JOANNA BRIGGS INSTITUTE

Diagnostic Imaging

Best Practice

Evidence-based information sheets for health professionals

Risk factors and effectiveness of interventions in the reduction of contrast media extravasation

Recommendations*

- Inpatient status, recent hospitalization episode, intravenous drug use and female sex are the most likely factors indicating a risk of extravasation. (Grade B)
- A new catheter should be inserted to decrease the volume of extravasate. (Grade B)
- Where possible venous access should be obtained in the antecubital fossa to reduce extravasation rate. (Grade B)
- An extravasation detection accessory may be used to decrease the volume of extravasate. (Grade B)
- Warming the contrast agent iopamidol 370 (Bracco Diagnostics) to 37oC may reduce the risk of extravasation. (Grade B)

**For a definition of JBI's 'Grades of Recommendation' please see the last page of this sheet*

Information source

This Best Practice Information Sheet is a summary of evidence derived from a systematic review published in 2018 in the JBI Database of Systematic Reviews and Implementation Reports.[1]

Background

Computed tomography (CT) examinations are continuously increasing in use because of population ageing and technological improvements enhancing sensitivity and specificity in the diagnosis and monitoring of many pathologies. A majority of CT scans need an intravenous (IV) injection of contrast medium in order to enhance tissue differentiation or image vascularization, however adverse reactions from the contrast medium injection can occur.

Accidental leakage of injected fluid into the surrounding tissue (i.e. extravasation) is a well-recognized complication to contrast medium injection, which occurs in about 1% of patients. Adverse effects related to extravasation are generally mild (e.g. inflammatory reactions) but cause pain and discomfort to the patient that may persist in the long term. Major adverse reactions such as skin ulceration, soft-tissue necrosis, and compartment syndrome have also been documented. The occurrence of an extravasation requires close follow-up of the patient, as the symptoms may appear several hours after injection and may persist for a long period. The treatment of serious extravasation may involve surgical fasciotomy, skin grafting or amputation.

Additional delays and complications may occur in case of an extravasation such as the CT scan may be hindered and a new IV access must be secured, causing additional stress to the patient. The CT scan may even need to be repeated, which exposes the patient to additional ionizing radiation. These procedures have non-negligible financial and social implications.

Certain patient characteristics may be associated with an increased risk of extravasation such as venous thromboembolism, cancer, diabetes mellitus, or altered communication. Additionally, some intervention strategies may affect the risk of extravasation. These are related to the characteristics of the contrast media (e.g. concentration, viscosity, temperature, and rate of administration), apparatus used for injection (e.g. catheter gauge, extravasation detection device, and ultrasound) and the injection technique (e.g. venous access). Similarly, healthcare provider qualification and training may affect the risk of extravasation.

In this context, knowing the risk factors and intervention strategies to limit the frequency and volume of extravasation is important to improve patient care.

Risk factors and effectiveness of interventions in the reduction of contrast media extravasation

Objectives

The purpose of this Best Practice Information Sheet is to present the best available evidence regarding the identification of risk factors and interventions preventing or reducing contrast media extravasation in patients undergoing CT examination.

Types of intervention

The review considered studies that included patients admitted for CT scan with IV injection of contrast agents. It did not explore studies involving extravasation in the context of chemotherapy, anesthesia, or parenteral nutrition.

Patient demographics, comorbidities and medication history were the risk factors investigated in this review. Consideration was also given to any strategies related to: contrast media (e.g. temperature, concentration), injection per se (e.g. venous access, injection rate), material (e.g. catheter gauge) and apparatus used for injection (e.g. extravasation detection accessory), healthcare professionals performing the injection (e.g. skill level), and patient risk assessment performed by the radiology staff. Outcomes studied were extravasation rate, volume or severity and image quality.

Quality of the research

A total of 15 included papers (two randomized controlled trials and 13 quasi-experimental or observational studies) were independently evaluated by the reviewers using JBI's standardized assessment tools and criteria. For the randomized trials, the quality was moderate with scores of seven and eight out of 10. The quality of the other studies was lower (ranging from three to seven out of nine). The outcome measurements were reliable, performed over a sufficient period of time and in agreement with clinical practice.

Findings

Risk factors

Based on the findings of single studies, higher risks of extravasation were detected in inpatients compared to outpatients (p<0.0001), in patients who were recently hospitalized (adjusted odds ratio: aOR=2.0; 95% CI: 1.3-3.1) or with a history of IV drug use (aOR=5.8; 95% CI: 1.7-19.9). There were similar risks of extravasation noted when comparing patients from a cancer center to those from an outpatient center.

Two studies presenting data related to patient gender were synthesized into a meta-analysis and included 356,582 participants. A higher extravasation rate was detected in women (p<0.001), compared to men (OR: 1.37; 95% CI; 1.15-1.64). This finding was supported by a separate study not included in the meta-analysis showing women were at increased risk with an aOR of 1.8 (95% CI: 1.1-2.9). Gender and age did not seem to impact the extravasated volume.

The findings of a single study demonstrated extravasation occurred more frequently in older patients (>50 years: 1.4%) compared to younger patients (≤50 years: 0.6%; p=0.019). However, in another study, the extravasation rates were not significantly different: 0.12% (18 to 60 years) and 0.14% (>60 years; p=0.12).

Interventions

Cannula

The extravasation frequency did not seem to differ between fenestrated and non-fenestrated catheters. Nor did the type of catheter change the extravasated volume and image quality. Four studies investigated the effect of cannula sizes, among which, one showed more extravasations with a 22G catheter (2.2%), compared to 20G (1%) and 18G (1.1%; p<0.05). The other studies demonstrated no significant effect; the catheter tested in these studies were 18-20G, 20-22G, and 16-18-20-22-24G. The extravasated volume was not significantly different between the size of the catheter, 18G (59.7mL), 20G (50.5mL) and 22G (29.7mL; p=0.14).

Manual versus power injection

There was no significant difference in extravasation rate between power and manual injection (0.3% vs. 0.2%).

Infusion rate

The infusion rate had no effect on the extravasation frequency, reaction to contrast media and image quality. Furthermore, the findings reported on extravasation volume differed with one study demonstrating an increased volume with a faster injection rate and the other study an increased volume with a slower injection rate.

Ultrasound guided intravenous catheter insertion (USGIV)

Catheter insertion with USGIV increased the extravasation frequency (3.6%) compared to without (0.3%), but not the severity of extravasation (relative risk = 0.71, 95% CI: 0.25-2.00). This result should be interpreted cautiously because of the non-random selection of the participants.

Venous access location

When venous access was the dorsum of the hand, more extravasations were observed (1.8%; 13/725) compared to the antecubital fossa (0.8%; 23/2751; p=0.018). The extravasation rates for other venous access sites were 1.6% (16/975: forearm) and 0% (0/26: foot). Care must be taken when interpreting these results due to the different constitutions of the groups. Injection on the hand could reduce the extravasated volume, compared to the antecubital fossa (respectively 23.9mL and 55.1mL; p<0.05).

Warming of contrast media

Warming of the contrast medium iopamidol 370 (Bracco Diagnostics) decreased extravasation frequency (0.87% vs. 0.27%; p=0.05) but not the volume (43mL vs. 47mL). For iopamidol 300, neither the extravasation rate (0.23% vs. 0.30%) nor the volume (56mL vs. 49mL) were significantly modified with warming.

Health professional

The extravasation frequency was not modified by the experience of the health professional administering the media (medical students: 1.2%, staff radiologists: 1.1%, interns: 1.3%) nor by its affiliation to the radiology department (0.2 vs. 0.3%).

Catheter dwelling time

A reduction of the extravasated volume was achievable through a newly inserted catheter (63.1 ± 44.5 mL), as compared to the use of a pre-existing one (40.6 ± 37.9; p=0.0005).

Practice quality improvement project

A quality improvement project, including the distribution of educational materials, showed a non-significant reduction in the extravasation rate (0.28%: 469/166193 vs. 0.23%: 374/163100); volumes and injury severity were not impacted.

Extravasation detection accessory

The use of an extravasation detection accessory reduced the volumes of extravasate (p=0.05).

Conclusions

The included studies investigated the risk factors to extravasation and interventions to prevent or reduce extravasation. Although the studies were judged to be of medium to low quality, these studies provide evidence that some patient characteristics may constitute risk factors for extravasation. Accordingly, health professionals should be aware of these risks factors. This systematic review also highlights some strategies that could decrease extravasation risk, volume, injury severity and reaction to contrast media. Some studies assessed image quality but not the effect of the interventions on patient workflow. This review highlights the importance of conducting more research on the prevention and reduction of extravasation.

Implications for practice

Health professionals should be aware of potential risk factors that place the patient at increased risk of extravasation, and where possible reduce the occurrence of extravasation through the use of appropriate interventions. The following characteristics place the patient at increased risk: inpatient status, recent hospitalization episode, intravenous drug use and female sex. To reduce the extravasation volume, the use of an extravasation detection accessory, as well as the insertion of a new catheter are strategies worth pursuing. The venous access in the antecubital fossa may decrease the extravasation frequency, whereas venous access in the hand may diminish the volume of the extravasation. The use of the iopamidol 370 contrast medium warmed to 37°C relative to its use at room temperature may decrease the extravasation rate. See **Figure 1**.

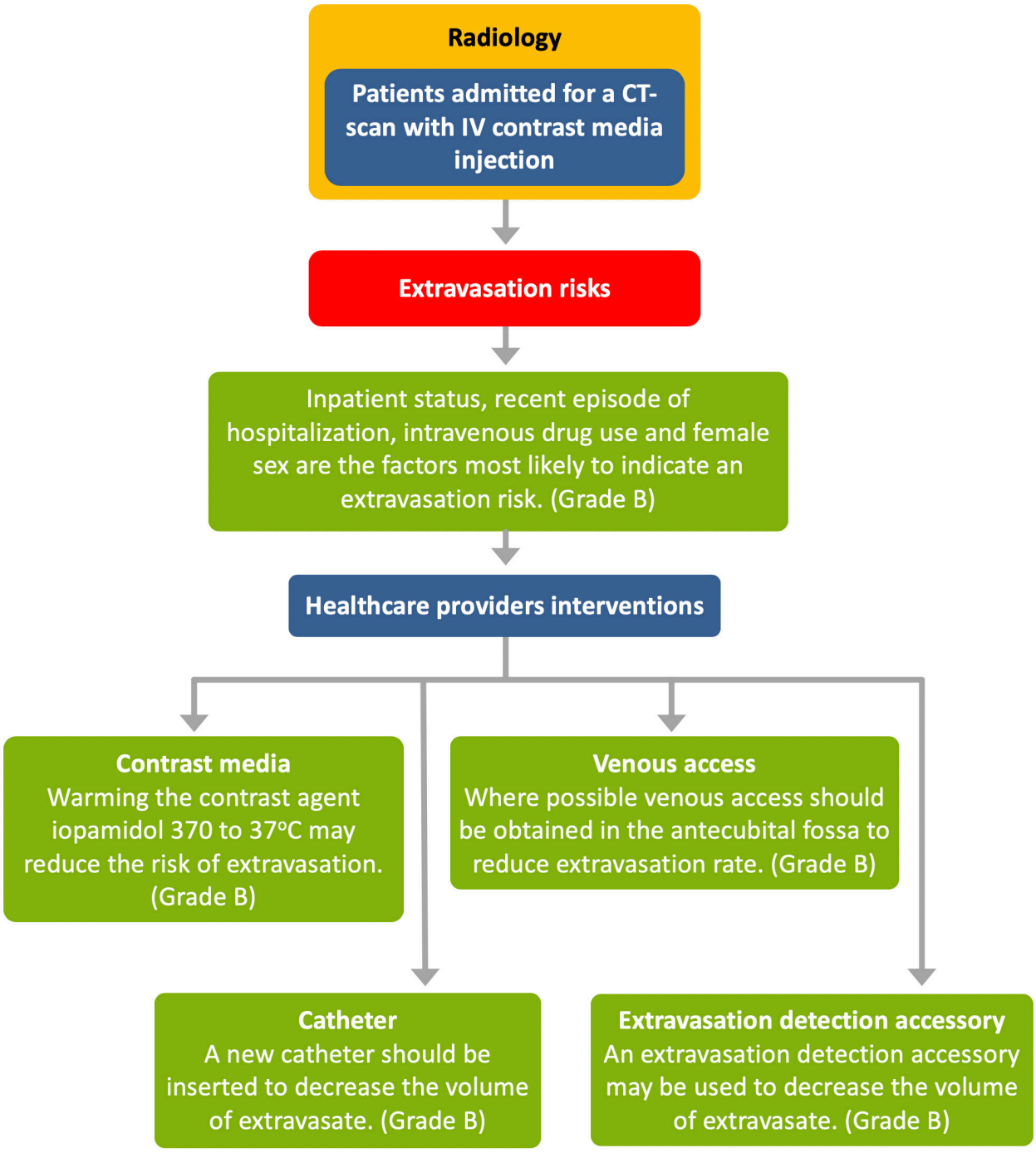

Figure 1: Risk factors for extravasation and health professional interventions

Participants	A participant/actor e.g. specific health care professional, a patient group or carer. May include presentation	Action	A suggested action that can be taken as well as a grade of recommendation
Condition/Diagnosis or Presentation	A condition or diagnosis e.g. 'acute wound' or specific condition that has arisen e.g. 'infection'	Context	A specific context or situation e.g. 'emergency ward' or 'remote health clinic'

References

1. Ding S, Richli Meystre N, Campeanu C, Gullo G. Contrast media extravasations in patients undergoing computerized tomography scanning: a systematic review and meta-analysis of risk factors and interventions. JBI Database System Rev Implement Rep. 2018;16(1): 87-116.

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