

Extravasation Bullet Points and Recommendations with Associated Strength of Evidence

Below is a summary of the recommendations related to contrast extravasation and the associated strength of evidence for those recommendations using the [ACR Appropriateness Criteria® Methodology](#).

Frequency

- **0.1-1.2% of CT injections result in extravasations [1-9].**
- **Most extravasations resolve without complication [6, 7, 11, 13, 14]; severe extravasation injuries, including compartment syndrome (most common [11]) and skin ulceration / necrosis, are very rare (<<1% of extravasations) [7, 8, 11].**

Risks

- Extravasations and severe extravasation injuries are more common in patients who 1) are uncommunicative, 2) have altered circulation in the injected extremity, 3) have had radiation of the injected extremity, or 4) are injected in the hand, foot, or ankle [1, 32].
- Extravasations are also more common in patients injected with more viscous contrast material [6, 8, 35].
- The risk of extravasation can be minimized by 1) using angiocatheters rather than butterfly needles, 2) performing meticulous intravenous catheter insertion technique (confirming intravenous location by aspirating blood through an inserted catheter and flushing the inserted catheter with a test injection), 3) and carefully securing an inserted catheter [41].

Evaluation and treatment

- **A health care provider should examine any patient in whom a contrast-media extravasation occurs; physical examination should include assessment of tenderness, swelling, erythema, paresthesia, active and passive range of finger motion, and perfusion [22].**
- **There is no known effective treatment for contrast medium extravasation, although initial steps should include elevation of the affected extremity above the level of the heart [22, 24], and use of cold or warm compresses [22-25]. No medical interventions have been deemed helpful [15, 22, 28, 29].**
- **Since severe extravasation injuries can develop slowly (up to hours after an extravasation), all discharged outpatients should be given clear instructions concerning where and when to seek additional medical care (including for worsening pain, development of paresthesia, diminished range of motion, and new skin ulceration or blistering) [22].**
- **Surgical consultation should be obtained whenever there is concern for a severe extravasation injury [11, 22]; this can be suspected if the patient develops severe pain, progressive swelling or pain, decreased capillary refill, change in sensation, worsening active or passive range of motion in the elbow, wrist, or fingers, or skin ulceration or blistering [17]; reliance on an extravasation volume threshold to trigger surgical consultation is not recommended [11, 13, 18].**

Power-injection through central venous catheters and peripherally inserted central catheters (PICCs)

- **Contrast material can only be power-injected into central venous catheters [38] or PICCs [39] if these catheters have been certified for such use, with the flow-rate limit provided. All manufacturer recommendations should be followed.**

Gadolinium-based contrast media

- Extravasation injuries after injection of gadolinium-based contrast media are much less common than those seen after injection of iodinated contrast material [20], likely due, in part, to less toxicity [21] and the low volumes of gadolinium-based contrast media that are injected.

Summary Questions and Answers

(Study Quality = SQ)

Question 1. What actions can be performed to minimize the likelihood of an extravasation?

Recommendation 1: Extravasation risk is minimized by 1) using angiocatheters over butterflies, 2) performing meticulous intravenous insertion technique (confirming intravenous location by aspirating blood through an inserted catheter and flushing the inserted catheter with a test injection), 3) and carefully securing an inserted catheter.

Strength of evidence: Limited 1

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
41	2	-	2

Question 2: What risk factors should clinicians take into consideration in determining the likelihood of a contrast extravasation?

Recommendation 1: Clinicians should consider patient related factors such as history of altered circulation in the injected extremity, prior radiation to the injected extremity, or uncommunicative patients.

Strength of evidence: Limited 1

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
1	2	-	2
32	4	-	4

Recommendation 2: Clinicians should consider contrast and injection parameters such as viscosity of contrast material and location of injection other than non-antecubital fossa regions (such as hand, foot, and ankle more at risk)

Strength of evidence: Viscosity = Strong 3

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
6	2	-	2
8	2	-	2
35	2	-	2

Strength of evidence: Location of injection = Strong 3

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
1	2	-	2
20	4	-	4
36	2	-	2

Question 3: How should clinicians evaluate patients for potential contrast extravasation?

Recommendation 1: Clinicians should do a physical exam of the affected extremity to evaluate for tenderness, swelling, erythema, paresthesia, active and passive range of finger motion, and perfusion.

Strength of evidence: Limited 3

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
22	4	-	4

Question 4: How should contrast extravasations be treated?

Recommendation 1: Elevation of the affected extremity above the heart.

Strength of evidence: Limited 3

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
22	4	-	4
24	4	-	4

Recommendation 2: Cold compresses or ice packs should initially be applied to the extravasation site (rather than warm compresses)

Strength of evidence: Limited 1

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
22	4	-	4
23	Inadequate	-	Inadequate
24	4	-	4
25	1	-	1

Recommendation 3: Routine use of hyaluronidase or corticosteroid injections or aspiration of the affected limb is not recommended.

Strength of evidence: Limited 1

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
15	4	4	4
22	4	-	4
28	4	-	4
29	2	-	2

Recommendation 4: All discharged outpatients should be given clear instructions concerning where and when to seek additional medical care (including for worsening pain, development of paresthesia, diminished range of motion, and new skin ulceration or blistering) as severe extravasation could develop several hours later.

Strength of evidence: Limited 3

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
11	4	3	3
22	4	-	4

Question 5: When should surgical consultation be placed?

Recommendation 1: Surgical consultation should not be routinely requested based on volume alone.

Strength of evidence: Strong 3

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
11	4	3	3
13	4	4	4
18	1	-	1
14	2	-	2

Recommendation 2: Surgical consultation should be requested whenever there is concern for a severe extravasation injury; this can be suspected if the patient develops severe pain, progressive swelling or pain, decreased capillary refill, change in sensation, worsening active or passive range of motion in the elbow, wrist, or fingers, or skin ulceration or blistering.

Strength of evidence: Limited 3

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
11	4	3	3
22	4	-	4

Question 6: Can automated (power) injectors be utilized for injections in central venous or PICC lines?

Recommendation 1: Use central venous catheter to power inject contrast or PICCs if the catheters have been certified for such use, with the flow-rate limit provided. All manufacturer recommendations should be followed.

Strength of evidence: Limited 1

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
38	2	-	2
39	4	-	4

Question 7: What is the extravasation risk from injection of gadolinium-based contrast media?

Recommendation 1: Extravasation injuries are extremely unlikely during gadolinium-based contrast media injection, likely due to lower toxicity than iodinated contrast agents and lower total volumes of injected contrast media.

Strength of evidence: Limited 3

<u>Reference #</u>	<u>Original SQ</u>	<u>Reassessed SQ</u>	<u>Final SQ</u>
20	4	-	4
21	4	-	4

EXTRAVASATION OF CONTRAST MEDIA

Frequency

The reported incidence of intravenous (IV) contrast media extravasation in adults and children related to power injection for CT has ranged from 0.1% to 1.2% [1-9] (1/1,000 patients to 1/83 patients). Extravasation can also occur during hand injections. Extravasations may occur at both low and high flow rates [10]. Extravasation occurring with dynamic bolus CT may involve large volumes of contrast media [11].

Initial Signs and Symptoms

Most extravasations are limited to the immediately adjacent soft tissues (typically the skin and subcutaneous tissues).

Although most patients complain of initial swelling or tightness, and/or stinging or burning pain at the site of extravasation, some experience little or no discomfort [11,12]. On physical examination, the extravasation site may be edematous, erythematous, and tender [11].

Extravasation of Iodinated Contrast Material

In most patients, initial swelling and tenderness resolves within hours to days after the extravasation. The vast majority of patients in whom extravasations occur recover without clinically important sequelae [6,7,11,13,14]. However, in some patients, extravasated iodinated contrast media can result in injury to surrounding tissues, particularly the skin, producing an acute local inflammatory response that peaks at 24 to 48 hours [15]. Most of the time there are no lasting complications. Only rarely will a low-osmolality contrast media (LOCM) extravasation injury proceed to a severe adverse event [11]. Acute tissue injury resulting from extravasation of iodinated contrast media is probably related at least in part to its hyperosmolality [16,17].

Several large series have illustrated the infrequency of severe injuries after LOCM extravasation. In one single institutional study, all 321 extravasation injuries were mild [8]. In another single institutional study [11], only one of 442 adult LOCM extravasations resulted in a severe injury (a compartment syndrome). Three other patients developed blisters or ulcerations that were successfully treated locally. In a third study, utilizing a practice quality improvement database established by the American College of Radiology [7] only six of 1,085 reported extravasations resulted in severe injuries, and only one patient required surgical intervention.

The most commonly reported severe injury after LOCM extravasation is compartment syndrome [11]. Compartment syndrome results from mechanical compression and is probably more likely to occur after extravasation of larger volumes of contrast media; however, it also has been observed after extravasation of small volumes, especially when these occur in less capacious areas (such as over the ventral or dorsal surfaces of the wrist) [11]. Compartment syndrome may develop soon after an extravasation [11] or result from swelling that sometimes occurs hours after the extravasation [18].

Less commonly encountered severe injuries include skin ulceration and tissue necrosis [19]. These can occur within hours or days of the extravasation event.

Extravasation of Gadolinium Based Contrast Media

Extravasation of gadolinium-based contrast media is less common (i.e., approximately one-sixth as often) than iodinated contrast media [20]. The difference is likely due to much lower volumes of administered gadolinium-based contrast media for most clinical indications. Additionally, on a cc to cc basis, gadolinium-based contrast media may also have less toxicity than iodinated contrast agents [21].

Evaluation of Patients in Whom Extravasations Occur

A responsible health care provider should be summoned to examine any patient in whom an extravasation of contrast material has occurred. The patient should be asked about symptoms of pain and paresthesias. A brief examination should be performed and should include assessment of extremity tenderness, swelling, erythema, paresthesia, active and passive range of motion of the fingers, and perfusion [22].

Treatment

Studies evaluating potential treatments of extravasation injuries are generally of low quality [23]. Given the absence of any studies demonstrating definite efficacy of any specific treatment regimen, the optimum treatment of extravasation events has not been determined. Our limited guidance is to suggest treatments that have a low risk of harm, but that might have some efficacy.

Extravasations that resolve rapidly probably need no treatment other than brief observation and discharge instructions (see section entitled Discharging Patients in Whom Extravasations Occur, below). More symptomatic extravasations may be treated with extremity elevation above the level of the heart (to decrease capillary hydrostatic pressure and thereby promote resorption of extravasated fluid [22, 24]) and either warm or cold compresses that an outpatient may continue intermittently at home until symptoms resolve, along with discharge instructions, or may be continued on the wards for inpatients. Controlled studies demonstrating the efficacy of these interventions are lacking, however [25]. There is no clear evidence favoring the use of warm over cold compresses or vice versa [25]. Some surgeons empirically recommend initial use of cold compresses to promote vasoconstriction and diminish inflowing blood and swelling [22,24].

Severe cases in which there is concern for neurologic or vascular compromise or skin ulceration and necrosis require surgical consultation to assess the need for operative management (see next section).

There is no consistent evidence that the effects of an extravasation can be mitigated by trying to aspirate the extravasated contrast medium through an inserted needle or angiocatheter [22,26]. When such attempts are made, usually little or no extravasated contrast material can be successfully aspirated. Therefore, aspiration is not recommended.

Some have suggested that the extravasation site can be treated by performing multiple punctures around the extravasation site and then manually squeezing the site [27,28]; however, the effectiveness of this approach has not been validated and it is not recommended.

Topical application of silver sulfadiazine ointment and steroid cream three to four times daily has been recommended by some as an approach to soothe irritated skin, reduce inflammation, and to prevent infection should any blistering occur, although the efficacy of this treatment is unknown [12].

There is no consistent evidence that local injection of potentially therapeutic agents, such as corticosteroids or hyaluronidase is beneficial [15,29]. Hyaluronidase has been used in the management of extravasation events for medications unrelated to contrast media, and there are a few case reports in which it was attempted following a contrast material extravasation event [30, 31]. However, no adequate studies confirm efficacy of hyaluronidase after contrast media extravasation [28]. Therefore, use of hyaluronidase for the management of contrast material extravasation is not recommended [22].

Surgical Consultation

Urgent surgical consultation should be obtained whenever there is concern for a severe extravasation injury [11,22]. Although consultation can prolong length of stay (eg, by 2.5 hours in one ED population [14]), it should be obtained for any patient in whom one or more of the following extravasation-related signs or symptoms develops: severe pain; progressive swelling or pain; altered tissue perfusion as evidenced by decreased capillary refill; change in sensation in the affected limb; worsening passive or active range of motion; and skin ulceration or blistering [17].

Reliance on an extravasation volume threshold (such as estimated volumes exceeding 100 or 150 mL) to indicate the need for surgical consultation has been recommended by some [11,13]. Although a severe injury is probably more likely when larger volumes are involved, most patients with large volume extravasation do not develop severe complications, even when distal to the elbow [13]. Because of this, surgical consultation should be based on signs and symptoms rather than an absolute volume threshold. If the patient is asymptomatic or has only mild symptoms, appropriate evaluation and clinical follow-up are usually sufficient.

Discharging Patients in Whom Extravasations Occur

Outpatients who have suffered contrast media extravasation should be released from the radiology department only after an initial period of observation, provided the radiologist is satisfied that any signs and symptoms that were present initially have improved or that new symptoms have not developed during the observation period. Clear instructions should be given to the patient to seek additional medical care for severe pain, progressive pain, numbness or tingling, diminished range of motion (active or passive), skin ulceration, or other neurologic or circulatory symptoms [22]. This is because initial symptoms of a serious compartment syndrome may be absent or relatively mild (such as limited to the development of focal paresthesia) [18].

Other Considerations

Patients at Increased Risk for Extravasations

Extravasations are more common in patients who cannot communicate effectively (e.g., the elderly, infants and children, and patients with altered consciousness), severely ill or debilitated patients, and patients with abnormal circulation in the limb to be injected [32]. Patients with altered circulation include

those with atherosclerotic peripheral vascular disease, diabetic vascular disease, Raynaud's disease, venous thrombosis or insufficiency, or prior radiation therapy or extensive surgery (e.g., axillary lymph node dissection or saphenous vein graft harvesting) in the limb to be injected. Women may have a mild increased risk of extravasation [23]. Some of these conditions are systemic and cannot be avoided by choosing a different injection site.

Certain intravenous access sites (e.g., hand, wrist, foot, and ankle) are more likely to result in extravasation and should be avoided, when possible [1, 8, 33]. However, use of these alternate injection sites may be necessary due to lack of availability of the more traditional locations.

In some studies, extravasations were more common in patients injected through small-bore (22 gauge) catheters compared to larger-bore catheters (2.2% versus 1.0-1.1%) [1].

While some reviews have found that injection at higher flow rates likely increases the risk of extravasation [8], in others, no such difference has been detected [1,35]. In fact, it has been shown that flow rates of up to 3 and 5 mL/sec can be safely achieved through 22 gauge and 20 gauge intravenous catheters, respectively, in the vast majority of patients, provided that there is no increased resistance or pain during a rapid test injection [34].

Patients injected with more viscous contrast material may be more likely to have extravasations than are patients injected with less viscous contrast material [6,8,35]. This effect may be mitigated for viscous media by extrinsic warming to human body temperature prior to injection [35].

The risk of extravasation also appears to be increased in patients in whom deep brachial intravenous access is achieved under ultrasound guidance, a practice used more often in Emergency Departments for patients in whom IV access is otherwise difficult [36]. In one series, contrast media extravasation occurred during CT in 0.3% of all patients, but in 3.6% of patients who were injected through ultrasound-guided peripheral intravenous catheters [37]. That difference is likely in part due to selection bias (patients requiring ultrasound-guided access likely have more difficult venous access).

Extravasation Risk of Injection through Indwelling Central Venous Catheters

All central venous catheter port sites can be utilized for venous access if gentle hand injections are performed; however, only certain central venous catheter port sites are certified for use with mechanical injectors. Prior to using a central venous line for power injection, it is important to ensure that the port site is certified as power-injectable, and the flow limit should be noted. If this process is followed, it can be safe. In one report of 142 injections through certified power port sites (11 at high rates up to 5 mL/second), there were no extravasations [38].

Mechanical injections can also be performed through some pressure-injectable peripherally inserted central catheters (PICCs). Manufacturer recommendations should be followed. There have been isolated reports of PICC tip migrations following pressure injections through these catheters [39].

Patients at Increased Risk for a Severe Extravasation Injury Once an Extravasation Occurs

A severe extravasation injury may be more likely to result from an extravasation in certain patients, such as those with arterial insufficiency or compromised venous or lymphatic drainage in the affected extremity. In addition, extravasations involving larger volumes of contrast media and those occurring in the dorsum of the hand, foot, or ankle are more likely to result in severe injury [22, 32].

Preventing Extravasation Injuries

Methods for reducing the risk of extravasation include: meticulous intravenous line insertion technique, using angiocatheters instead of butterfly catheters, confirming position by aspirating blood (although failure to aspirate blood does not exclude the possibility of proper catheter location), flushing an inserted catheter with a test injection of saline to ensure proper flow into the accessed vein, and carefully securing the inserted catheter [41].

Low-risk intravenous line insertion sites are preferred when feasible. If not feasible, higher risk sites may be considered depending on the risks and benefits of administering contrast media for the examination indication. Use of a preliminary saline flush to assess injection pressure prior to contrast media administration has been advocated by a few investigators [41]; however, this has not been adopted by most institutions. Some have recommended use of a hand-held alarm, which the patient can press should any new symptoms develop [12]. Interestingly, the practice quality improvement project created by the ACR to assist practices in identifying improvements that could be made to reduce the frequency of extravasations did not find that any significant improvement could be achieved, even when risk factors for extravasations were identified and attempts were made to reduce the extravasation risk in advance [7].

Documentation

All extravasation events and their treatment should be documented in the medical record. In addition, the referring provider should be notified following any symptomatic extravasation.

Revision History

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