnecessary anticoagulation. The pur-

pose of this manuscript is threefold:

1. Examine the literature for evidence of the reliability of Homan's sign and other clinical signs and symptoms to detect DVT.
2. Examine health assessment textbooks to determine techniques recommended for detecting DVT, as well as the signs and symptoms of DVT.
3. Make recommendations for nursing practice with regard to the detection of and screening for DVT.

The Cumulative Index for Nursing and Allied Health (CNAHL), OVID, and PubMed databases were searched using the key terms *deep vein thrombosis*, *thrombophlebitis*, *phlebitis*, and *DVT*. Search dates were not restricted in order to retrieve all articles, both current and classic, on the subject. Studies that examined the effectiveness of signs and symptoms in detecting DVT were selected. The research in this area was quite dated, with the most recent study published in 1986. Despite the lack of currency, the research studies were remarkably consistent.

Maureen Anthony, PhD, RN, is Associate Professor, University of Detroit Mercy, McAuley School of Nursing, Detroit, MI.

Literature Review

The dorsiflexion sign, first mentioned as a clinical sign of DVT in 1941 by Dr. John Homan, was described as “discomfort behind the knee on forced dorsiflexion of the foot” (p. 179). Dr. Homan also referred to tenderness and swelling of the affected extremity, tachycardia, and slight rise in temperature as signs and symptoms indicative of DVT. Allen and colleagues applied the name *Homan’s sign* to the dorsiflexion sign in a 1943 article. The authors further defined a positive Homan’s sign as pain or soreness of the calf muscles upon dorsiflexion of the foot, with the patient’s knee in a straight position (Allen, Linton, & Donaldson, 1943). Other signs of DVT suggested by these authors included “tenderness over the leg veins, swelling of the leg however slight, dilated superficial veins... slight elevation of temperature, pulse, and respirations” (p. 739).

Homan (1944) stated, “...dorsiflexion of the feet is intended to bring out, on the side of the venous thrombosis, some degree of irritability of the posterior muscles, the soleus and gastrocnemius. Discomfort need have no part in this reaction” (p. 53). He continued to indicate dorsiflexion of the foot may be limited on the affected side, or there may be involuntary flexion of the knee during dorsiflexion to release the tension on the posterior muscles. Despite Homan’s caution that pain need not be elicited for a positive response, pain as an indicator of a positive Homan’s sign has been found throughout the literature (Haeger, 1969; Hirsh, Hull, & Raskob, 1986; McLachlin et al., 1962; Urbano, 2001).

In 1943, Allen and colleagues examined the records of 202 patients with DVT who had undergone surgical femoral vein interruption, a procedure performed at that time for the purpose of preventing pulmonary emboli. Only 42% of the patients were reported to have a positive Homan’s sign, while 67% had swelling of the extremity and 61% had tenderness. McLachlin and colleagues (1962) evaluated the various

clinical signs of DVT, including Homan’s sign, skin temperature, tenderness, venous dilation, and swelling, in patients with suspected DVT. Homan’s sign was positive in 8% of patients confirmed to have DVT, and 6% of patients in whom DVT was not found; the authors understandably called the results disappointing. Unilateral ankle swelling was considered the most predictive clinical sign, being present in 83% of verified cases of DVT and in only 6% of those without DVT. Skin temperature changes were present in 50% of patients with DVT and in none of the patients without DVT. Local tenderness was present in 41% of persons with DVT and 11% of those without DVT, while venous dilation was present in 25% of patients with DVT and 11% of those without DVT.

Haeger (1969) examined 72 patients with suspected DVT using the following clinical signs and symptoms: spontaneous calf pain, pain to palpation, skin temperature, ankle edema, Homan’s sign, and Lowenberg’s sign (pain upon inflation of a blood pressure cuff on the calf). A positive Homan’s sign was present in 33% of those confirmed by phlebography to have DVT and in 21% of those found not to have DVT. Ankle edema, which had been associated previously with DVT, was found equally (76%) in both groups. Calf pain was actually higher in the group without DVT (97% vs. 90%). Lowenberg’s sign was positive in 20% of persons with DVT and 15% of those without DVT. The authors concluded none of the signs or symptoms was considered reliable to diagnose or exclude DVT.

In 1976, Cranley and associates followed 124 patients with 133 extremities that exhibited clinical signs of DVT. Clinical signs were defined as muscle pain, muscle tenderness, swelling, and positive Homan’s sign. In 72 cases, the diagnosis of DVT was confirmed with phlebography. Each of the four clinical signs and symptoms was equally present in the affected and non-affected extremities. The Homan’s sign was present in 48% of the extremities with proven DVT and in

41% of the extremities without DVT. Tenderness was present in 82% of the extremities with DVT and in 72% without DVT. Muscle pain and swelling occurred slightly more often in the extremities shown not to have DVT. These authors also concluded clinical signs were not sufficient to diagnose or exclude DVT.

In 1986, Vaccaro and colleagues examined the records of 150 patients who had both physical examinations and venograms to diagnose DVT. “The physical findings included tenderness, swelling, heat, redness, and the presence of Homan’s sign” (p. 233). No statistically significant difference between those with DVT and those without DVT were found with regard to tenderness, heat, redness, or Homan’s sign. Patients with confirmed DVT were statistically more likely to have swelling in the affected extremity (81% of those with a positive venogram vs. 55% of those with a negative venogram.)

Review of Health Assessment Textbooks

Swartz (2010) listed the signs and symptoms of DVT as “swelling, venous distension, erythema, pain, increased warmth, and tenderness” (p. 450), and further described “resistance to dorsiflexion of the ankle” (p. 450). A positive Homan’s sign was described as pain elicited by “gentle squeezing of the affected calf or slow dorsiflexion of the ankle” (p. 450). Swartz suggested that as only 50% of patients with femoral vein thrombosis will have a positive Homan’s sign, this test should not be the only criterion for diagnosing DVT.

Seidel and co-authors (2011) listed signs and symptoms of DVT as swelling, pain, and tenderness over a vein, and directed the practitioner to slightly flex the patient’s knee and dorsiflex the foot to elicit Homan’s sign. A positive response was listed as calf pain, which “may indicate venous thrombosis” (p. 444), but the authors added that absence of a positive Homan’s sign would not exclude a diagnosis of DVT.

Weber and Kelly (2010) defined a

positive Homan's sign as "aching or cramping" with "dorsiflexion of the foot" (p. 401). The examiner was instructed to bend the knee slightly and apply sharp dorsiflexion of the foot. Although Weber and Kelly suggested Homan's sign is controversial because the test may "dislodge the clot" (p. 402), the test appears in case studies and sample charting throughout the text (pp. 409, 607, 627, 639), and in a clinical algorithm.

The *Professional Guide to Signs and Symptoms* (2011) described a positive Homan's sign as calf pain after abrupt dorsiflexion of the ankle. It cautioned that a positive Homan's sign occurs in only 35% of people with DVT, and thus should be considered unreliable. Practitioners were instructed to slightly bend the knee, although the accompanying illustration showed the foot approximately 8 to 10 inches off the bed and the knee bent at a 90-degree angle. Additional signs and symptoms of a positive Homan's sign included resistance by the patient to ankle dorsiflexion or involuntary flexion of the knee. The text cautioned the examiner to perform Homan's test "very carefully to avoid dislodging the clot" (p. 383).

Jensen (2011) described "unilateral edema of the extremity, redness, pain or achiness, and warmth" (p. 556) as the signs and symptoms of DVT. The author recommended measuring the leg "daily at the same place throughout treatment" (p. 556). No mention was made of Homan's sign.

Jarvis (2012) instructed the practitioner to flex the person's knee and "gently compress the gastrocnemius (calf) muscle anteriorly against the tibia" (p. 505). Alternatively, he or she could dorsiflex the foot sharply. This text advised, "flexing of the knee first exerts pressure on the posterior tibial vein" (p. 505). A positive response to either maneuver would be pain or tenderness. Jarvis further stated a positive Homan's occurs in 35% of DVT cases and is not specific to DVT.

Evaluation of Health Assessment Textbooks

Health assessment textbooks published within the last 5 years were

reviewed to examine recommended assessment techniques, as well as signs and symptoms suggesting the presence of DVT. Of the six reviewed textbooks, only Jensen (2011) did not mention this clinical test. The technique for performing Homan's test varied among the texts. Swartz (2010) instructed the practitioner to squeeze the calf muscle, or perform slow dorsiflexion of the foot. Weber and Kelly (2010) and Jarvis (2012) also recommended squeezing the calf muscle but alternatively suggested *sharply* dorsiflexing the foot. Homan's test as described by its originators did not include squeezing the patient's calf muscles (Allen et al., 1943; Homan, 1944), and no mention of this variation was found in the literature reviewed for this manuscript.

Most of the textbooks instructed the practitioner to bend the knee slightly (*Professional Guide to Signs and Symptoms*, 2011; Seidel et al., 2011; Weber & Kelly, 2010), although early discussion of Homan's sign clearly stated the knee should be straight (Allen et al., 1943). Swartz (2010) did not mention position of the knee, and Jarvis (2012) just suggested the practitioner flex the knee without instruction concerning the degree of flexion. *Professional Guide to Signs and Symptoms* (2011) was the only textbook that was consistent with the original description of Homan's sign by Dr. John Homan (1944); that is, a positive response could be resistance to dorsiflexion or involuntary flexion of the knee in addition to pain, although the accompanying illustration was misleading. Other reviewed textbooks described pain as a positive response to Homan's test (Jarvis, 2012; Jensen, 2011; Seidel et al., 2011; Swartz, 2010; Weber & Kelly, 2010). Although some of the textbooks did caution Homan's sign should not be the only screening criterion (*Professional Guide to Signs and Symptoms*, 2011; Seidel, 2011; Swartz, 2010), use of Homan's test is not supported at all by research and neither should be performed by practitioners nor taught to students. Eliciting a false Homan's sign could serve to exclude the possibility of a DVT in the mind

of a practitioner, while a positive response could lead to unnecessary additional testing and anticoagulation.

In addition, two of the textbooks cautioned performance of Homan's test maneuver could dislodge a clot, causing a pulmonary embolism (*Professional Guide to Signs and Symptoms*, 2011; Weber & Kelly, 2010). The *Professional Guide to Signs and Symptoms* suggested firm and abrupt dorsiflexion of the ankle, yet cautioned the practitioner to "elicit the Homan's sign very carefully to avoid dislodging the clot" (p. 383). Instruction as to how it should be performed carefully was not described. Although theoretically possible, the literature does not support the claim that performing Homan's test can result in an embolism. None of the journal articles in the literature reviewed for this manuscript cited PE as a possible complication of this maneuver.

Discussion

In view of the poor sensitivity and specificity of individual clinical signs and symptoms for diagnosing DVT, current clinical decision guidelines utilize information gathered regarding the patient's history and physical examination to place the patient in high and low-risk categories. A review of the literature by Tan, van Rooden, Westerbeek, and Huisman (2009) found a clinical decision model by Wells and colleagues (1995) to be well tested and validated. With this model, patients in a high-risk category would be considered at significant risk of developing DVT and additional diagnostic tests would be warranted. This model initially consisted of major and minor points that suggested risk of DVT. The Wells model later was simplified to include nine clinical characteristics (Scarvelis & Wells, 2006). The nine clinical characteristics, each worth 1 point, are active cancer, paralysis or casting of an extremity, bedridden more than 3 days or major surgery with general anesthesia during the previous 3 months, localized tenderness along the deep venous system, swelling of the entire

Instructions For Continuing Nursing Education Contact Hours

Nursing Assessment of Deep Vein Thrombosis

Deadline for Submission:
April 30, 2015

MSN J1308

To Obtain CNE Contact Hours

1. For those wishing to obtain CNE contact hours, you must read the article and complete the evaluation through **AMSN's Online Library**. Complete your evaluation online and print your CNE certificate immediately, or later. Simply go to www.amsn.org/library
2. Evaluations must be completed **online** by April 30, 2015. Upon completion of the evaluation, a certificate for 1.1 contact hour(s) may be printed.

Fees – Member: FREE Regular: \$20

Objectives

This continuing nursing educational (CNE) activity is designed for nurses and other health care professionals who are interested in assessment of deep vein thrombosis. After studying the information presented in this article, the nurse will be able to:

1. Explain the significance and incidence of deep vein thrombosis (DVT).
2. Summarize nursing assessment practices for DVT in the literature.
3. Discuss implications for nursing practice of recommended assessments for DVT.

Note: The author, editor, and education director reported no actual or potential conflict of interest in relation to this continuing nursing education article.

This educational activity has been co-provided by AMSN and Anthony J. Jannetti, Inc.

Anthony J. Jannetti, Inc. is a provider approved by the California Board of Registered Nursing, provider number CEP 5387. Licensees in the state of CA must retain this certificate for four years after the CNE activity is completed.

Anthony J. Jannetti, Inc. is accredited as a provider of continuing nursing education by the American Nurses' Credentialing Center's Commission on Accreditation.

Accreditation status does not imply endorsement by the provider or ANCC of any commercial product.

This article was reviewed and formatted for contact hour credit by Rosemarie Marmion, MSN, RN-BC, NE-BC, AMSN Education Director. Accreditation status does not imply endorsement by the provider or ANCC of any commercial product.

CNE

leg, calf swelling of greater than 3 cm larger than asymptomatic side, pitting edema confined to the symptomatic leg, dilated superficial veins of the affected leg, and previously documented DVT. Two points are deducted when an alternative diagnosis is at least as likely as DVT. A score of 2 or more places the patient in a high-risk category and a score of less than 2 indicates DVT is unlikely. The Wells model is highly predictive of DVT, with excellent inter-observer reliability (Scarvelis & Wells, 2006).

Implications for Nursing Practice

DVT is a serious threat to hospitalized patients because of various comorbid conditions and immobility. Early recognition of DVT is hindered by the lack of sensitive and specific clinical signs and symptoms. Given the seriousness of DVT and its potential to result in PE, early detection is critical. The clinical decision guidelines proposed by Scarvelis and Wells (2006) can provide a framework for nursing risk assessment. Criteria can be divided into predisposing factors and clinical signs and symptoms. Predisposing factors (e.g., active cancer) and clinical signs and symptoms (e.g., dilated superficial veins) were identified in the previous discussion of the Wells model. This predictive model should be taught to nursing students and incorporated into nursing assessment, similar to the use of tools that assess risk for falls or pressure ulcers. Patients with even one of the predisposing factors should be considered at high risk for developing DVT, and should be assessed at least twice daily for clinical signs. Patients who score 2 or higher should be assessed further for the presence of DVT through D-dimer assay blood testing and ultrasound (Somarouthu, Abbara, & Kalva, 2010).

Conclusion

Homan's sign has been shown to be nonspecific and nonsensitive, and thus of no clinical value in screening for DVT (Cranley et al., 1976; Haeger, 1969; McLachlin et al., 1962; Tovey & Wyatt, 2003; Urbano,

2001; Vaccaro et al., 1986). It should not be included in health assessment textbooks or taught in nursing programs, and nurses in health care settings should not rely on this test to screen for DVT. The risk of embolism as a result of performing Homan's sign is not supported by the literature. Similarly, erythema and warmth of the extremity have not been found to be suggestive of DVT. Best clinical practice is supported by the use of the Wells clinical decision model (Scarvelis & Wells, 2006), which should be incorporated into nursing assessment. **MSN**

REFERENCES

- Allen, A., Linton, R., & Donaldson, G. (1943). Thrombosis and embolism. *Annals of Surgery, 118*(4), 728-740.
- Centers for Disease Control and Prevention (CDC). (2012). *Deep vein thrombosis/pulmonary embolism (DVT/PE)*. Retrieved from <http://www.cdc.gov/ncbddd/dvt/index.html>
- Collins, S. (2009). Deep vein thrombosis – An overview. *Practice Nurse, 37*(9), 23-27.
- Cranley, J., Canos, A., & Sull, W. (1976). The diagnosis of deep vein thrombosis. *Archives of Surgery, 111*(1), 34-36.
- Emanuele, P. (2008). Deep vein thrombosis. *AAOHN Journal, 56*(9), 389-392.
- Haeger, K. (1969). Problems of acute deep venous thrombosis. *Angiology, 20*(4), 219-223. doi:10.1177/000331976902000406
- Hirsh, J., Hull, R., & Raskob, G. (1986). Clinical features and diagnosis of venous thrombosis. *Journal of the American College of Cardiologists, 8*(6), 114B-127B.
- Homan, J. (1941). Exploration and division of the femoral and iliac veins in the treatment of thrombophlebitis of the leg. *The New England Journal of Medicine, 224*(5), 179-186.
- Homan, J. (1944). Diseases of the veins. *The New England Journal of Medicine, 231*(2), 51-59.
- Jarvis, C. (2012). *Physical examination and health assessment* (6th ed.). Philadelphia, PA: W.B. Saunders.
- Jensen, S. (2011). *Nursing health assessment: A best practice approach*. Philadelphia, PA: Lippincott Williams & Wilkins.
- McLachlin, J., Richards, T., & Paterson, J. (1962). An evaluation of clinical signs in the diagnosis of venous thrombosis. *Archives of Surgery, 85*, 58-64.
- Professional Guide to Signs and Symptoms* (6th ed). (2011). Philadelphia, PA: Lippincott, Williams & Wilkins.
- Scarvelis, D., & Wells, P. (2006). Diagnosis and treatment of deep-vein thrombosis. *Canadian Medical Association Journal, 175*(9), 175-179.

continued on page 123

Deep Vein Thrombosis

continued from page 98

- Seidel, H., Ball, J., Dains, J., Flynn, J., Solomon, B., & Stewart, R. (2011). *Mosby's guide to physical examination* (7th ed.). St. Louis, MO: Mosby Elsevier.
- Somarouthu, B., Abbara, S., & Kalva, S. (2010). Diagnosing deep vein thrombosis. *Postgraduate Medicine*, 122(2), 66-73.
- Swartz, M. (2010). *Textbook of physical diagnosis* (6th ed.). Philadelphia, PA: Saunders Elsevier.
- Tan, M., van Rooden, C., Westerbeek, R., & Huisman, M. (2009). Diagnostic management of clinically suspected acute deep vein thrombosis. *British Journal of Haematology*, 146, 347-360.
- Tovey, C., & Wyatt, S. (2003). Diagnosis, investigation, and management of deep vein thrombosis. *BMJ*, 326(7400), 1180-1184. doi:10.1136/bmj.326.7400.1180
- Urbano, F. (2001). Homan's sign in the diagnosis of deep vein thrombosis. *Hospital Physician*, 37(3), 22-24.
- Vaccaro, P., Van Aman, M., Miller, S., Fachman, J., & Smead, W. (1986). Shortcoming of physical examination and impedance plethysmography in the diagnosis of lower extremity deep vein thrombosis. *Angiology -The Journal of Vascular Diseases*, 44, 232-235.
- Watkins, J. (2009). Deep vein thrombosis. *Practice Nursing*, 20(8), 409-410.
- Weber, J., & Kelly, J. (2010). *Health assessment in nursing* (4th ed.). Philadelphia, PA: Lippincott Williams & Wilkins
- Wells, P., Hirsh, J., Anderson, D., Lensing, A., Foster, G., Kearon, C., ... Prandoni, P. (1995). Accuracy of clinical assessment of deep vein thrombosis. *The Lancet*, 345(8961), 1326-1330.

ADDITIONAL READINGS

- Kyrle, P., & Eichinger, P. (2005). Deep vein thrombosis. *The Lancet*, 365(9465), 1163-1174.
- Wilson, S., & Giddens, J. (2009). *Health assessment for nursing practice* (4th ed.). St. Louis, MO: Mosby Elsevier.