An audit of contrast extravasation in patients undergoing contrast enhanced CTs at radiology department in a tertiary care hospital in Pakistan

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Abstract

Objective: To audit the radiology department of a health facility, focusing on contrast extravasations management pre- and post-implementation of a standard protocol.

Methods: The audit was conducted at the Radiology Department of Shifa International Hospital, Islamabad, Pakistan and comprised reported computed tomography contrast extravasation incidents from January 2017 to December 2019 in the retrospective phase before the implementation of a standard protocol. Post-implementation, re-audit was done prospectively to assess compliance from January 2020 to May 2021. Overall score of >80% was chosen arbitrarily as a qualifying standard for adequate documentation.

Results: Of the 49 total cases, 26(53%) related to the first phase and 23(47%) to the second. In the first phase, 2(20%) of the 10 parameters cleared the cut-off mark; 'study performed' 25(96%) and 'limb assessment by technician' 26(100%). In the second phase, 2(20%) parameters failed to clear the cut-off mark; site of cannula/extravasation' 18(78.3%) and 'volume of contrast' 15(65%).

Conclusion: Lack of early identification and appropriate management, especially in cases of large-volume extravasation, may result in significant morbidity.

Keywords: Contrast extravasation, Contrast-enhanced CT, IV contrast media. (JPMA 72: 1603; 2022)

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Introduction

Contrast extravasation is a not an uncommon complication resulting from contrast-enhanced conmputed tomography (CT) imaging, especially on using an automated power injector to deliver the contrast.[1] Paediatric and geriatric groups with debilitating conditions are at a greater risk.[2] Female gender has been reported to have greater predilection as well, especially those with morbid obesity. Fortunately, a large number of contrast extravasations result in mild swelling over the cannula site with induration.[1] However, it can lead to a potentially limb-threatening event, and ensuring adequate patient assessment and management following this adverse clinical event is essential to prevent lethal limb damage.[2,3]

Timely identification of moderate to severe extravasation and appropriate referral within 4 hours can reduce the risk of debilitating complications.[3,4]

There was an increased number of reported CT contrast extravasations notice at the site of the current study in 2019 which prompted a search for causative factors and the need for departmental audit in order to meet the international standards. Though incident reporting and documentation had significantly improved after Joint Commission International accreditation (JCIA), inefficient staff response and confusion was identified regarding how to deal with contrast extravasation.

The current study was planned to audit the radiology department, focussing on contrast extravasations management pre- and post-implementation of a standard protocol.

Materials and Methods

The audit was conducted at the Radiology Department of Shifa International Hospital, Islamabad, Pakistan, and comprised reported CT contrast extravasation incidents from January 2017 to December 2019 in the retrospective phase before the implementation of a standard protocol. Post-implementation, re-audit was done prospectively to assess compliance from January 2020 to May 2021. After approval from the institutional ethics review committee, the audit covered the entire period since the first reported case of contrast extravasation in the department.

The target was to meet certain standards and to evaluate documentation which have been agreed upon at the study site in the light of American College of Radiology (ACR) contrast media guidelines[5] and the Patient Care Report (RCR) audit template.[6] Overall score of >80% was chosen arbitrarily as a qualifying standard for an adequate documentation.

The standards stipulated that contrast extravasation

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should be reported and recorded in the incident register as adverse incidents; examination of patient must be done by healthcare professional/physician; site of extravasation, volume and flow rate of contrast media must be mentioned; assessment of limb either as diagram or written description, must be documented; management, and appropriate referral to plastic surgery must be documented; and discharge with advice must be documented.

An effort was made to identify the factors which lead to

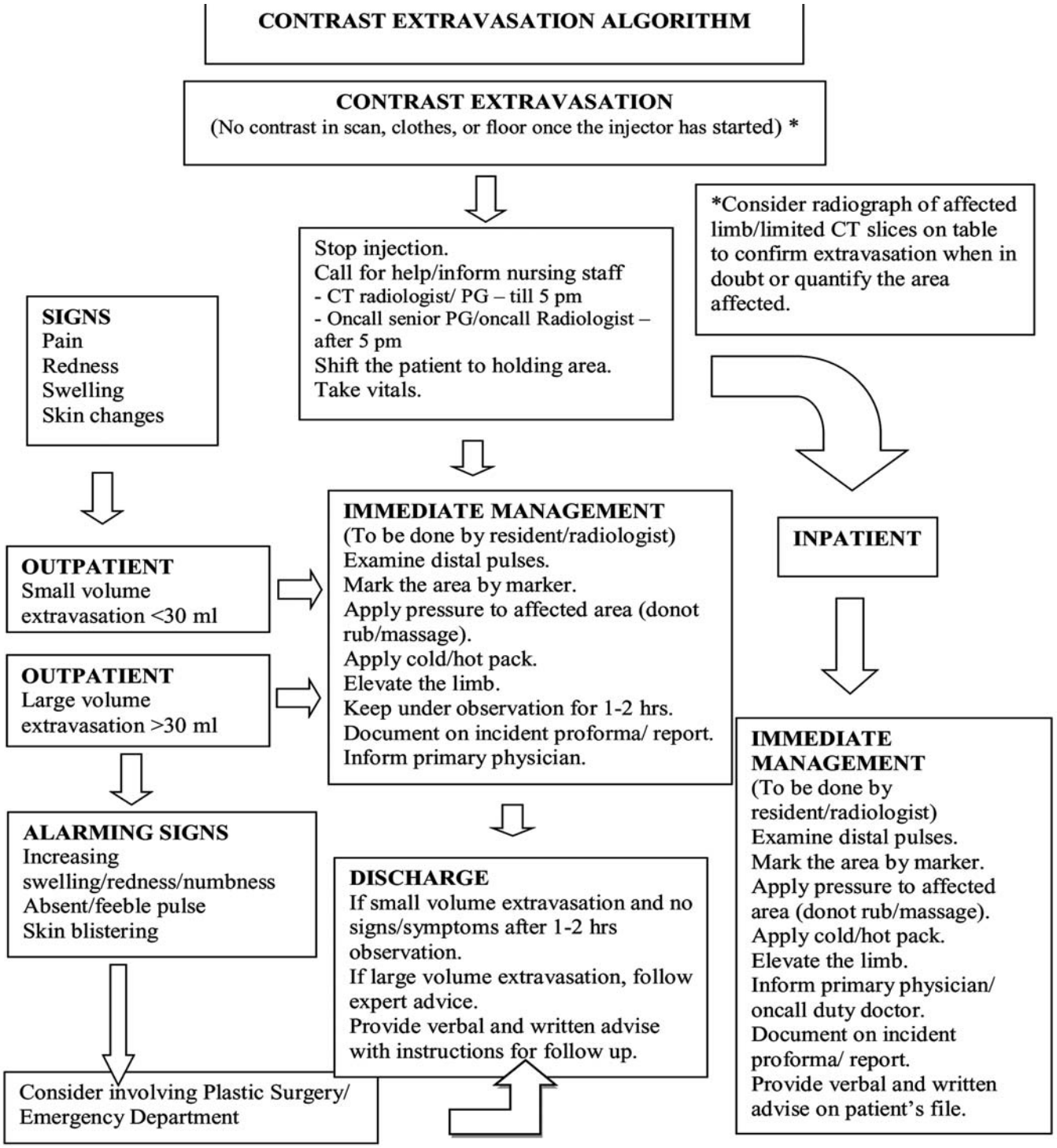

Figure-1: Contrast extravasation algorithm.

contrast extravasation, like pressure of power injector, flow rate/dose of the contrast injected, patency of intravenous (IV) cannula, and insufficient staff knowledge regarding assessment and management of contrast extravasation.

The following strategic protocols were introduced:

Informed consent of patient and briefing regarding risk of contrast extravasation and potential complications with management, prior to postcontrast CT examination in the history room.

The IV cannulas older than 72 hours were replaced. Standardised 18G or 20G IV cannulas were placed at antecubital fossa, especially for angiographic CT studies. The CT contrast media was placed on a heater, especially during the winter season, to maintain contrast temperature at 37 degrees Centigrade.

The maximum pound-force per square inch (PSI) of automated injector was set at 325.

CT technologist closely monitored the patient starting from visual examination of the cannula site, giving test dose of 10ml normal saline and flushing it out, and examining the skin for any induration or swelling from auto-injection of the contrast media followed by beginning of CT scan till 5-15min of the completion of examination.

If during the procedure, no contrast was seen in the CT scan slices, on patient's clothes or the floor, it was assumed that contrast extravasation had occurred. The scan was stopped and an emergency response protocol for CT contrast extravasation was initiated (Figure-1).

If on examination of the patient's affected limb, no apparent evidence of contrast extravasation was seen due to anasarca, subfascial/intra-compartmental extravasation, absence of pain or the patient being unconscious, or if there was a large volume of contrast extravasation, with no evidence on the already performed CT slices, the procedure was continued as limited CT to confirm and mark the affected area.[7]

Use of contrast extravasation kit was placed in the patient holding area, as advised by the radiologist with the help of the nursing staff, which contained hydrocortisone cream/injection, dexamethasone ampoule, 25ml sodium chloride (NaCl) IV, alcohol wipes, sterile gauge, marker, gloves, and hot/cold packs.

A vein finder was installed (Accu vein AV500) to ease IV cannulation process and to limit the risk of extravasation, especially in elderly patients with thin fragile veins. Separate meetings were conducted along with power-point presentations and practical demonstrations for residents/radiologists, radiographers/technicians dealing with CT and magnetic resonance imaging (MRI) scans, and nursing aides detailing contrast extravasation, its management and how to follow the emergency response protocol. Detailed flowsheets were pasted on notice boards in the CT console room, holding area and history room for the ease of staff.

In the second prospective phase post-implementation of the target standards, re-audit was done to assess compliance through analysis of documentation and medical records from patient files.

Data analysis was done using descriptive statistics for qualitative and quantitative variables with the help of Microsoft Excel 365 software.

Results

Of the 49 total cases, 26(53%) related to the first phase and 23(47%) to the second. The overall patient age ranged 14-90 years. Of the 49 cases, 24(48.9%) were males and 25(51.02%) were female patients. In the first phase, 3(0.061%) cases each were reported in 2017 and 2018, while 20(40.8%) cases were reported in 2019. Post-implementation, there were 17(36.7%) cases in 2020 and 6(0.122%) till May 2021. In 2019, there were a total of 32396 CTs performed, and 20(0.061%) incidents of contrast extravasations were reported compared to 32396 CTs and 17(0.052%) reported contrast extravasations.

Of the 49 contrast extravasation cases, 17(34.7%) had dynamic CT, 18(36.7%) had CT angiographic studies and 14(28.6%) had single post-contrast venous studies. All 49(100%) patients were held under observation in the department's holding area under the supervision of a dedicated nursing aide. In the first phase, 18(69.2%) patients received ice pack and limb elevation as the first line of management, but in the second phase, all 23(100%) received it. In the first phase, data mentioned 3(11.5%) plastic surgery consultations, but the volume of contrast media extravasation and the details of the consultations were not mentioned. In the re-audit, data mentioned 3(13%) plastic surgery consultations with adequate details showing large volume extravasations >30ml of contrast. In 1(2%) case, the patient had to undergo suction and saline flush-out to counter extravasation of 80ml volume. On follow-up no complications were seen in the said patient. In the first phase, 2(20%) of the 10 parameters cleared the 80% cut-off mark; 'study performed' 25(96%) and 'limb assessment by technician' 26(100%). In contrast, in the second phase, only 2(20%) parameters failed to clear the cut-off mark;

Table: Standard documentation as per Patient Care Report (RCR) and American College of Radiology (ACR guidelines).[5,6]

Documentation Parameters	First Study Period N=26 (%)	Second Study Period N=23(%)
Patient details	17(65%)	19(82%)
Study performed	25(96%)	23(100%)
Site of cannula/extravasation	7(26.9%)	18(78.3%)
Flow rate	4(15%)	23(100%)
Volume of contrast	5(19%)	15 (65.2%)
Reviewed by Radiology Resident/consultant	20(76%)	23(100%)
Limb assessment by Technician	26(100%)	23(100%)
Limb assessment by Resident/ Consultant	1(3%)	23(100%)
Management details	25(96.1%)	23(100%)
Discharge details	14(53.8%)	20(86.9%)

site of cannula/extravasation' 18(78.3%) and 'volume of contrast' 15(65%) (Table).

Discussion

The audit found a lot of discrepancies in documentation and patient management in the incident record in the first study period, which warrants a strong suspicion of underreporting hugely based on the stigmata among CT technicians that in the event of extravasation, they are to blame. There was lack of awareness regarding proper documentation among the radiology residents as well. These issues were addressed and found to be rectified in the re-audit, but there was still lag in documentation regarding volume of contrast media injected and site of cannulation/extravasation by technicians and residents both.

Extravasation of CT contrast media is an uncommon occurrence with non-ionic low osmolar contrast media.[8,9] Contrast media that are concurrently being used in the study site in order of decreasing frequency are iohexol (Kopaq 350, Omnipaque 350) and iopromide (Ultravist 370), which are low osmolar contrast media. The frequency of contrast extravasations was 0.061% and 0.052% in 2019 and 2021, which is less than the rates reported in earlier with the use of an automated power injector (0.25-0.7%).[1,2]

Common complications resulting from extravasation of contrast media include localised pain, skin induration, oedema, necrosis or, rarely, compartment syndrome.[10,11] Majority of mild to moderate cases can be treated conservatively by icing the affected area and elevating the limb.[12] There is, however, no data supporting the efficacy of icing over warm compress, and both may serve the same purpose of alleviating the limb swelling by the former due to pain relief and increasing the blood circulation by the latter with improved absorption of

PATIENT INCIDENT NO.		
DATE		
NAME		
MR NO.		
AGE/GENDER		
REFERING PHYSICIAN		
MODALITY		
STUDY		
CANNULATON SITE	☐ ANTECUBITAL ☐ DORSUM HAND ☐ LOWER LIMB ☐ CENTRAL LINE	
CONTRAST AGENT		
CANNULA GAUGE		
VEIN FINDER		
FLOW RATE		
VOLUME OF CONTRAST EXTRAVASATED		
EXAMINATION TO CONFIRM EXTRAVASATION	☐ RADIOGRAPH	☐ LIMITED CT
SITE MARKED ON SKIN	☐ YES	☐ NO
SIGN / SYMPTOMS	PAIN SENSATION SKIN COLOUR PULSES	
MANAGEMENT		
PLASTIC SURGERY INTERVENTION	CONSERVATIVE OTHER TREATMENT (specify)	
DISCHARGE		
DOCUMENTATION ON CLINICAL REGISTER	☐ COMPLETE	☐ INCOMPLETE
TECHNOLOGIST		
RESIDENT		
RADIOLOGIST		

Figure-2: Contrast extravasation proforma to be filled in for every incident.

extravasation.[13] Only patients with large-volume contrast extravasation may benefit from a plastic surgery intervention. The indications for specialist intervention are increasing pain, numbness, change in skin colour surrounding the site of extravasation in the involved limb, or compartment syndrome.[4,5,14] Only few patients required plastic surgery consultation in the current patient cohort, with the majority having been managed conservatively, and only one patient was treated with saline flush-out.[15] This is consistent with literature review.[2,6,9,16]

There were a lot of discrepancies and missing data in the first-phase audit regarding contrast extravasations, but in the second phase 100% compliance with most of the set standards was noted. There was still <80% compliance reported in documenting the exact contrast volume, seen in earlier months of 2020, which is probably attributed partly to the fact that emergency response to contrast extravasation was new to some of the technical stuff and

residents which took them time to properly adopt it and learn the details of documentation since it is an infrequent occurrence. The second parameter with lag in compliance percentage was documentation of the site of extravasation, a pure human error, as it was documented accurately in 18 (78.2%) cases.

The limitations of the current study are that the findings are entirely dependent on the documentation, as there was no other way to confirm or refute these. Also, the study is unable to accurately state whether all these preventative measures had actually reduced the rate of contrast extravasations or not. Additionally, there are no records currently available to show in which patients the vein finder was used for IV cannulation. This requires an annual intra-department audit with the help of a proforma-based survey that has been designed for the department (Figure-2) to ensure that performance benchmarks are met with consistency for quality assurance as well as to reduce the causative factors.

Based on the current findings, a specialist review must be obtained for any patient showing signs of limb compromise, especially in large-volume >30ml extravasation. The rest of the cases can be managed conservatively and sent home with clear instructions regarding when to consult emergency services.

Conclusion

Curtailing the risk of contrast media-related reactions, including extravasation, following post-contrast injection in a patient undergoing CT scan is a key element of clinical risk management and assessment in radiology departments. Lack of early identification and appropriate management, especially in cases of large-volume extravasation, may result in significant morbidity and permanent damage to the patient. Hence, setting up predefined departmental policy and guidelines are imperative to safeguard patient care and reputation of the department.

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