

Case Report

Acute Compartment Syndrome of the Forearm and Hand due to Extravasation of Computed Tomography Contrast Material

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Although Compartment Syndrome is a common surgical emergency with a plethora of aetiologies, Intravenous extravasation of Computed Tomography (CT) contrast medium causing acute compartment syndrome has been reported very rarely. We present a 61-year-old female who underwent abdominal CT with Intravenous contrast for irreducible, recurrent incisional hernia, presented with persistent excruciating pain and progressive multiple blister formation over the left forearm and hand following intravenous contrast material injection via the left dorsum of the hand. Clinical diagnosis of compartment syndrome was made, X-ray left forearm and hand confirmed soft tissue contrast extravasation. She was taken for emergency decompression fasciotomy of the left forearm and hand compartments, and later partial wound closure and split skin graft into remaining areas were carried out. Clinicians and radiologist should aware of this potential complication for its early recognition, management and prevention.

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Key words : Contrast Extravasation injury, Compartment syndrome, contrast medium, Fasciotomy.

Acute Compartment Syndrome (ACS) is defined as increased intra compartmental pressure (within 30 mmhg of Diastolic Pressure) causes compression of intra compartment structures which compromises the microcirculation and function of the tissues within that space^{1,2}.

It occurs most frequently soon after significant trauma involving long bone fractures of the extremity, penetrating trauma, crush injury, severe thermal burns, electric burns or animal envenomation. Non-traumatic causes of ACS occur less frequently from ischemia-reperfusion injury, coagulopathy, spontaneous haemorrhage or hematoma, soft tissue infection or prolonged circumferential limb compression by constrictive bandages, splints, or casts^{1,2}.

Nevertheless, compartment syndrome caused by intravenous extravasation injury from an injected high-pressure contrast medium for a CT scan is seldom reported. To the best of our knowledge, only 15 such cases^{2,5,7-18} have been reported in world literature till now. This is the third case of ACS involving both forearm and hand due to contrast extravasation injury to be reported.

The aim of reporting this case is to contribute in part to the better understanding and awareness of this rare limb-threatening complication of contrast extravasation injury for its early recognition, management and prevention.

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Editor's Comment :

- It is necessary to have a high clinical suspicion of acute compartment syndrome following intravenous contrast injection.
- Prompt decompression fasciotomy may salvage the limb before permanent damage occurs.
- Proper selection of high calibre vein and catheter, supervised contrast injection, early identification of contrast extravasation and prompt termination may prevent the extremity from major contrast extravasation injury.

CASE REPORT

A 61-year-old woman underwent abdominal CT with contrast material injected intravenously in her left hand. Her medical history was significant for right breast carcinoma treated with breast conservation surgery followed by chemotherapy and radiotherapy 1 year ago, and her surgical history was significant with total abdominal hysterectomy 21 years ago for multiple fibroid uterus and open incisional hernia repair 11 years ago.

She was taken up for a contrast-enhanced CT abdominal scan for recurrent irreducible incisional hernia in another institution on an outpatient basis. She revealed that there were multiple attempts of vein puncture during intravenous cannulation and the contrast medium was injected intravenously through a rapid infusion pump in her dorsum of the hand. During infusion, she developed severe pain in her left dorsum of the hand. Hence, further infusion and CT were abandoned. Analgesics and local ice application were advised and she was sent home.

About 9 hours following the procedure, she presented to our Emergency Department with persistent excruciating pain and rapidly progressing swelling over her left hand and forearm. Physical examination of the forearm and hand revealed a tender, tense, diffuse oedema with multiple skin blisters on the dorsum of the

hand and forearm (Fig 1). Passive stretching of the fingers were painful. Gross blunted sensation along the median nerve distribution was noted. The radial pulse was palpable.

Active movements of fingers were painful and capillary refilling time was normal. Oxygen saturation was 99% at room air.

Significant contrast extravasation into the sub-cutaneous and sub-fascial compartment was evident with the X-ray left forearm and hand (Fig 2).

Based on clinical findings, compartment syndrome was diagnosed. Hand surgeon opinion was sought and decided to proceed with emergency decompression fasciotomy.

Under anaesthesia, decompression fasciotomy of forearm and hand with carpal tunnel release was performed, interstitial fluid admixed with partially clotted blood was released.

At 72 hours, the wound was inspected and found to be healthy (Fig 3), next day the wound was dealt with by partial closure and the remaining areas being resurfaced with split-thickness skin graft harvested from the ipsilateral ulnar border of the forearm. The patient was discharged on the 4th postoperative day with an immobilizer above-elbow slab. At 4 weeks, she recovered well without any complications and undergoing physiotherapy (Fig 4).



Fig 1 — showing oedematous left hand and forearm with multiple blisters



Fig 2 — X-ray picture of right forearm and hand showing contrast extravasation into the sub-cutaneous and sub-fascial compartment

DISCUSSION

Extravasation of an intravenous contrast medium is defined as the accidental delivery of a variable amount of contrast solution, from the intravascular compartment into the adjacent muscular, sub-fascial or subcutaneous compartment³.

Although extravasation is one of the well-known complications of intravenous contrast medium injection, its incidence is very low, accounting for approximately 0.1 to 0.9%^{3,6}. It commonly occurs with an automated mechanical contrast injector^{2,5,7-18}.

Risk factors associated with extravasation injury are injection in distal and or small calibre veins, multi-punctured veins, use of a metallic catheter, hyperosmolar contrast, high flow rate and lack of supervision during injection, and patient dependent factors such as extreme ages, unconscious patient, obesity, or vascular fragility due to chemotherapy drugs^{3,4}.

In our case, a high flow infusion pump, chemotherapy treatment for breast carcinoma and injection at the dorsum of hands are recognized risk factors for extravasation injury.

The location of the intravenous catheter tip may influence the probability of extravasation of the contrast and compartment syndrome²⁻⁴.

A-List of documented cases of acute compartment syndrome of an extremity due to extravasation of



Fig 3 — Postoperative day 3 status of healthy fasciotomy wound



Fig 4 — Postoperative follow-up image showing healed surgical site

Computed Tomography contrast material, risk factors and management has discussed in Table 1.

Diagnosis of ACS is mainly based on history and examination findings.

Rapid progression of symptoms like persistent intense pain, numbness and paresthesia, and signs like blistering, redness, oedema, pain on passive stretching of flexors muscles (early sign), tense compartment with firm “wood-like” feeling, decreased sensation in the form of prolonged two point discrimination, pallor, pulselessness, muscles weakness and paralysis (late sign) over a few hours following intravenous contrast injection are consistent with the diagnosis of ACS³⁻⁵.

The great majority of patients suffering minor extravasation injury with small volumes of contrast-medium resolved spontaneously within 24 to 48 hours³⁻⁵. However, early decompression fasciotomy of involved extremity within six hours of symptom onset is the only recognized treatment for major extravasation injury-causing ACS to relieve neurovascular compromise and to salvage the limb^{2,6}.

Complication due to extravasation injury can be prevented by proper choice of puncture site, adequate calibre catheter, use of plastic venous lines, and intravenous aspiration before contrast injection, low

Table 1 — A List of documented cases of Acute Compartment Syndrome of an extremity due to extravasation of computed tomography contrast material in literature

Case no.	Age	Risk factor	Injection site	Involved compartment	Site of extravasated contrast	Management	Reference
1	N/A	Automated injection	Dorsal hand	Forearm	Subfascial	N/A	benson grand
2	48y	Automated injection	N//A	Forearm	Subcutaneous and subfascial	Fasciotomy	
3	72y	Mal positioned vein catheter	Dorsal hand	Hand	Subcutaneous and subfascial	Fasciotomy	strav
4	63y	mechanical bolus injector	Dorsal hand	Hand	Subcutaneous and subfascial	Fasciotomy	vinod
5	60-y	mechanical bolus injector	Dorsal hand	Hand	N/A	Fasciotomy	yudakul
6	50y	mechanical bolus injector	Dorsal hand	Hand	Subcutaneous	Fasciotomy	belzungui
7	81y	mechanical bolus injector	Dorsal hand	Hand	Subcutaneous	Fasciotomy	D'ASERO
8	48y	Automated pump	Dorsal hand	Hand	Subcutaneous	Fasciotomy	Wang
9	70y	Automated pump,Chemotherapy	Dorsal hand	Hand	N/A	Fasciotomy	Selek
10	51y	Automated pump,Chemotherapy	Dorsal hand	Hand	Subcutaneous	Fasciotomy	stein
11	66y	mechanical bolus injector	Antecubital fossa	Biceps brachi	Subfascial	Fasciotomy	chew
12	43y	infusion pump	Forearm	Forearm	Subfascial	Fasciotomy	van Veelen
13	42y	automated injector	Dorsal hand	Hand and forearm	Subcutaneous and subfascial	Fasciotomy	Jae-Won Jung,
14	80y	injector pump,altered level of consciousness	Dorsal hand	Hand	N/A	Conservative management with immediate suction by a squeezing manoeuvre, ice pack local application, limb elevation, regular dressing and split-thickness skin graft after 4 weeks	JH Kwon1
15	23 days	Infusion pump, infancy	Hand	Hand and forearm	N/A	Fasciotomy	Egemen
16	61y	Infusion pump, chemotherapy	Hand	Hand and forearm	Subcutaneous and subfascial	Fasciotomy	Index case

osmolar contrast and supervised intravenous injection^{3,4}.

CONCLUSION

Despite being one of the rare complications of contrast-enhanced imaging studies, it is necessary to have a high clinical suspicion of acute compartment syndrome following intravenous contrast injection. X-ray of the involved limb may show contrast extravasated compartment. Prompt decompression fasciotomy may salvage the limb before permanent damage occurs. Proper selection of high calibre vein and catheter, supervised contrast injection, early identification of contrast extravasation and prompt termination may prevent the extremity from major contrast extravasation injury.

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