

Thromboembolic Events Associated With Novel Therapies in Patients With Multiple Myeloma: Consensus Statement of the IMF Nurse Leadership Board

**Sandra Rome, RN, MN, AOCN®, CNS, Deborah Doss, RN, OCN®,
Kena Miller, RN, MSN, FNP, Jeanne Westphal, RN,
and the IMF Nurse Leadership Board**

Patients with myeloma are at risk for serious and life-threatening thromboembolic events because of their disease, individual risk factors, and antimyeloma or other medications. The International Myeloma Foundation's Nurse Leadership Board developed this consensus statement for assessment and prevention of thromboembolic events. Prophylactic measures are categorized as mechanical, regimen related, and antithrombotic drug, based on individual and myeloma-related risk factors. Aspirin is suggested for patients with no or one risk factor, low-molecular-weight heparin or full-dose warfarin for patients with two or more risk factors, and low-molecular-weight heparin or full-dose warfarin for all patients with therapy-related risks, including high-dose dexamethasone, doxorubicin, or multiagent chemotherapy.

Thromboembolic events, including deep vein thrombosis (DVT) and pulmonary embolism (PE), are among the adverse events that can affect patients with multiple myeloma. Patients are at risk for the serious and potentially life-threatening events because of their disease, the presence of individual risk factors, and antimyeloma agents or other medications. Although use of the novel immunomodulatory drugs lenalidomide (Revlimid®, Celgene Corporation) and thalidomide (Thalomid®, Celgene Corporation) and the proteasome inhibitor bortezomib (Velcade®, Millennium Pharmaceuticals, Inc.) have increased response rates and survival times for patients with multiple myeloma in recent years (Ghobrial et al., 2007; Manochakian, Miller, & Chanan-Khan, 2007; Rajkumar et al., 2005; Richardson & Anderson, 2006; Richardson, Hideshima, Mitsiades, & Anderson, 2007), their use has been associated with an increased risk of thromboembolic events. The increase is related, in part, to administration of concomitant medications, including dexamethasone (Bennett et al., 2006; Celgene Corporation, 2007a, 2007b; Durie et al., 2006; Palumbo et al., 2008; Rajkumar et al.; Rajkumar & Gertz, 2006; Zonder et al., 2006). Thromboembolic events have been reported in patients receiving single-agent bortezomib, but at a much lower rate than that observed in patients with multiple myeloma treated with other agents, including lenalidomide or thalidomide (Celgene Corporation, 2007a, 2007b; Harousseau et al., 2006; Lonial et al., 2007). However, patients receiving bortezomib may be at risk for DVT and PE as a result of other risk factors, including some concomitant therapies.

At a Glance

- ◆ Patients with multiple myeloma are at risk for thromboembolic events (deep vein thrombosis and pulmonary embolism) because of the disease, individual risk factors, and treatment.
- ◆ Patients must be monitored and, if indicated, receive prophylaxis for thromboembolic events, which are serious and potentially life altering and life threatening.
- ◆ Measures to prevent thromboembolic events associated with novel therapies include mechanical, myeloma regimen related, and antithrombotic pharmaceutical and are based on individual patient-related and myeloma-related risk factors.

Sandra Rome, RN, MN, AOCN®, CNS, is a clinical nurse specialist at Cedars-Sinai Medical Center in Los Angeles, CA; Deborah Doss, RN, OCN®, is a clinical research nurse at Dana-Farber Cancer Institute in Boston, MA; Kena Miller, RN, MSN, FNP, is a nurse practitioner at Roswell Park Cancer Institute in Buffalo, NY; and Jeanne Westphal, RN, is an oncology nurse at Meeker County Memorial Hospital in Litchfield, MN. Doss is a member of the speakers bureaus for Celgene Corporation and Millennium Pharmaceuticals, Inc. Miller is a member of the speakers bureaus for Celgene Corporation and Kyphon, Inc., and the advisory board for Millennium Pharmaceuticals, Inc. Westphal is a member of the speakers bureau for Medical Education Resources. Mention of specific products and opinions related to those products do not indicate or imply endorsement by the *Clinical Journal of Oncology Nursing* or the Oncology Nursing Society. (Submitted October 2008. Accepted for publication January 5, 2008.)

Digital Object Identifier:10.1188/08.CJON.51.21-27

Table 1. National Cancer Institute Common Terminology Criteria for Adverse Events: Vascular Toxicity Grades

ADVERSE EVENT	GRADE 2 (MODERATE)	GRADE 3 (SEVERE)	GRADE 4 (LIFE THREATENING OR DISABLING)
Thrombosis/embolism (vascular access related)	Deep vein thrombosis or cardiac thrombosis; intervention (e.g., anticoagulation, lysis, filter, invasive procedure) not indicated	Deep vein thrombosis or cardiac thrombosis; intervention (e.g., anticoagulation, lysis, filter, invasive procedure) indicated	Embolic event, including pulmonary embolism or life-threatening thrombus
Thrombosis/thrombus/embolism	Deep vein thrombosis or cardiac thrombosis; intervention (e.g., anticoagulation, lysis, filter, invasive procedure) not indicated	Deep vein thrombosis or cardiac thrombosis; intervention (e.g., anticoagulation, lysis, filter, invasive procedure) indicated	Embolic event, including pulmonary embolism or life-threatening thrombus

Note. Vascular toxicity has no grade 1 (mild).

Note. Based on information from National Cancer Institute, 2006.

The International Myeloma Foundation's Nurse Leadership Board, in recognition of the need for specific recommendations on managing key side effects of the novel antimyeloma agents, developed this consensus statement for the assessment and prevention of thromboembolic events, including DVT and PE, associated with novel therapies. The recommendations are designed to be used by healthcare providers in any type of medical institution (Bertolotti et al., 2007, 2008).

Issue Statement

Certain populations are at increased risk for thromboembolic events, including DVT and PE. Patients with cancer are among those with an increased risk for thromboembolic events (Heit et al., 2000, 2002; Otten et al., 2004; Prandoni, 2005; Van Gerpen & Mast, 2004), and patients with multiple myeloma may incur an even higher incidence (Hussein, 2006; Palumbo et al., 2008). Some combination treatments and concomitant therapies for multiple myeloma also may increase the incidence of thromboembolic events (Palumbo et al.).

Disruption of the vascular endothelium by trauma, surgery, or disease can expose the subendothelium to clotting elements in the blood. In normal coagulation, platelet activation, granule secretion, and aggregation are followed by activation of the plasma coagulation cascade, ultimately leading to fibrin formation. Thrombosis can result from the unregulated activation of coagulation that occurs with continued endothelial damage, reduced blood flow in deep veins, and hypercoagulability. The resulting thrombus may obstruct blood vessels partially or completely or may dislodge from the site of formation to become an embolus (Handin, 2005; Story, 2006; Viale & Schwartz, 2004).

Thromboembolic events can produce life-altering complications, affecting physiologic functions such as breathing, cognition, and overall function, and should be considered medical emergencies. Thromboembolic events can permanently affect the lives of patients and their families. Impairment resulting from thromboembolic events can interfere with therapy, treatment options, drug combinations, and patient adherence.

Patient and Caregiver Educational Recommendations

Patient education, focused nursing assessment, and proactive prophylaxis against thromboembolic events may increase positive patient outcomes. Nursing opportunities include identifying and recommending prophylaxis against thromboembolic events in conjunction with the healthcare team and implementing prophylaxis algorithms such as those included in the National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology™ for venous thromboembolic disease (NCCN, 2007), the International Myeloma Working Group (IMWG) consensus statement recommendations (Palumbo et al., 2008), this consensus statement, and other nursing practices that have been identified to reduce the risk of thromboembolic events.

Global Statement

Recommendations for prevention and prophylaxis of thromboembolic events in patients with multiple myeloma depend on institutional practices, drug therapies and combinations, and factors specific to individual patients (e.g., concomitant illnesses, medical history, cost of therapy, insurance, patient abilities, adherence, allergies and sensitivities).

Tool for Grading Thromboembolic Events

Healthcare professionals can quantify the severity of thromboembolic events with the National Cancer Institute (NCI) Common Terminology Criteria for Adverse Events (CTCAE). The NCI CTCAE are used for identifying treatment-related adverse events to facilitate the evaluation of new cancer therapies, treatment modalities, and supportive measures. For most adverse events, the NCI CTCAE defined grades 1 through 5 using unique clinical descriptions; each grade is assigned a severity: grade 1 is mild, grade 2 is moderate, grade 3 is severe, grade 4 is life threatening or disabling, and grade 5 is death related to the adverse event. Table 1 defines the NCI CTCAE version 3.0 vascular toxicity

Individual Demographics

- Older age
- Obesity
- Immobilized, bed ridden, or low activity level (e.g., during prolonged air travel)
- Smoker or user of other forms of tobacco
- Varicose veins
- Pregnancy

Genetic Factors

- Strong family history of thromboembolic events
- Blood-clotting disorders
 - Factor V Leiden mutations
 - Factor VIII elevation
 - Prothrombin mutations
 - Protein C deficiency
 - Protein S deficiency
 - Antithrombin III deficiency
 - Hyperhomocysteinemia

Disease or Medical Condition

- Sickle cell disease and sickle cell trait
- Previous superficial vein thrombosis or venous thromboembolism
- Cardiac diseases, including myocardial infarction and congestive heart failure
- Chronic renal disease and nephrotic syndrome
- Neurologic disease or stroke with paralysis
- Hospitalization within previous three months with or without surgery
- Cancer with or without chemotherapy, including a diagnosis of myeloma
- Trauma
- Diabetes
- Acute infection
- Hepatic disease
- Regional bulky lymphadenopathy with extrinsic vascular compression
- Autoimmune diseases (e.g., rheumatologic and inflammatory bowel diseases)

Procedure-Related Factors

- Current or previous central venous catheter, IV catheter, or pacemaker
- Recent general, orthopedic, neurologic, or gynecologic surgery
- Anesthesia

Medications

- Chemotherapy for cancer, including some antimyeloma agents and supportive therapies
- Estrogenic agents, including
 - Hormone-replacement therapy
 - Oral contraceptives
 - Tamoxifen or raloxifene
 - Diethylstilbestrol
- Vitamin K
- Antimyeloma therapy and other myeloma medications (see Table 3)

Figure 1. General Risk Factors for Thromboembolic Events

Note. Based on information from Austin et al., 2007; Bauer, 2001; Heit et al., 2000, 2002; Joffe et al., 2004; Khorana et al., 2006; National Comprehensive Cancer Network, 2007; Palumbo et al., 2008; Prandoni, 2005; Prandoni et al., 2005; Spencer et al., 2007; Ven Gerpen & Mast, 2004.

grades 2 through 4 (NCI, 2006). The events are included under the categories “thrombosis/embolism (vascular access related)” and “thrombosis/thrombus/embolism,” and the category contains no grade 1 (mild) adverse event. The grades may be used for monitoring thromboembolic event toxicities and determining the need for intervention.

Assessment of Risk Factors

Ongoing and focused nursing assessment, proactive prophylaxis, and prompt recognition and diagnostic workup of potential or actual thromboembolic events, particularly DVT and PE, can help patients with multiple myeloma achieve positive outcomes. Figure 1 lists general risk factors for thromboembolic events. Assessment tools to determine risk for venous thromboembolism and DVT are available for practitioners and patients (Caprini, 2006; Coalition to Prevent Deep-Vein Thrombosis, 2006). The IMWG consensus statement for the prevention of thromboembolic events associated with thalidomide and lenalidomide in the treatment of patients with multiple myeloma relies on the number of individual and myeloma-related risk factors to determine specific recommendations (Palumbo et al., 2008).

If a thromboembolic event is suspected, a complete history should be taken and a laboratory workup should be performed. Figure 2 lists the signs and symptoms of DVT and PE, which can be used for physical assessment. Table 2 summarizes the tests that are used to diagnose DVT and PE.

As mentioned, therapy with lenalidomide or thalidomide may increase the risk of thromboembolic events for patients with multiple myeloma, particularly in combination with other antimyeloma agents and concomitant medications. Table 3 lists therapy-related risk factors for thromboembolic events. Although the risk for thromboembolic events with lenalidomide or thalidomide administered as a single agent is low, both immunomodulatory drugs are indicated in combination with dexamethasone for the treatment of multiple myeloma. Low-dose dexamethasone should be distinguished from high-dose dexamethasone, which is defined as 480 mg or more per month; low-dose dexamethasone, defined as less than 480 mg per month, is not a risk factor for thromboembolic events (Palumbo et al., 2008). In contrast, the proteasome inhibitor bortezomib is indicated for administration as a single agent; as such, it is not associated with an increased risk of thromboembolic events (Harousseau et al., 2006; Lonial et al., 2007; Millennium Pharmaceuticals, Inc., 2007). However, some evidence suggests that the addition of bortezomib to regimens including lenalidomide and other combination therapies associated with thromboembolic events may decrease the incidence of such events (Barlogie et al., 2005; Richardson et al., 2006). Erythropoietin administered with lenalidomide or thalidomide is a risk factor for thromboembolic events, but administration of erythropoietin with bortezomib does not result in an increased risk of thromboembolic events (Harousseau et al.; Palumbo et al.).

Recommendations for Prophylaxis

Clearly, recognizing factors that put patients at risk for thromboembolic events and instituting preventive measures are better than attempting to treat adverse events after they occur.

Deep Vein Thrombosis

- Slight fever
- Tachycardia
- Unilateral swollen, erythematous, warm extremity
- Cyanosis and cool skin if venous obstruction is present
- Dull ache, pain, or tight feeling over area and with palpation
- Positive Homan's sign (calf pain when knee is flexed and foot is dorsiflexed); present in approximately 35% of patients; high false-positive rate
- Obvious swelling (may not be present early)
- Distension of superficial venous collateral vessels

Pulmonary Embolism (a medical emergency)

- Anxiety
- Sudden dyspnea
- Chest discomfort; may appear anginal at first, then pleuritic; increases with inspiration
- Tachycardia or tachypnea
- Low-grade fever
- Pleural friction rub, crackles followed by diminished breath sounds; wheezing also may be present.
- Electrocardiogram right axis deviation or new right bundle branch block

Figure 2. Signs and Symptoms of Thromboembolic Events

Note. Based on information from Story, 2006; Van Gerpen & Mast, 2004.

Prophylactic measures against thromboembolic events may be categorized as mechanical, myeloma regimen related, and antithrombotic pharmaceutical (clot-preventing agent). Figure

3 describes recommendations for thromboembolic prophylaxis in each of the categories. Prophylaxis should take into account the patient's risk based on individual factors and the patient's antimyeloma and other therapeutic regimens. For example, measures to reduce the risk of thromboembolic events that are not related to myeloma or its therapy but are associated with individual patient factors (e.g., diet, exercise, lowering of cholesterol, weight reduction) may be recommended.

Some antithrombotic agents may be contraindicated in the presence of thrombocytopenia, renal impairment, or other comorbidities in patients with multiple myeloma because of their disease or antimyeloma therapy. For patients with a platelet count of $50 \times 10^9/L$ or less, aspirin and other anticoagulants generally should be held. Prophylaxis for thromboembolic events related to high-dose dexamethasone might consist of administration of low-molecular-weight heparin or heparin only on the days that dexamethasone is given. Less aggressive dosing schedules and lower doses of thalidomide and steroids alone or in combination may decrease incidence of thrombotic events; therefore, judicious dose reductions may increase quality of life and adherence to the therapeutic regimen.

The recommendations for prophylaxis presented in this article are made in consideration of the IMWG consensus statement (Palumbo et al., 2008). The IMWG's recommendations for thrombotic prophylaxis that take into account individual or myeloma-related risk factors, such as those listed in Figure 1 and Table 3, are as follows.

- Aspirin for patients with zero or one individual or myeloma-related risk factor
- Low-molecular-weight heparin or full-dose warfarin for patients with two or more individual or myeloma-related risk factors

Table 2. Diagnostic Testing for Thromboembolic Events

ASSAY TYPE	DEEP VEIN THROMBOSIS (DVT)	PULMONARY EMBOLISM (PE) ^a
Imaging examinations	Doppler ultrasonography: sensitivity/specificity of 95%; less reliable for diagnosing DVT in calf veins and upper extremities than venograph Contrast venography: "gold standard" but invasive Impedance plethysmography: not method of choice for lower extremities or asymptomatic patients Radionuclide scintigraphy: less reliable in calf or in recurrent DVT	Ventilation perfusion lung (V/Q) scan: If PE exists, lung perfusion is decreased without interfering with ventilation. If normal, no other studies are needed. Spiral (helical) computed tomography (CT) angiography: three-dimensional view; highly sensitive and specific for PE Pulmonary angiography: previous "gold standard" but invasive and not usually needed with availability of V/Q and spiral CT scans
Laboratory tests	Serum D-dimer (enzyme-linked immunosorbent assay) for fibrin degradation products: may be elevated in other conditions; high negative predictive value and sensitivity in presence of intermediate to high clinical risk; exclusionary test for DVT and PE in outpatients with low clinical probability Antithrombin level: Decrease corresponds to severity of thrombosis. If DVT or PE is diagnosed: prothrombin time, adjusted partial thromboplastin time, and baseline international normalized ratio	Serum D-dimer (enzyme-linked immunosorbent assay) for fibrin degradation products: may be elevated in other conditions; high negative predictive value and sensitivity in presence of intermediate to high clinical risk; exclusionary test for DVT and PE in outpatients with low clinical probability Antithrombin level: Decrease corresponds to severity of thrombosis. If DVT or PE is diagnosed: prothrombin time, adjusted partial thromboplastin time, and baseline international normalized ratio

^a Pulmonary embolism is a medical emergency.

Note. Based on information from Qaseem et al., 2007; Story, 2006; Van Gerpen & Mast, 2004.

Table 3. Therapy-Related Risk Factors for Thromboembolic Events

THERAPY	FACTORS ASSOCIATED WITH INCREASED RISK	FACTORS ASSOCIATED WITH NO OR DECREASED RISK
Lenalidomide	Administration in combination with high-dose dexamethasone (defined as ≥ 480 mg per month), dexamethasone plus erythropoietin, erythropoietin, cyclophosphamide, or combinations containing doxorubicin (including liposomal doxorubicin)	Administration in combination with bortezomib or low-dose dexamethasone
Thalidomide	Administration in combination with high-dose dexamethasone, erythropoietin, melphalan, melphalan plus prednisone, or doxorubicin (including liposomal doxorubicin) with or without dexamethasone, or in combination with two or more chemotherapy agents with or without a corticosteroid	Administration in combination with low-dose dexamethasone
Bortezomib	Administration in combination with some multidrug therapies	Administration in combination with erythropoietin with or without high-dose dexamethasone or with liposomal doxorubicin, in combination with lenalidomide, or in combination with VDT-PACE (bortezomib, dexamethasone, thalidomide, cisplatin, doxorubicin, cyclophosphamide, and etoposide)

Note. Based on information from Barlogie et al., 2005; Bennett et al., 2006, 2007; Celgene Corporation, 2007a, 2007b; Harousseau et al., 2006; Hussein, 2006; Knight et al., 2006; Lonial et al., 2007; Manochakian et al., 2007; Millennium Pharmaceuticals, Inc., 2007; Offidani et al., 2005; Ortho Biotech Products, L.P., 2007; Palumbo et al., 2008; Richardson et al., 2007; Zangari et al., 2002.

- Low-molecular-weight heparin or full-dose warfarin for all patients with therapy-related risks, including high-dose dexamethasone, doxorubicin, or multiagent chemotherapy

The labeling for thalidomide and lenalidomide recommends monitoring for signs and symptoms of thromboembolic events. According to the thalidomide label, preliminary data suggest that patients who are appropriate candidates may benefit from concurrent prophylaxis with aspirin or an anticoagulant (Celgene Corporation, 2007b). The lenalidomide label states

that the decision to use prophylaxis should be made after assessment of each patient's risk factors (Celgene Corporation, 2007a).

Individual patient risk factors, the presence of multiple myeloma, and the use of antimyeloma therapies or other medications all contribute to the risk of serious and life-threatening thromboembolic events in patients with myeloma. Prophylactic measures based on individual and myeloma-related risk factors can reduce or eliminate the risk.

Mechanical Prophylaxis

Sequential compression devices
Antiembolism stockings
Exercise regimens

Myeloma Regimen–Related Prophylaxis^b

Reduce thalidomide from 100 mg PO to 50 mg PO daily, or reduce by 50 mg increments from current dosage.
Administer dexamethasone 20–40 mg once weekly.
Administer dexamethasone 20 mg days 1–4 only (monthly cycle) versus standard pulse (days 1–4, 9–12, and 17–20).

Antithrombotic Pharmaceutical Prophylaxis^c

Salicylic acid (aspirin): low (81 mg) or standard dose (325 mg) PO daily

^a Not all-inclusive

^b Prophylaxis should be tailored to each individual patient's risk profile.

^c See prescribing information for indications, dosages, warnings, precautions, contraindications, drug interactions, and adverse events.

Antithrombotic Pharmaceutical Prophylaxis (Continued)

Unfractionated heparin: 5,000 IU subcutaneously twice daily (Baxter Healthcare, 2004)

Low-molecular-weight heparin (e.g., enoxaparin, dalteparin): enoxaparin 40 mg subcutaneously daily (sanofi-aventis, 2007); dalteparin 200 IU/kg total body weight subcutaneously daily for 30 days, then reduce to 150 IU/kg subcutaneously daily (Pfizer, Inc., 2007)

Fondaparinux (inhibitor of activated factor X = factor Xa): 2.5 mg subcutaneously daily (GlaxoSmithKline, 2005)

Warfarin: oral or IV formulation at a dose to achieve and maintain an international normalized ratio of 2.0–3.0 (Bristol-Myers Squibb, 2007); weight-based dosing: 1 mg if body weight < 70 kg and 2 mg if body weight 70 kg or more (Miller et al., 2006)

Figure 3. Mechanical, Myeloma Regimen Related, and Antithrombotic Pharmaceutical Prophylaxis^a

Note. Based on information from Barlogie et al., 2005; Bennett et al., 2006, 2007; Celgene Corporation, 2007b; Harousseau et al., 2006; Hussein, 2006; Knight et al., 2006; Lonial et al., 2007; Manochakian et al., 2007; Millennium Pharmaceuticals, Inc., 2007; Offidani et al., 2005; Ortho Biotech Products, L.P., 2007; Palumbo et al., 2008; Richardson et al., 2007; Zangari et al., 2002.

The authors gratefully acknowledge Brian G.M. Durie, MD, and Robert A. Kyle, MD, for critical review of the manuscript and Lynne Lederman, PhD, medical writer for the International Myeloma Foundation, for assistance in preparation of the manuscript.

Author Contact: Sandra Rome, RN, MN, AOCN®, CNS, can be reached at romes@cshs.org, with copy to editor at CJONEditor@ons.org.

References

- Austin, H., Key, N.S., Benson, J.M., Lally, C., Dowling, N.F., Whitsett, C., et al. (2007). Sickle cell trait and the risk of venous thromboembolism among blacks. *Blood*, *110*(3), 908-912.
- Barlogie, B., Tricot, G., Rasmussen, E., Anaissie, E., van Rhee, F., Zangari, M., et al. (2005). Total therapy 3 (TT3) incorporating Velcade® (V) into upfront management of multiple myeloma (MM): Comparison with TT2 + thalidomide (T) [Abstract 1154]. *Blood*, *106*, 1154.
- Bauer, K.A. (2001). The thrombophilias: Well-defined risk factors with uncertain therapeutic implications. *Annals of Internal Medicine*, *135*(5), 367-373.
- Baxter Healthcare. (2004). Heparin sodium injection, USP [Package insert]. Deerfield, IL: Author.
- Bennett, C.L., Angelotta, C., Yarnold, P.R., Evens, A.M., Zonder, J.A., Raisch, D.W., et al. (2007). Thalidomide- and lenalidomide-associated thromboembolism among patients with cancer. *JAMA*, *296*(2), 2558-2560.
- Bennett, C.L., Hussain, Z., Courtney, M., Yarnold, P., Raisch, D., & McKoy, J.M. (2006). RADAR update on thalidomide (Thal)- and lenalidomide (Len)-associated venous thromboembolism (VTE): Safety concerns persist for multiple myeloma (MM) despite FDA approvals in this setting [Abstract 3310]. *Blood*, *108*, 3310.
- Bertolotti, P., Bilotti, E., Colson, K., Curran, K., Doss, D., Faiman, B., et al. (2007). Nursing guidelines for enhanced patient care. *Haematologica*, *92*(Suppl. 2), 211.
- Bertolotti, P., Bilotti, E., Colson, K., Curran, K., Doss, D., Faiman, B., et al. (2008). Management of side effects of novel therapies for multiple myeloma: Consensus statements developed by the International Myeloma Foundation's Nurse Leadership Board. *Clinical Journal of Oncology Nursing*, *12*(3, Suppl.), 9-12.
- Bristol-Myers Squibb. (2007). Coumadin® (warfarin sodium) anticoagulant [Package insert]. Princeton, NJ: Author.
- Caprini, J.A. (2006). *Venous thromboembolism risk factor assessment*. Retrieved October 22, 2007, from <https://www.med.umich.edu/clinical/images/VTE-Risk-Assessment.pdf>
- Celgene Corporation. (2007a). Revlimid® (lenalidomide) [Package insert]. Summit, NJ: Author.
- Celgene Corporation. (2007b). Thalomid® (thalidomide) [Package insert]. Summit, NJ: Author.
- Coalition to Prevent Deep-Vein Thrombosis. (2006). *Are you at risk for a DVT blood clot?* Retrieved September 18, 2007, from <https://www.preventdvt.org/docs/pdf/DVTRiskAssessmentTool.pdf>
- Durie, B.G., Richardson, P., Palumbo, A., Dimopoulos, M.A., Cavo, M., Hajek, R., et al. (2006). Deep vein thrombosis in myeloma: Estimate of prevalence and recommendations for therapy based upon a survey of members of the International Myeloma Working Group (IMWG) [Abstract 3751]. *Blood*, *108*, 3571.
- Ghobrial, J., Ghobrial, I.M., Mitsiades, C., Leleu, X., Hatjiharissi, E., Moreau, A.S., et al. (2007). Novel therapeutic avenues in myeloma: Changing the treatment paradigm. *Oncology*, *21*(7), 785-792.
- GlaxoSmithKline. (2005). Arixtra® (fondaparinux sodium) [Package insert]. Research Triangle Park, NC: Author.
- Handin, R.I. (2005). Bleeding and thrombosis. In D.L. Kasper, A.S. Fauci, D.L. Longo, E. Braunwald, S.L. Hauser, J.L. Jameson, et al. (Eds.), *Harrison's principles of internal medicine* (16th ed., pp 1-24). New York: McGraw-Hill.
- Harousseau, J.L., Jagannath, S., Richardson, P.G., Sonneveld, P., Schuster, M.W., Esseltine, D.L., et al. (2006). Bortezomib in combination with high-dose dexamethasone (HD dex) and erythropoietin (EPO) does not result in an increased risk of thromboembolic complications [Abstract]. *Blood*, *108*, 3543.
- Heit, J.A., O'Fallon, W.M., Petterson, T.M., Lohse, C.M., Silverstein, M.D., Mohr, D.N., et al. (2002). Relative impact of risk factors for deep vein thrombosis and pulmonary embolism. A population-based study. *Archives of Internal Medicine*, *162*(11), 1245-1248.
- Heit, J.A., Silverstein, M.D., Mohr, D.N., Petterson, T.M., O'Fallon, W.M., & Melton, J. (2000). Risk factors for deep vein thrombosis and pulmonary embolism. A population-based case-control study. *Archives of Internal Medicine*, *160*(6), 809-815.
- Hussein, M. (2006). Thromboembolism risk reduction in multiple myeloma patients treated with immunomodulatory combinations. *Thrombosis and Haemostasis*, *95*(6), 924-930.
- Joffe, H.V., Kucher, N., Tapson, V.F., & Goldhaber, S.Z. (2004). Upper-extremity deep vein thrombosis: A prospective registry of 592 patients. *Circulation*, *110*(12), 1605-1611.
- Khorana, A.A., Francis, C.W., Culakova, E., Fisher, R.I., Kuderer, N.M., & Lyman, G.H. (2006). Thromboembolism in hospitalized neutropenic cancer patients. *Journal of Clinical Oncology*, *24*(3), 484-490.
- Knight, R., DeLap, R.J., & Zeldis, J.B. (2006). Lenalidomide and venous thrombosis in multiple myeloma. *New England Journal of Medicine*, *354*(19), 2079-2080.
- Lonial, S., Richardson, P.G., San Miguel, J., Sonneveld, P., Schuster, M., Blade, J., et al. (2007). Hematologic profiles with bortezomib in relapsed MM. *Haematologica*, *92*(Suppl. 2), 159-160. Retrieved April 10, 2008, from http://www.haematologica.it/content/vol92/6_supplement_2/index.dtl
- Manochakian, R., Miller, K.C., & Chanan-Khan, A.A. (2007). Clinical impact of bortezomib in frontline regimens for patients with multiple myeloma. *Oncologist*, *12*(8), 978-990.
- Millennium Pharmaceuticals, Inc. (2007). Velcade® (bortezomib) [Package insert]. Cambridge, MA: Author.
- Miller, K., Padmanabhan, S., Dimicelli, L., Depaolo, D., Landrigan, B., Yu, J., et al. (2006). Prospective evaluation of low-dose warfarin for prevention of thalidomide associated venous thromboembolism. *Leukemia and Lymphoma*, *47*(11), 2339-2343.
- National Cancer Institute. (2006). *Common Terminology Criteria for Adverse Events v.3.0*. Retrieved August 8, 2007, from <http://ctep.cancer.gov/forms/CTCAEv3.pdf>
- National Comprehensive Cancer Network. (2007). *NCCN Clinical Practice Guidelines in Oncology™: Venous thromboembolic disease* [v.1.2007]. Retrieved September 10, 2007, from http://www.nccn.org/professionals/physician_gls/PDF/vte.pdf
- Offidani, M., Corvatta, L., Marconi, M., Visani, G., Alesiani, F., Brunori, M., et al. (2005). Thalidomide, dexamethasone and pegylated-liposomal doxorubicin (ThaDD) for untreated multiple myeloma patients aged over 65 years [Abstract 2558]. *Blood*, *106*, 2558.
- Ortho Biotech Products, L.P. (2007). Doxil® (doxorubicin HCl liposome injection) [Package insert]. Bridgewater, NJ: Author.

- Otten, H.M., Mathijssen, J., ten Cate, H., Soesan, M., Inghels, M., Richel, D.J., et al. (2004). Symptomatic venous thromboembolism in cancer patients treated with chemotherapy. *Archives of Internal Medicine*, *164*(2), 190-194.
- Palumbo, A., Rajkumar, S.V., Dimopoulos, M.A., Richardson, P.G., San Miguel, J., Barlogie, B., et al. (2008). Prevention of thalidomide- and lenalidomide-associated thrombosis in myeloma. *Leukemia*, *22*(2), 414-423.
- Pfizer, Inc. (2007). Fragmin® (dalteparin sodium injection) [Prescribing information]. New York: Author.
- Prandoni, P. (2005). Acquired risk factors for venous thromboembolism in medical patients. *Hematology*, *1*, 458-461.
- Prandoni, P., Falanga, A., & Piccioli, A. (2005). Cancer and venous thromboembolism. *Lancet Oncology*, *6*(6), 401-410.
- Qaseem, A., Snow, V., Barry, P., Hornbake, E.R., Rodnick, J.E., Tobic, T., et al. (2007). Current diagnosis of venous thromboembolism in primary care: A clinical practice guideline from the American Academy of Family Physicians and the American College of Physicians. *Annals of Family Medicine*, *5*(1), 57-62.
- Rajkumar, S.V., & Gertz, M.A. (2006). Response (to Zonder et al., *Blood* 2006): Lenalidomide therapy and deep-vein thrombosis in multiple myeloma [Letter to the editor]. *Blood*, *108*, 404.
- Rajkumar, S.V., Hayman, S.R., Lacy, M.Q., Dispenzieri, A., Geyer, S.M., Kabat, B., et al. (2005). Combination therapy with lenalidomide plus dexamethasone (Rev/Dex) for newly diagnosed myeloma. *Blood*, *106*(13), 4050-4053.
- Richardson, P.G., & Anderson, K. (2006). Thalidomide and dexamethasone: A new standard of care for initial therapy in multiple myeloma. *Journal of Clinical Oncology*, *24*(3), 334-335.
- Richardson, P.G., Hideshima, T., Mitsiades, C., & Anderson, K.C. (2007). The emerging role of novel therapies for the treatment of relapsed myeloma. *Journal of the National Comprehensive Cancer Network*, *5*(2), 149-162.
- Richardson, P.G., Jagannath, S., Avigan, D.E., Alsina, M., Schlossman, R.L., Mazumder, A., et al. (2006). Lenalidomide plus bortezomib (Rev-Vel) in relapsed and/or refractory multiple myeloma (MM): Final results of a multicenter phase 1 trial [Abstract 405]. *Blood*, *108*, 405.
- sanofi-aventis. (2007). Lovenox® (enoxaparin sodium injection) [Package insert]. Bridgewater, NJ: Author.
- Spencer, F.A., Lessard, D., Emery, C., Reed, G., & Goldberg, R.J. (2007). Venous thromboembolism in the outpatient setting. *Archives of Internal Medicine*, *167*(14), 1471-1475.
- Story, K.T. (2006). Deep venous thrombosis. In D. Camp-Sorrell, & R.A. Hawkins (Eds.), *Clinical manual for the oncology advanced practice nurse*. (2nd ed., pp. 281-290). Pittsburgh, PA: Oncology Nursing Society.
- Van Gerpen, R., & Mast, M.E. (2004). Thromboembolic disorders in cancer. *Clinical Journal of Oncology Nursing*, *8*(3), 289-299.
- Viale, P.H., & Schwartz, R.N. (2004). Venous thromboembolism in patients with cancer. Part I. Survey of oncology nurses' attitudes and treatment practices for ambulatory settings. *Clinical Journal of Oncology Nursing*, *8*(5), 455-461.
- Zangari, M., Siegal, E., Barlogie, B., Anaissie, E., Saghafifar, F., Fassas, A., et al. (2002). Thrombogenic activity of doxorubicin in myeloma patients receiving thalidomide: Implications for therapy. *Blood*, *100*(4), 1168-1171.
- Zonder, J.A., Barlogie, B., Durie, B.G.M., McCoy, J., Crowley, J., & Hussein, M.A. (2006). Thrombotic complications in patients with newly diagnosed multiple myeloma treated with lenalidomide and dexamethasone: Benefit of aspirin prophylaxis. *Blood*, *108*(1), 403.

Receive free continuing nursing education credit for reading this article and taking a brief quiz online. To access the test for this and other articles, visit www.cjon.org, select "CE from CJON," and choose the test(s) you would like to take. You will be prompted to enter your Oncology Nursing Society profile username and password.

Patient Education Sheet: Preventing Blood Clots and Thromboembolic Events With Novel Agents for Multiple Myeloma

KEY POINTS

Patients with cancer are at increased risk for developing blood clots (thromboembolic events). Patients with multiple myeloma may have an even higher risk of developing blood clots. Novel therapies used to treat myeloma include thalidomide and lenalidomide. These drugs, in combination with other medications, may increase the incidence of clots. Prevention of blood clots can reduce complications and contribute to successful treatment. Changes in your medication may be made by a healthcare provider based on your symptoms.

TYPES OF THROMBOEMBOLIC EVENTS

- Deep vein thrombosis (DVT): a small blood clot in the arm, leg, hand, or foot; DVT is the most common thromboembolic event.
- Pulmonary embolus (PE): a blood clot that travels to the lungs
- Cerebral infarction (stroke): a blood clot that travels to the brain

SYMPTOMS OF DEEP VEIN THROMBOSIS

- Swelling, aching, pain, tightness, or a hard or soft lump in the arm, leg, hand, or foot
- Fast heartbeat
- Veins larger than usual (distended)

SYMPTOMS OF PULMONARY EMBOLUS

- Anxiety
- Fast heartbeat and fast breathing
- Chest pain or new onset of shortness of breath
- Coughing up blood

SYMPTOMS OF STROKE

- Change in emotional or mental behavior and confusion

Note. For more information, please contact the International Myeloma Foundation (1-800-452-CURE; www.myeloma.org). The foundation offers the Myeloma Manager™ Personal Care Assistant™ computer program to help patients and healthcare providers keep track of information and treatments. Visit <http://manager.myeloma.org> to download the free software.

Note. Patient education sheets were developed in June 2008 based on the International Myeloma Foundation Nurse Leadership Board's consensus guidelines. They may be reproduced for noncommercial use.

- Severe headache
- Chest pain
- Loss of coordination
- Sudden numbness or weakness

TREATMENT

- DVT, PE, and stroke are considered medical emergencies.
- Report any symptoms to your healthcare provider immediately.
- You will need regular examinations and may need to receive medications to prevent clots.
- The treatments or medications you receive will be based on your individual risk factors.
- Low-dose aspirin may be suggested if you have no risk factors or only one risk factor.
- Pills or injectable anticoagulating drugs may be prescribed if you have more than one risk factor.

RISK FACTORS FOR CLOT FORMATION

- Lack of activity
- Obesity
- Smoking
- History of blood clots in you or your family
- Taking estrogen compounds (hormone replacement)
- Taking drugs to increase the amount of red blood cells, such as erythropoietin, epoetin alfa, or darbepoetin alfa
- Recent surgery
- Prolonged air travel

WAYS TO REDUCE CLOT RISK

- Exercise, such as walking, ankle circles, and knee to chest lifts.
- Lose weight.
- Stop smoking.
- Take medications prescribed by your healthcare providers.