CLINICAL Q&A

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Assessing Venous Access Devices: When to Obtain a Venogram

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Question: When a lack of blood return from a venous access device (VAD) occurs, when should the patient have a venogram? Can the patient receive chemotherapy (particularly a vesicant) through the VAD if no blood return is occurring but the VAD appears to flush well?

Answer: Occluded VADs are not a minor problem, with an estimated 3%–70% failing to yield a blood sample (Mayo, 2001; Rihn, 2001; Whitman, 1996). Partial occlusion exists when a catheter flushes easily but will not aspirate blood. Total occlusion is characterized by the inability to withdraw blood or infuse fluid. Occlusions can occur from a fibrin tail, fibrin sheath, intraluminal thrombus, mural thrombus, drug precipitates, catheter malposition, pinch-off syndrome, or catheter kinkage (see Figure 1). Essentially, all catheters will develop fibrin sheaths, frequently within the first 24 hours after insertion (Hadaway, 2000). All VADs should be evaluated clinically at the initial sign of occlusion. If an occlusion still is evident after repositioning the patient, and the nurse is confident that the noncoring access needle is in the correct place with an implanted port, administration of a thrombolytic agent usually is recommended (Masoorli & Angeles, 2002; Tilford & Haire, 2001). If no blood return is established after thrombolytic therapy, then the diagnosis of an occlusion can be based on symptoms or evaluated by radiographic techniques including a chest x-ray, venous ultrasound, and/or a venogram (Perry, Sheiman, & Hartnell, 1995).

Obtaining a chest x-ray often is the first step in evaluation for catheter tip malposition, kinkage, and pinch-off syndrome. When a chest x-ray does not reveal an obvious cause for a lack of blood return, other radiologic studies may be necessary to determine a definitive cause (Hadaway, 2000). If the chest x-ray is normal, a venogram would be appropriate to help determine the fluid pathway through the catheter (Hadaway). A venogram allows the use of contrast dye to visualize the catheter's distal tip and backtracking of fluid along the tunnel tract. When a fibrin sheath is present, the administration of thrombolytic agents may help to treat the occlusion (Masoorli & Angeles, 2002). If the patient is unable to undergo a venogram because of a totally occluded catheter, an ultrasound or venous doppler examination may be considered, especially if clinical symptoms depicting possible deep vein thrombosis are evident.

Although the literature reports the use of chest x-rays, venous ultrasounds, and venograms in the identification of problems with VADs, no published guidelines for evaluation of VAD patency exist, and a workup must be individualized for each patient according to the symptoms presented. If the cause is thought to be related to a thrombotic complication and a chest x-ray has ruled out mechanical occlusion or catheter malposition, then a venogram would be the imaging study of choice. When the VAD has a total occlusion, a venous ultrasound is appropriate. Although serial chest x-rays obtained every one to three months have been recommended to evaluate for pinch-off syndrome (Nace & Ingle, 1993), no other guidelines exist as to how often to evaluate VADs that have inadequate blood return or occlusions.

No studies have provided evidence-based data as to when to give medications through a VAD without a blood return. In numerous clinical settings, medications are given through a partially occluded VAD without a blood return after patency has been verified by an imaging study. Administration of vesicants should be prohibited unless nurses can ensure that the catheter tip placement and catheter body are intact (Camp-Sorrell, 1996). If a fibrin sheath or clot resulting in backflow is present on the catheter tip, the VAD should not be used for vesicant administration (Mayo & Pearson, 1995; Schulmeister & Camp-Sorrell, 2000). Extravasation can occur with backtracking of the vesicant along the tunnel. A physician's order should be obtained to use a VAD without a blood return. Further research is needed to answer these questions.

Fibrin tail: Occurs when fibrin located at the catheter tip acts as a one-way valve, in which fluid infuses but no blood return occurs.

Fibrin sheath: Occurs when fibrin adheres to the external surface of the catheter and can extend the total catheter length.

Intraluminal thrombus: Occurs when fibrin or clots form in the catheter lumen.

Mural thrombus: Occurs when fibrin from a vessel wall injury binds to the fibrin covering the catheter surface, leading to a venous thrombus formation.

Drug precipitates: Occur from infusion of incompatible solutions or inadequate flushing, resulting in drug crystallization in the catheter or at the distal tip.

Catheter malposition: Catheter tip no longer is located in the superior vena cava at the right atrial juncture.

Pinch-off syndrome: Refers to the anatomic mechanical compression of a catheter as it passes between the clavicle and first rib at the costoclavicular space; the catheter lies in the costoclavicular space next to the subclavian vein instead of inside the vein.

Catheter kinkage: Occurs when the catheter migrates and becomes twisted or bends inside the vein or in the subcutaneous tunnel tract.

FIGURE 1. DEFINITION OF TERMS

Note. Based on information from Camp-Sorrell, 1996; Mayo, 2001.

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Ketoconazole in the Treatment of Prostate Cancer

Maureen E. O'Rourke, RN, PhD

Question: What is the rationale for using ketoconazole in the treatment of prostate cancer? What are the nursing implications of this therapy?

Answer: The first-line therapy for the treatment of prostate cancer that has not been cured by surgery or radiotherapy is androgen deprivation therapy. Men who experience disease progression following curative intent therapies often are treated with lutenizing hormone releasing hormone and antiandrogens. However, once a relapse occurs following hormonal therapy, hormone-resistant metastatic prostate cancer is one of the most difficult cancers to treat. Treatment strategies focus on suppressing endogenous androgen production and/or blocking the action of androgen.

Ketoconazole is a systemic antifungal agent whose antiandrogen effects have been well known for since the early 1980s (Trachtenberg, Halpern, & Pont, 1983). At high doses, ketoconazole inhibits cytochrome P-450 (Pont et al., 1982), suppressing testicular and adrenal androgen production. At high doses of 400 mg three times daily, the drug also has direct cytotoxic activity, although the precise mechanism of this action remains unclear (Eichenberger, Trachtenberg, Toor, & Keating, 1989).

A growing body of evidence suggests that among other biologic factors, low levels of circulating vitamin D are a risk factor for the development of prostate cancer (Gross, Peehl, & Feldman, 1997). Vitamin D receptors have been located on prostatic epithelial cells. Vitamin D inhibits growth, increases cellular differentiation, and decreases the invasiveness of prostatic cells in vitro (Feldman, Zhao, & Krishnan, 2000).

The active metabolite of vitamin D, calcitriol, is synthesized in the kidney. Ketoconazole inhibits the enzyme necessary for this synthesis, resulting in lower circulating levels of calcitriol (Peehl, Seto, & Feldman, 2001). Based on this understanding, scientists postulate that the combination of ketoconazole and calcitriol may be advantageous in achieving the inhibition of prostate cancer cell growth and the prevention of vitamin D deficiency induced by ketoconazole as single-agent therapy (Peehl et al.).

Ketoconazole also may be given at lower doses, usually 200 mg three times daily. Harris, Weinberg, Bok, Kakefuda, and Small (2002) reported combining ketoconazole with oral hydrocortisone replacement therapy, with a dosage of 20 mg in the morning and 10 mg in the evening. The addition of hydrocortisone replacement is predicated on the knowledge that ketoconazole is a potent inhibitor of all adrenal steroid synthesis pathways and thus may cause systemic adrenal insufficiency, as well as the fact that glucocorticoids also have antitumor effects (Harris et al.). At least one study has demonstrated moderate success with the low-dose regimen and lower toxicity levels as compared to the high-dose regimens (Harris et al.).

The approximate cost of high-dose therapy with ketoconazole at 400 mg three times daily is $13 per day (ePocrates Rx™ Formulary, version 5.5, ePocrates, Inc., San Mateo, CA). The duration of therapy varies; response to ketoconazole treatment is measured by monitoring prostate specific antigen (PSA) levels. Treatment outcomes also are variable. One review noted symptomatic improvement and PSA level decreases of greater than or equal to 50% with a typical duration of treatment of two to six months (Oh, 2002).

Gastrointestinal intolerance is one of the main limiting factors of ketoconazole therapy, followed by fatigue, hepatotoxicity, and skin changes (Bok & Small, 1999). Skin changes have been described as ranging from mild to severe dryness and eczema, as well as nail dystrophia (Vanuytsel et al., 1987). Other researchers have reported unusual skin stickiness and easy bruising (Small, Baron, & Bok, 1997). Nurses should monitor liver function tests prior to the initiation of therapy and at regular intervals throughout, as well as perform thorough skin and fatigue level assessments. Men undergoing androgen ablation therapy frequently report gynecomastia and breast tenderness; this information should be included in pretreatment education.

Gastrointestinal intolerance, including nausea, vomiting, and diarrhea, may result in discontinuation of the drug. Careful monitoring and aggressive treatment of these symptoms are a nursing priority. Low gastric pH levels or high gastric acidity enhance absorption of ketoconazole; therefore, ketoconazole should be taken on an empty stomach in the absence of antacids if possible (Oh, 2002).

Nursing assessment of patients receiving single-agent therapy with ketoconazole includes monitoring for signs of vitamin D deficiency. Vitamin D deficiency may cause muscle pain and weakness and results in osteomalacia and hypocalcemia. The use of ketoconazole among men with advanced prostate cancer who may not experience sufficient sunlight exposure to synthesize vitamin D further potentiates the risk of vitamin D deficiency.

Ketoconazole in combination with hydrocortisone with or without the addition of vitamin D seems to represent yet another therapeutic option for patients with hormone refractory prostate cancer. However, no study has yet determined a clear survival benefit. Ketoconazole is expensive, and some elderly patients may not have adequate insurance coverage to pay for this oral medication.

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Kyphoplasty as a Treatment for Vertebral Compression Fractures as a Result of Multiple Myeloma

Diane Coen, RN, MS

Question: Patients with a diagnosis of multiple myeloma now are having a procedure called kyphoplasty for the vertebral compression fractures that are a complication of this disease. What is kyphoplasty, and who can benefit from this procedure?

Answer: Kyphoplasty is an outpatient, or one-day stay, surgical procedure that treats patients' compression fractures that result from hemangioma, osteoporosis, or osteolytic cancer (as a result of multiple myeloma) (Dudeney, Lieberman, Reinhardt, & Hussein, 2002; Theodorou, Theodorou, Duncan, Garfin, & Wong, 2002). With a compression fracture, the vertebral body collapses, thereby shortening the spine and tilting it forward. This causes patients to have painful kyphosis, or humped over appearances, and, at times, spinal instability with possible motor, sensory, and neurologic impairment (NeuroCare Network, 2002). The kyphoplasty procedure attempts to straighten this kyphosis of the spine. The procedure has evolved from percutaneous vertebroplasty, which initially was developed in France in 1984 but not introduced in the United States until 1994 at the University of Virginia (Gross, 2002). Although both procedures are successful in relieving fracture-induced pain, only the kyphoplasty procedure can partially restore structural alignment and height (Lane, Johnson, Khan, Girardi, & Cammisa, 2002).

Vertebroplasty and kyphoplasty involve percutaneous injection under fluoroscopy of a bone cement (polymethylmethacrylate) into the collapsed vertebral body or bodies to stabilize the spine. With kyphoplasty, before the cement is injected, the kyphosis, or hump, of the spine is straightened with the inflation of a balloon into the vertebral body (Garfin, Yuan, & Reiley, 2001). The U.S. Food and Drug Administration approved the balloon used in this procedure in 1998 (Brown & Wong, 2000).

This procedure is shown in Figures 1–6 depicting the KyphX® Inflatable Bone Tamp (IBT) (Kyphon, Inc., Sunnyvale, CA), a special inflatable balloon. Figure 1 illustrates a normal vertebral body height. In Figure 2, the vertebral body has collapsed as can occur with osteolytic cancer, hemangiomas, and osteoporosis. In Figure 3, the surgeon creates a narrow pathway into the fractured bone and inserts the IBT. This is the most complex step of the procedure. With the patient in the prone position, a small incision is made at the level of the affected vertebral body that has been identified with fluoroscopy. A bone biopsy needle is introduced into the front third of the vertebral body and guided continuously by fluoroscopy. A bone drill then is used to form a larger pathway for the IBT (Garfin et al., 2001; Theodorou et al., 2002). In Figure 4, the IBT is inflated, moving the collapsed vertebral fragments to the edges of the vertebral body that restores the vertebral body height. Figure 5 demonstrates the IBT

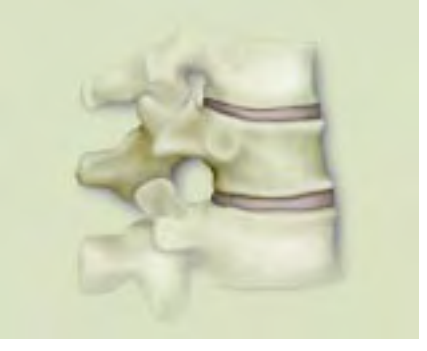

Figure 1. Normal Vertebra

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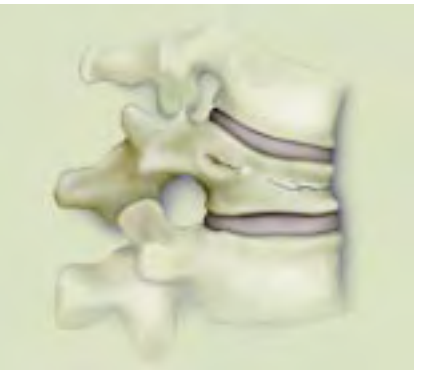

Figure 2. Fractured Vertebra

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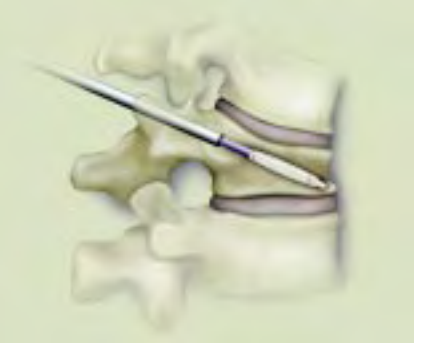

Figure 3. Insertion of Inflatable Bone Tamp

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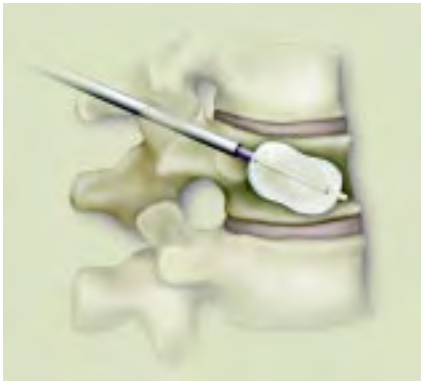

Figure 4. Inflation of Bone Tamp

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being deflated and withdrawn. The cement (polymethylmethacrylate) then is injected into the space created by the balboon using a cement filler. The cement is injected slowly under low pressure to fill the cavity created by the balloon tamp as confirmed by fluoroscopy. After filling, the cement filler is removed, and hemostasis occurs at the incision site (Garfin et al.; Theodorou et al.). The procedure takes approximately 30–60 minutes per vertebral level (Brown & Wong, 2000; Theodorou et al.). Figure 6 is a close-up illustration of the IBT.

Although study findings are limited because the procedure is fairly new, benefits of this procedure have been documented. In cadaver vertebral bodies, kyphoplasty was shown to increase vertebral body height (Belkoff, Jasper, & Stevens, 2002). This finding was supported in living patients as well, with improvements observed in function and pain relief (Garfin et al., 2001; Lieberman, 2001; Theodorou et al., 2002). However, the procedure is not without risk. Although complications are rare,

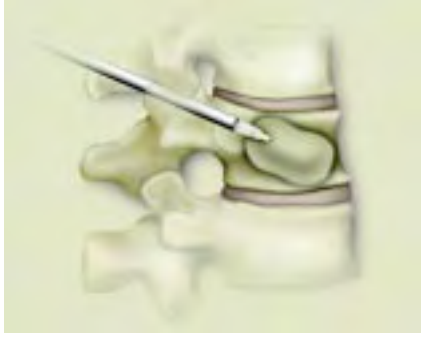

Figure 5. Removal of Inflatable Bone Tamp

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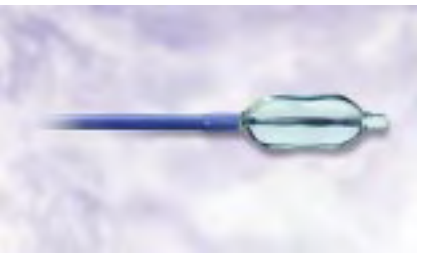

Figure 6. Close-Up of Inflatable Bone Tamp

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patients may experience rib fractures from lying in the prone position during the procedure, nerve damage, epidural bleeding, and cement leakage into the spinal canal, as well as an allergic reaction to the dye used during the fluoroscopy (Phillips, Wetzel, Lieberman, & Campbell-Hupp, 2002). Patients undergoing kyphoplasty must be in reasonably good health in case an emergency decompression of the spinal canal is needed if complications do occur (Garfin et al.).

Successful kyphoplasty depends on surgeon skill, appropriate advanced imaging equipment, and patient selection (Watts, Harris, & Genant, 2001). Patients who may benefit from this procedure are those who have uncontrolled pain for several weeks, problems such as pulmonary or digestive interference because of significant height loss, or difficulty walking or performing daily activities. Contraindications to the kyphoplasty procedure include patients with complete loss of vertebral height, posterior vertebral wall destruction, spinal cord impingement, metastatic lesions that destroy bone-building cells, and coagulation disorders. Also, patients with fractures older than six months usually do not see much improvement with the procedure. In fact, Garfin et al. (2001) noted that the efficacy of the procedure declines if the fracture is more than three months old.

More than 1,000 patients have been treated with kyphoplasty (Hardouin, Fayada, Leclet, & Chopin, 2002). Carefully designed studies are needed to evaluate the cost versus the benefit of this new procedure. With the necessary disposable bone tamp and high-technology imaging equipment, the cost of kyphoplasty is high. Short-term positive outcomes have been demonstrated with these patients in the relief of pain, improved function, and restoration of vertebral body height. Complications are few, but long-term outcomes are unknown at this time. Further studies should be completed to measure longevity of patients' initial pain relief, improved functioning because of vertebral height restoration, and long-term benefits of the kyphoplasty procedure.

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