A Case Report of Moderate Iodinated Contrast Agent Extravasation and Review of the Literature

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Ethical Statement
This study protocol was approved by the Ethical Committee of Tongji Medical College, Huazhong University of Science and Technology, and the patient in this case signed an informed consent form.

Conflict of Interest
There is no one who has conflict of interest related to this manuscript.

Consent
Yes

ABSTRACT

This article encapsulates the nursing methodologies and encounters in managing a case of moderate intravenous extravasation of iodinated contrast media, with the objective to furnish references for diminishing the incidence of intravenous extravasation of iodine contrast media and mitigating the accompanying tissue injury.

Enhanced CT, predicated on conventional CT plain scanning, involves the instantaneous bolus infusion of iodinated contrast media (ICM) into peripheral superficial veins via a high- pressure injector. The ICM subsequently transits through the peripheral circulation to reach the target lesion site. By leveraging the differential phagocytosis of ICM between normal tissues and pathological areas, this technology facilitates the qualitative detection and differential diagnosis of abnormalities [1]. In instances where the ICM fails to enter the intended vessel and is instead disseminated into the perivascular tissue, which is defined as intravenous extravasation of ICM, it may precipitate local tissue complications such as pain, swelling, bulla formation, secondary wound infections, abscesses, tissue adhesions, compartment syndrome, and, occasionally, amputation [2,3]. Literature [4] has previously delineated a grading system for ICM-induced extravasation injuries: (1) Mild: characterized by pain, inflammation, minor erythema, and mild to moderate edema solely; (2) Moderate: featuring moderate to severe erythema, bulla formation, persistent pain, or other wounds necessitating additional therapy, with all symptoms subsiding within two weeks; (3) Severe: manifesting by profound erythema, blistering, persistent pain and swelling, skin discoloration, tissue necrosis, necessitating additional therapies or surgical intervention. Irrespective of its severity, ICM extravasation detrimentally affects patients' physiological and psychological health, potentially culminating in extensive hospitalization and elevated costs. Hence, scholars globally have directed significant attention to investigating the injuries inflicted by ICM extravasations, identifying influencing factors, formulating intervention strategies, and devising preventive measures, yielding an abundance of research achievements [5]. Recently, a case of moderate ICM extravasation occurred at our institution, which, subsequent to proactive nursing interventions, resulted in a positive prognosis for the patient. The specifics of the case and the implemented interventions are detailed as follows.

CASE REPORT

BACKGROUND

The article has significant importance in various aspects, covering positive impacts on medical practice, patient safety, and the development of the discipline in multiple dimensions:

1. Enhancing clinical healthcare professionals' awareness of contrast media extravasation, improving their ability to identify and recognize risks.
2. Summarizing best practices to optimize and refine the prevention and management measures for contrast media extravasation.
3. Reducing patient suffering, ensuring patient safety, and improving the quality of healthcare.
4. Promoting academic exchange and the development of the discipline, expanding the research field of contrast media extravasation.

Clinical Data

A 64-year-old female patient was admitted to the hospital due to bilateral lower limb edema. Prior to undergoing a multi-layer adrenal CT scan with contrast enhancement, the ward's responsible nurse placed an 18G indwelling venous catheter on the patient's right wrist, with the needle inserted halfway and the dressing properly secured. Before the examination, the nurse in the CT room inquired about the patient's allergy history and medical background. After confirming the patency of the indwelling needle, the nurse programmed the high-pressure injector according to the Tongji Index [6], setting the injection rate of the contrast medium at 3.5 ml/s with a total volume of 68 ml. A saline preload of 18 mL was administrated, maintaining a normal <300 psi pressure gauge reading. However, while administering the contrast medium of Lomeprol (Shanghai Bracco Sine Pharmaceutical Corp., Ltd.), extravasation ended the scan prematurely. Upon examining the patient in the CT room, visible swelling, discomfort, and pain were discovered on her right hand/wrist region due to extravasation, classified as Grade 2 on established scales. Following aspirating the fluid, the indwelling needle was removed, and Hirudoid Cream was gently applied, followed by limb elevation and a fresh puncture on the left upper arm. Examination resumed; post-procedure, the bedside nurse patiently educated the patient's kin and provided appropriate guidelines, including a contact phone number. Immediate post-scan monitoring and limb observation were advised. Back in the ward, the patient and family bid the bedside nurse farewell.

Patient care plan includes: (1) On first day of extravasation: Continuous application of Hirudoid Cream and use of ice packs on right arm and fingers. Due to limited mobility caused by swelling, right forearm is raised using a comfortable pillow at 15° to 30°. Patient reports painful forearm; per doctor's instructions, 50mg Pethidine injected and 5mg Dexamethasone administered IV. Small blisters appear on wrist, with the largest measuring about 2cm × 3cm. Skin color turns darker red and skin temperature rises. Liquid in blisters is extracted then alternating cold compresses with 0.05% Dexamethasone and 50% magnesium sulfate applied [7,8]. The Intravenous Therapy Specialist Team suggests applying ConvaTec Aquacel Hydrogel (Wound Dressing Gel) over aspirated blisters [9], covered with cling film. The patient's wrist status is illustrated in figure 1. (2) Second-day extravasation: Swelling remains unchanged despite repeated Pethidine injections. Surgical consultation for possible compartment syndrome is arranged [10]. Medical order for 125ml 20% Mannitol IV is implemented [11]. Blisters on hand and wrist increase in size so they're aspirated, cleaned with wound cleansing gel, and bandaged with Silver Sulphadiazine lmpregnated Hydrocolloid Dressing and cling film [12]. The limb is kept elevated and physical therapy for joints is encouraged [13]. The updated wrist status can be seen in figure 2. (3) Third-day extravasation: Swollen right forearm improves, wrist blisters decrease. Same care measures continue. Upgraded wrist condition depicted in figure 3. (4) Forth-day extravasation: Noticeable improvement in swelling, further reduction in blisters. Same-day nursing care methods maintained. An improved wrist situation is presented in figure 4. (5) Fifth-day extravasation: Slight puffiness persists on right forearm, no additional blisters on wrist or hand. Consistency with previous day's care preserved. Progressed wrist picture is accessible in figure 5. (6) Sixth-day extravasation: Swellings on right arm recede, wrist and hand skin starts to heal. rhEGF spray is applied to expedite wound healing. Postoperative wrist photograph is depicted in figure 6. (7) Seventh-day extravasation: Wounds on hand and wrist are healing nicely, swelling disappears. At subsequent checkup one month later, wound is fully healed except for mild skin pigmentation.

DISCUSSION

ICM bolus injection during enhancement CTs is a crucial diagnostic tool. Despite its clinical significance, risks such as ICM leakage might occur due to a variety of reasons like health status, vascular issues, venipuncture location, equipment used and speed of injection.

Our review identified several potential triggers associated with your ICM extravasation incident: (1) physiology factors: elder persons, with thinned subcutaneous tissue and damaged vasculature, face elevated risks. Aged individuals, particularly above 60, display thickened intima, constricted lumens, tough/ hardened vessel walls, reduced elasticity, and diminished strength [14,15]. High-pressured shots might strain these vessels further, causing leaks. Your gender, aside from being female, affects vessel size; studies hint that women tend to have smaller, winding blood vessels compared to men [16]. Subclinical health issues add to the risk - you currently battle hypertension, bilateral leg swelling, and sluggish blood flow [17]. Environmental factors also play a part; researchers state that hypertensive individuals, Coronary heart patients, obese or malnourished individuals, diabetics, patients with dermatological disorders, and limited blood supply might face enhanced vulnerabilities [17]. (2) Nursing management: The chosen vein, a handback, was listed among the more risky choices by Wienbeck S et al., who noted leakage on the dorsum of the hand [18,19]. The ICM substance (Lomeprol 400), whilst thick, could disrupt circulation and provoke venous endothelial cells' irritation. During low-bore catheter application, the forceful

injection could produce substantial resistance, heightening the chance of leakage [14]. □ The absence of an ICM extravasation alarm mechanism contributed to the mishap [20]. □ Rapid dose administration under high-pressure presented challenges; non-fluid arrest during detection of extravasations was essential [22], and a lower flow rate should be adopted for high-risk patients [23]. Thus, increased extravasated volumes pose a larger threat to venous integrity.

This scenario underscores that:(1) For successful venipuncture, careful scrutiny of veins, preferably large, straight ones in the forearms/upper arms, whilst avoiding the hands' and feet' joints, is key. Important: Ensure proper securing of the jugular vein once the catheter is set.(2) Before proceeding, nurses must ensure each patient's health status including IV placement, putting special emphasis on female patients and ages 10 and above or 60 and below. Specialized treatments for these vulnerable individuals should be considered. Image quality is important yet try minimizing the contrast agent's rate to lower the likelihood of ICM extravasation.(3) Remember, ICM extravasation might trigger significant pain due to vascular endothelial damage, leading to red blood cell deformation and aggregation, increasing local arterial pressure and vascular permeability, further causing fluid leakage. Think of the rapid swelling after extravasation - it has to do with this [24]. Post ICM extravasation, raising the affected limb aids in lymphatic and venous flow, mitigating edema. Cold compresses using 50% magnesium sulfate help relax blood vessels and enhance microcirculation, aiding in tissue swelling reduction and inflammation, pain, and swelling relief. As per doctor's advice, 125ml of 20% Mannitol and 5mg Dexamethasone were infused intravenously for quick diuresis and swelling reduction. The patient reported persistent pain in their right forearm, rated 9 out of 10, on the night of extravasation and the next day. Following doctor's orders, 50mg of Pethidine was given intramuscularly. Regular monitoring of pain, circulation, and swelling was done to avoid masking any worsening of the condition.(4) In case of skin blisters, maintain strict aseptic techniques to prevent infections. Cases like this, with significant swelling, pain, and numerous blisters, are rare. Beyond standard care like limb elevation for better local blood circulation, reducing capillary hydrostatic pressure, and easing local edema and inflammatory exudate, 0.05%.

Dexamethasone injections and cold compresses prevent ICM from spreading under the skin, reducing swelling and pain. They aid in vascular repair, reduce tissue fluid leakage, steer away inflammatory cells, dim the activity of phagocytic cells, and limit the production and release of inflammation-causing agents. Wound cleansing gel and Silver Sulphadiazine-impregnated Hydrocolloid Dressing facilitate autolytic debridement of necrotic tissue. The silver ions in the dressing fight germs, while the moist environment aids tissue regrowth [25,26]. rhEGF, a cell growth factor, was utilized during the wound healing stage. It stimulates the growth of various cells, regulates protein synthesis [27]. This case highlights the effectiveness of our treatment method. (5) Nurses' commitment is key - they should offer continuous care, empathy, and health education. Regular documentation of ICM extravasation nursing records is vital, including information like ICM concentration, injection speed, extravasate volume, damage area, patient feedback, nursing measures taken, and consecutive checksuntil symptoms subside [28].

QUESTIONS

Question1: What are the levels of venous extravasation injury of ICM?

1. Mild, with only pain, inflammation, mild erythema, and mild to moderate edema; (applies)
2. moderate, moderate or severe erythema, blisters, persistent pain, or other injury requiring additional treatment, but all symptoms resolve within 2 weeks; (applies)
3. Severe, very severe erythema, blisters, persistent pain and swelling, cyanosis of the skin, and tissue necrosis requiring additional treatment or surgical intervention. (applies)
4. Severe, necrotic
5. Mild, abundant blisters

Explanation:

1. Mild, with only pain, inflammation, mild erythema, and mild to moderate edema;
2. moderate, moderate or severe erythema, blisters, persistent pain, or other injury requiring additional treatment, but all symptoms resolve within 2 weeks;
3. Severe, very severe erythema, blisters, persistent pain and swelling, cyanosis of the skin, and tissue necrosis requiring additional treatment or surgical intervention.
4. Severe, necrotic
5. Mild, abundant blisters

Question 2: Which of the following measures should be taken after the occurrence of venous extravasation of ICM?

1. Elevate the affected limb(applies)
2. Wet compress with 50% magnesium sulfate(applies)
3. Ice(applies)
4. Hirudoid Tu(applies)
5. Topical application of fresh potato chips(applies)

Explanation:

1. Elevate the affected limb
2. Wet compress with 50% magnesium sulfate
3. Ice [Cold wet compress can not only shrink blood vessels, slow down the spread of ICM in the subcutaneous tissue, relieve edema and pain, but also repair local vascular endothelium, reduce tissue fluid exudation and inflammatory cell infiltration, inhibit phagocytic cell function and inflammatory mediators' synthesis and release]
4. Hirudoid Tu
5. Topical application of fresh potato chips

Question 3: Can debridement glue be used on wounds?

1. Use on fresh wounds after debridement(applies)
2. Cannot be used
3. Use after the wound is crusted

4. For wound infection
5. Intermittent use

Explanation:

1. Use on fresh wounds after debridement [Debridement adhesives create a moist healing environment that facilitates tissue growth, promotes wound healing, and prevents infection]
2. Cannot be used
3. Use after the wound is crusted
4. For wound infection
5. Intermittent use

Question 4: What should be the focus of the site of venous extravasation of ICM?

1. Pain(applies)
2. Skin temperature(applies)
3. Blood circulation(applies)
4. Degree of swelling(applies)
5. Arm circumference

Explanation:

1. Pain [Pay attention to the degree of pain, skin temperature, blood circulation and swelling of the affected limb to avoid tissue infection and necrosis]
2. Skin temperature [Pay attention to the degree of pain, skin temperature, blood circulation and swelling of the affected limb to avoid tissue infection and necrosis]
3. Blood circulation [Pay attention to the degree of pain, skin temperature, blood circulation and swelling of the affected limb to avoid tissue infection and necrosis]
4. Degree of swelling [Pay attention to the degree of pain, skin temperature, blood circulation and swelling of the affected limb to avoid tissue infection and necrosis]
5. Arm circumference

Question 5: How to choose blood vessels for venipuncture?

1. Vein condition was coarse, straight, and well filled (applies)
2. Be resilient(applies)
3. Avoid joints(applies)
4. Easy to touch and few venous sinuses(applies)
5. Not easy to slide(applies)

Analysis: Venepuncture should try to choose the forearm and upper arm thick and straight, good elastic blood vessels, avoid hand and foot joints

Explanation:

1. Vein condition was coarse, straight, and well filled [Venepuncture should try to choose the forearm and upper arm thick and straight, good elastic blood vessels, avoid hand and foot joints]
2. Be resilient [Venepuncture should try to choose the forearm and upper arm thick and straight, good elastic blood vessels, avoid hand and foot joints]
3. Avoid joints [Venepuncture should try to choose the forearm and upper arm thick and straight, good elastic blood vessels, avoid hand and foot joints]
4. Easy to touch and few venous sinuses [Venepuncture should try to choose the forearm and upper arm thick and straight, good elastic blood vessels, avoid hand and foot joints]
5. Not easy to slide [Venepuncture should try to choose the forearm and upper arm thick and straight, good elastic blood vessels, avoid hand and foot joints].

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FIGURES

Figure 1: On first day of extravasation.

Figure 2: Second-day extravasation.

Figure 3: Third-day extravasation.

Figure 4: Forth-day extravasation.

Figure 5: Fifth-day extravasation.

Figure 6: Sixth-day extravasation

KEYWORDS

Enhanced CT; Iodinated Contrast Media; Intravenous Extravasation; Nursing Intervention.

ABBREVIATIONS

ICM = IODINATED CONTRAST MEDIA
CT = COMPUTED TOMOGRAPHY
ML = MILLILITER
RHEGF = RECOMBINANT HUMAN EPIDERMAL GROWTH FACTOR DERIVATIVE