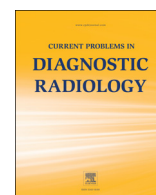




# Current Problems in Diagnostic Radiology

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## Contrast Media Extravasation of Computed Tomography and Magnetic Resonance Imaging: Management Guidelines for the Radiologist<sup>☆, ☆☆☆</sup>

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Intravenous contrast administration has been of great importance in diagnostic radiology, but it is not without risks either due to the local, systemic allergic reactions or due to subcutaneous extravasation of contrast media. Subcutaneous contrast medium extravasation is an infrequent, yet a well-recognized complication. However, most incidents are minor and can be managed conservatively, but there are a few cases that require immediate surgical intervention. This article discusses the risks factors, clinical manifestations, and conservative and surgical approaches of subcutaneous contrast media extravasation for both computed tomography and magnetic resonance imaging.

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### Introduction

Although administration of intravenous (IV) iodinated contrast has many benefits, there are inherent risks such as local allergic reaction, systemic allergic reaction, and subcutaneous contrast media extravasation. Subcutaneous contrast media extravasation can occur under the supervision of any radiologist, regardless of the level of training or expertise.<sup>1</sup>

The injuries from subcutaneous contrast media extravasation are minor, resolve spontaneously, and usually they require just follow-up. However, in some instances there are serious complications, which occur because of direct toxicity of the contrast agent or pressure effects, such as compartment syndrome.<sup>2</sup>

These complications may require immediate surgeries, which sometimes can have a detrimental effect on the patient and health care system because they result in longer hospital stays, thus causing an increase in the patient's morbidity and mortality.<sup>3</sup>

This article discusses the risk factors, signs, and guidelines for medical and surgical management of contrast media extravasation as well as steps for prevention.

### Definition of Subcutaneous Contrast Media Extravasation

Subcutaneous contrast media extravasation is defined as the inadvertent administration of vesicant fluid into the surrounding healthy tissue instead of the intended vessel.<sup>4</sup> A vesicant is an agent that has the capability to cause blistering or tissue necrosis.<sup>5</sup>

As a result, the extravasation of contrast media typically has a detrimental effect on the surrounding cells and tissues. The incidence of subcutaneous contrast media extravasation varies from 0.1%–0.9% of all contrast-enhanced computed tomography (CT) examinations. According to a review of 6 series of articles published between 1991 and 2000, the estimated contrast extravasation rate is 0.45%.<sup>6,7</sup>

For magnetic resonance imaging (MRI), gadolinium-based contrast agents are associated with less adverse events and are even less common as the volume of contrast administered is minimal and is typically injected by the hand.

### Risk Factors for Subcutaneous Contrast Media Extravasation

#### Patient Population

Extravasation is typically more common in the children, elderly, and patients with a low level of consciousness due their inability to verbalize the pain caused by extravasation.<sup>1,2</sup>

Patients with fragile veins such as the elderly, frequent vein punctures, history of radiation therapy in the concerned area, chemotherapy, little muscle mass, and atrophy of the subcutaneous tissue are susceptible to subcutaneous contrast media extravasation.<sup>7</sup>

Also, the history of peripheral vascular conditions such as atherosclerosis, diabetes, Raynaud's syndrome, or venous or lymphatic

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return disorders (thrombosis or venous failure and lymphedema due to previous surgery) does not increase the risk of extravasation, but they are associated with a greater possibility of serious injuries.<sup>1,2,8</sup> Finally, Shaqdan et al<sup>3</sup> also demonstrated that female inpatients are more likely to develop contrast extravasation either with CT or MRI.

### *Injection Technique*

The choice of injection site is an inherent risk of developing extravasation. Areas outside the antecubital fossa, such as the distal veins of the lower extremity and dorsal veins of the hand, are more susceptible to contrast extravasation.<sup>9,10</sup>

Initially, it was thought that infusion rate or the use of power injectors is associated with higher rates of subcutaneous contrast extravasation, but this has been disproven.<sup>11</sup> Jacobs et al<sup>12</sup> have shown that subcutaneous contrast media contrast extravasation can occur at the same rate with a manual or power injector and nonionic or ionic contrast media. However, a low-osmolality contrast media is better tolerated than the conventional ionic contrast media.<sup>13</sup>

Wang et al<sup>6</sup> noted that larger volumes of extravasation are associated with higher incidence of symptomatic contrast media extravasation. Injection through an indwelling peripheral IV line in place for more than 24 hours and multiple punctures into the same vein are also associated with an increased risk of extravasation.<sup>9</sup>

### **Prevention**

The direct monitoring of puncture site through palpation during the early stage of puncture is the best preventive measure to detect extravasation. Patients should be made aware of the scanner intercom and instructed to report any symptoms during injection to the CT technologist.

There are several steps that can be taken to avoid a subcutaneous contrast media extravasation. Whenever possible, in a low-osmolality non-ionic-iodinated contrast media if contrast extravasation does occur, tissue reaction is less severe than in hyperosmolar ionic-iodinated contrast media.<sup>1,6,14</sup> Also, before using an automated injector and connecting to the IV, a test should be performed with saline solution to insure that there is no resistance to the injection.<sup>15,16</sup> Also flow velocity should be appropriate for the size of the needle being used; 3 mL/s is recommended and should be used with a >20-gauge caliber needle with the most appropriate puncture site being the antecubital vein in the forearm. For a peripheral vein in a place such as hand, wrist, or ankle, a flow velocity beyond 1.5 mL/s is not recommended.<sup>15</sup>

Also, peripheral veins catheters cannulated over 24 hours should not be used as these are associated with phlebitis, which can increase vascular resistance and extravasation.<sup>1,15,17</sup> Also, one should not assume that all vascular catheters including a peripherally inserted central catheter would tolerate mechanical injections. It is essential to follow the instructions given by the catheter manufacturer to see if automatic injectors can be used owing to the risk of tear in some catheters.<sup>9,18</sup>

### **Manifestations and Management of Subcutaneous Contrast Media Extravasation**

#### *Mild Extravasation*

The diagnosis of subcutaneous contrast media extravasation is primarily by clinical and direct physical examination. Sometimes,

these are also diagnosed by the absence of contrast media in the images.<sup>16</sup> Once this is recognized, the study should be terminated immediately.<sup>9</sup>

Subcutaneous extravasation injuries are classified as mild, moderate, or severe. According to a recent multicenter review of 771 extravasation injuries by Dykes et al<sup>19</sup> the incidences of mild, moderate, and severe extravasation injuries are 94.6%, 4.7%, and 0.8%, respectively.

Few patients are asymptomatic, and most patients with mild extravasation complain of pain or itching, local swelling, and local erythema at the injection site, which can resolve within 24 hours.<sup>10</sup> In a study by Wang et al,<sup>6</sup> 350 of the 449 patients reported swelling, “bump,” edema, or induration. As it is difficult to predict the course of these injuries at the initial examination, it important that patients remain in the radiology department for 2–4 hours to detect any possibly new injuries, confirm the resolution, or detect progression of more serious injuries such as skin blistering, altered tissue perfusion, paresthesia, and increasing or persistent pain after 4 hours.<sup>2,8,16</sup>

The first step is to completely stop the injection and remove the extravasated IV. Regarding management of extravasation, the American College of Radiology (ACR) manual on contrast media recommends that management of mild extravasation should consist of elevation of the affected limb, topical application of ice, and monitoring the patient.<sup>15,16</sup>

At our institutions, outpatients are held in the radiology observation unit and are monitored closely by the nursing staff. Although it is important to elevate the affected extremity, serial neurovascular examination is recommended to assess for early signs of compartment syndrome. If patient's symptoms have improved after 2–4 hours, patients are allowed to leave the department. Before discharge, the patient is instructed to go directly to the hospital if they notice any skin blistering, numbness, or paresthesia. If symptoms have not improved, a surgical evaluation is recommended.

It is recommended to elevate the affected limb beyond the level of the heart, even though its efficiency has not been proven.<sup>15,16</sup> However, this maneuver may reduce capillary hydrostatic pressure, promoting the reabsorption of the extravasated fluid and reducing edema. This elevation of the extremity should be done without compromising its arterial supply or venous return.<sup>1,2,8,20</sup>

The application of ice or heat has not been supported by scientific evidence, but does limit inflammation.<sup>15</sup> However, the topical application of ice through ice bags wrapped up in gauzes or cloths in the area of extravasation 3 times a day for 15–60 minutes causes vasoconstriction, thus limiting inflammation, alleviates pain, and fewer skin ulcers.<sup>2,6,8</sup> Also, the topical application of heat can also promote resorption of contrast medium by causing vasodilatation.

According to the ACR manual on contrast media, there is no evidence to suggest that extravasation can be mitigated by trying to aspirate the contrast medium through a needle, liposuction, or local injection of other agents such as corticosteroids or hyaluronidase.<sup>15</sup> Contrast aspiration from the site of extravasation before removing the needle or in the operating room through liposuction cannulas is controversial. However, some studies have demonstrated some efficiency.<sup>1,2,21</sup> This should be performed no later than 1 hour after the occurrence.

Liposuction can also be performed with a single incision adjacent to the area of extravasation. Saline flush has been performed with use of 4 small local incisions through which a blunt-ended needle is inserted.

The administration of IV hyaluronidase can also be used to increase the distribution of locally injected substances through the connective tissue, thus facilitating their reabsorption of extravasated drugs and can reduce the risk of skin necrosis up to 500 mL

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