

# Implanted Ports, Computed Tomography, Power Injectors, and Catheter Rupture

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Patients with cancer often require computed tomography (CT) examinations to monitor the status of their disease. To enhance CT images, radiology personnel use power injectors to administer radiopaque contrast media at high pressures and controlled rates. If power injectors are used with implanted ports that are not designed to withstand pressures generated by the injectors, catheter ruptures can occur. Catheter rupture can lead to extravasation of vesicant contrast dye, catheter fragment emboli in the right atrium or pulmonary artery, and the need for port removal and replacement (U.S. Food and Drug Administration [FDA], 2006). Several vascular access manufacturers have recently developed implanted ports that are safe for power injection. For patients who may already have poor peripheral venous access, the ability to use their port to inject contrast media decreases discomfort from venipuncture and helps lower the risk for extravasation of vesicant contrast media.

Although power injectable ports have many benefits, serious adverse events can occur if safety processes are not developed and implemented. Oncology nurses can prevent catheter rupture by accurately identifying a port that is a power injectable port; using the correct power injectable, pressure-tested port needle to access the port; communicating with radiology personnel; and educating the patient about port safety issues.

## Overview

In 2004, the FDA reported receiving more than 250 adverse event reports in which vascular access devices ruptured when power injectors were used to give contrast media as part of CT or magnetic

resonance imaging studies (FDA, 2004). The events involved central venous catheters (including implanted ports), small-gauge peripheral catheters, extension tubings, and IV tubings. The catheter ruptures caused extravasation of vesicant contrast media, loss of catheter function, and the need for additional surgery to replace the line. In some cases, catheter rupture caused the catheter to fragment and embolize. The issue continued to occur despite warnings, resulting in additional FDA alerts (FDA, 2006).

## Catheter Rupture and Fragment Embolization

Published case reports of implanted port catheter rupture have described catheter fragment embolization as being an incidental finding with few harmful effects (Liu, Tseng, Chen, Chern, & Chang, 2004). However, other authors have reported the occurrence of severe complications to be as high as 71% (Fisher & Ferreyro, 1978). In a study by Surov et al. (2008) examining 41 implanted port catheter fractures, most catheter fragments were found in the pulmonary artery, superior vena cava, and right atrium. The most common symptom of catheter embolization was port malfunction (39%). Of the patients in whom the catheter fragments were located in the right atrium, right ventricle, and pulmonary artery, 7.3% presented with cardiac

symptoms. Complications included partial occlusion of the pulmonary artery, arrhythmias, pulmonary thromboembolism, pulmonary hypertension, and right ventricular failure. In 53.7% of cases, catheter embolism was found incidentally.

Factors causing pressure with resultant catheter rupture of the vascular access device or IV tubing included the flow rate of the power injector, catheter diameter and length, the viscosity of the contrast material, and obstruction to the flow of the contrast media (FDA, 2004). Obstructed flow in implanted ports can occur from fibrin, drug precipitates, catheter malposition, and the pinch-off syndrome. The pinch-off syndrome (also called costoclavicular pinching) refers to the process in which catheter compression between the clavicle and first rib over a prolonged period of time causes mechanical friction that weakens the catheter (Schulmeister, 2005). When the catheter is compressed, the risk for catheter rupture and fracture increases. The pinch-off syndrome has been reported to be the most common cause of catheter fracture (Surov et al., 2008).

The FDA's (2006) recommendations to prevent catheter fracture from occurring include checking the label of each vascular access device for its maximum pressure and flow rate, knowing the pressure limit setting for the power injector and how to adjust it, and verifying that the pressure

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