Adverse clinical events at the injection site are exceedingly rare following reported radiopharmaceutical extravasation in patients undergoing $^{99m}$Tc-MDP whole body bone scintigraphy: A 12-year experience.

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Running Title

Adverse events after radiotracer extravasation

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ABSTRACT

Rationale

The deleterious effects of high-dose radiation on normal tissue are sometimes extrapolated to diagnostic (SPECT and PET) radiopharmaceutical extravasations (RPE). It has been hypothesized that diagnostic RPE can have gradually evolving local tissue injury, and a potentially increased risk of local dermatologic or oncologic diseases over a longer period. However, data on clinical adverse events following diagnostic RPE is limited. Therefore, our primary aim was to study the occurrence of short-term and long-term clinical adverse events in patients who underwent $^{99m}$Tc-Methylene diphosphonate ($^{99m}$Tc-MDP) whole-body bone scintigraphy (WBBS) with reported RPE.

Methods

The records of $^{99m}$Tc-MDP WBBS performed from June 2010 to January 2022 were retrospectively examined for RPE documented in the scan reports. The clinical records of patients with a documented RPE were extensively reviewed for any related short-term adverse events (within two weeks of the WBBS – local symptoms, and care sought for local dermatologic or musculoskeletal issues), and long-term adverse events (until last follow-up - local deleterious effects, related consults for dermatology, plastic surgery, oncology or orthopedics).

Results

Retrospective review of the records of 31,679 $^{99m}$Tc-MDP WBBS showed RPE documented in 118 studies (0.37%). Medical records were not retrievable for 22 patients, yielding the final cohort of 96 patients with reported RPE. The median follow-up duration was 18.9 months (IQR: 7.8-45.7 months). Short-term events were noted in four patients, of whom one was asymptomatic. Of the three symptomatic patients, two experienced mild discomfort at injection site, and one had a tender swelling. Three of the four events had a prior intravenous contrast extravasation for a contrast-enhanced computed tomography performed earlier.
during the day, and a $^{99m}$Tc-MDP injection later at the same site likely leading to RPE. None of the long-term local events had any plausible link with the RPE event.

**Conclusion**

Reported RPE were rare and short-term local symptoms were observed in three patients (0.009%), all of which were likely related to the prior higher volume intravenous contrast extravasation. The smaller volume diagnostic RP injections for WBBS are highly unlikely to cause local symptoms on their own. No patient had any long-term adverse event with a plausible link to the RPE.

**Key-words**

Extravasation; Infiltration; Radiotracer; Radionuclide; MDP; Bone scan; Scintigraphy; Interstitial
INTRODUCTION

Radiopharmaceutical extravasation (RPE) refers to the unintended leakage of the radiopharmaceutical in the tissue surrounding the injection site (frequently during intravenous administration). The consequences of RPE depend on several factors, viz. the physical characteristics of the radionuclide (e.g. energy, half-life, type of emissions, etc.), properties of the radiopharmaceutical (e.g. pH, viscosity, osmolality, adjuvants), volume of injection, and fraction of the activity that was extravasated, site of extravasation and multiple patient related factors (1,2). There is a potential risk of physical harm to the patient, especially with extravasation of therapeutic radiopharmaceuticals (2). Further, insufficient delivery of the radiopharmaceutical to the target site(s) may negatively impact the image quality and its clinical interpretation, especially when quantitation is involved (2–4).

The detrimental effects of ionizing radiation on normal tissues have been described (5). The physical effects resulting from extravasation of chemotherapy drugs and intravenous iodinated contrast media are also well known (1,6). However, the unique situation with diagnostic radiopharmaceuticals is that they typically involve injections of lower volumes (~0.5-1 mL, compared to >50 mL for iodinated contrast media), with no direct cytotoxic effect of the pharmaceutical component (compared to intrinsic cytotoxicity of chemotherapy) and much lower radiation absorbed doses (compared to external beam radiation therapy) (1,2,5,7). A systematic review of radiopharmaceutical extravasations performed in 2017 noted a major deficiency in the literature on the adverse clinical effects of RPE involving diagnostic radiopharmaceuticals, especially with regards to lack of a clinical follow-up (2). The authors reported studies with a total 3016 cases of diagnostic RPE out of which only three (0.1%) had any follow-up data available. It has been hypothesized that diagnostic RPE can lead to potential complications, either due to the volume effect (e.g. local hematoma, phlebitis) or due to the local effects of radiation (e.g. ulceration, de-squamation) (2,8). However, in the absence of any systematically performed study in this space, the association of any adverse clinical effects with a diagnostic RPE remains unknown.
Most cases with diagnostic RPE (85.7%) have been reported with $^{99m}$Tc-Methylene diphosphonate ($^{99m}$Tc-MDP) used for skeletal scintigraphy which is likely because of the high volume of these studies and the acquisition of whole-body images that frequently capture the injection site (2). Therefore, we sought to review $^{99m}$Tc-MDP whole-body bone scintigraphy (WBBS) studies with RPE to determine the occurrence of any clinical adverse events in the patients. The primary objective of this study was to determine if $^{99m}$Tc-MDP injection extravasations occurring in patients undergoing WBBS are associated with adverse clinical events, in the short-term and/or the long-term. Secondary objectives were to estimate the rate of RPE in the $^{99m}$Tc-MDP WBBS studies performed at the hospitals associated with our institute and to assess the requirement of a repeat scan due to insufficient diagnostic quality of the images.

**METHODS**

We retrospectively reviewed the records of $^{99m}$Tc-MDP bone scans performed over 12 years (June 2010 to January 2022) at our medical center to identify WBBS studies where the scan report documented RP extravasation. Requirement of informed consent was waived for this retrospective analysis. Bone scans other than WBBS, such as limited field-of-view, regional studies were excluded. The clinical records of patients with a documented RPE during $^{99m}$Tc-MDP WBBS were extensively reviewed for any related short term adverse events (within two weeks of the study) — including local symptoms, any clinical documentation of the RPE (other than radiology and nuclear medicine), and care sought for dermatologic, neurological or musculoskeletal issues related to the site of RPE. If no results were found within the two weeks duration, the next available clinical encounter closest to the scan date was reviewed. Medical admissions if any, sought after the scan were also reviewed to determine the indication and if it was related to the RPE. Medical records were also searched for long-term adverse events (through the date of last follow-up) to look for any local deleterious effects, related consults for dermatology, plastic surgery, oncology, or orthopedics. The study workflow is shown in Figure 1.
Radiopharmaceutical injection and extravasation monitoring

The Division of Nuclear Medicine at our institute currently routinely utilizes a small gauge (23 or 25) butterfly needle (winged infusion set) for intravenous injections of $^{99m}$Tc-MDP. This policy was instituted in September 2017, prior to which a straight stick technique was more routinely used for intravenous injections. A previously placed peripheral intravenous line may also be utilized after confirming its patency. An easily palpable superficial vein in the ante-cubital fossa is the preferred site of cannulation. Proper placement of the needle in the lumen of the vein is verified by confirming adequate blood return prior to injecting the radiopharmaceutical. Under current institutional policy, if a RPE occurs, the incident is reported to the nuclear medicine physician for further guidance and documented in an on-line safety report. The nuclear medicine physician then assesses the severity of RPE by its impact to the patient in terms of likelihood of physical harm and to the study in terms of image quality. It is then determined if the patient requires further clinical evaluation and if a repeat study is required.

RESULTS

38,746 $^{99m}$Tc-MDP bone scans were performed over approximately 12 years (June 2010 to January 2022) of which 31,679 were WBBS. RPE was documented on 118 $^{99m}$Tc-MDP WBBS scan reports (0.37%). Medical records were available for 96 of these studies (performed in 96 patients) which formed the final cohort. Medical records of these 96 patients (mean age 63.8±14.3 years; 48 males, 48 females) were reviewed with a median follow-up period of 18.9 months (interquartile range: 7.8-45.7 months). At last follow-up, 76 patients were alive and 20 were deceased. The $^{99m}$Tc-MDP WBBS studies were performed for initial staging (n=26), re-staging (n=18) or evaluation of osseous disease (n=52). All the scans, except one were performed for an oncologic indication, the most common of which was prostate cancer (35.4%) followed by breast cancer (32.3%) (Table 1). The most common site for the radiopharmaceutical injection was the antecubital fossa (79.2%) followed by the hand, or wrist (19.8%). The radiopharmaceutical was injected directly in the central venous catheter in one patient. The injections were performed on the left side
in 50 patients and on the right side in 46 (including the injection in the central venous catheter). The mean injected activity of $^{99m}$Tc-MDP was 21.4±1.6 mCi (791.8±59.2 MBq).

**Short-term adverse events**

An extravasation-related event was documented in four patients of which three were symptomatic. Two patients experienced local discomfort with no blistering or erythema, and intact distal pulses, and sensation. One patient had local discomfort with a tender swelling, and intact distal pulses and sensation. One patient who remained asymptomatic was assessed to have normal grip strength and capillary refill. Of these four patients, three had an intravenous iodinated contrast infiltration previously on the same day while undergoing a contrast enhanced CT (Figure 2). The RP extravasation occurred at the same site. These three patients were recommended cold compresses with arm elevation at home. The recommendation of cold compresses (over hot compresses) was made in view of the high-volume intravenous contrast extravasation earlier during the day of scan, which was much higher than the volume of the RPE. Two of these patients had a documented complete resolution of symptoms (one - on the same day, second – within a week). An update on the clinical status was not documented for the third patient. The patient with RPE without any prior contrast extravasation did not require any active intervention and his symptoms resolved on the same day. No appointments or referrals were made for any of these patients with primary care, dermatology or plastic surgery. None of the patients had any severe RPE-related adverse events that required urgent care or hospital admission.

**Long-term adverse events**

No long-term local adverse events were observed in 88/96 (91.7%) patients. No appointments or referrals were made for any of these 96 patients (with dermatology, plastic surgery, oncology, or orthopedics related to the RPE. Adverse events were noted in eight patients of which none could be directly attributed to the RPE (Table 2). The most common diagnosis in three of these eight patients was carpal tunnel syndrome. Two patients had a temporary symptom arising due to RPE-unrelated factors (thrombophlebitis after an
intravenous peripheral catheter placement, and contact dermatitis). One patient developed weakness of the upper extremity due to brain metastases from their primary renal cell carcinoma. Two patients had paraesthesia in their arm, attributed to cervical radiculopathy in one patient and with an unknown etiology in the other.

93/96 (96.9%) studies with documented RPE were deemed adequate for clinical interpretation purposes and re-scanning was not recommended (Figure 3). A repeat scan was recommended in three patients due to the sub-optimal diagnostic quality of the initial scan with RPE. A repeat scan was subsequently performed uneventfully in two patients.

DISCUSSION

Several prior studies have reported RPE with $^{99m}$Tc-MDP or other radiopharmaceuticals for skeletal scintigraphy, however none describe any clinical adverse effects associated with the RPE (2). Most prior discussions have focused on the extra-skeletal distribution of the radiopharmaceutical following extravasation (9–13). In the absence of any significant clinical follow-up data following RPE during diagnostic studies, it has been hypothesized that clinical adverse events might occur but are under-reported (2). Our results provide evidence that clinical adverse events reported following $^{99m}$Tc-MDP RPE in patients undergoing WBBS are in fact rare. Among 96 patients with a RPE documented in the clinical report, only three had a short-term clinical adverse event. Out of these, only one was potentially directly related to the radiopharmaceutical, while the other two were almost certainly due to the volume/vesicant effects of an intravenous contrast extravasation earlier during the day.

Among the long-term local adverse events irrespective of etiology, the most common diagnosis was of carpal tunnel syndrome (3/8 patients). Carpal tunnel syndrome has a complex pathophysiology with several genetic, and environmental factors involved (14). Its prevalence in the general population has been reported to be ~3-5% with higher rates in workers in specific industries (15,16). The rate of carpal tunnel syndrome in patients with reported extravasation in our study was 3% which conforms to the expected rate in the
general population. With a median follow-up of over 18 months (longest: >8 years), we did not find any long-term local adverse events that could be related to the RPE. This is a significant addition to the existing literature as most prior studies do not report any follow-up of the patients with RPE. A systematic review published in 2017 showed that only three patients out of 3016 (0.1%) with a diagnostic RPE had any follow-up data reported (2). Two case reports included in the review describe ulcer development in two patients (after two, and three years) following RPE of $^{201}$Tl-thallous chloride, although an attempt to establish causation to a radiation-induced injury was not made. One report described an erythematous pruritic plaque following RPE of $^{131}$I-iodocholesterol (2).

Prior studies have reported RPE rates of ranging from 2-16% for PET/CT (17). Specifically, for $^{99m}$Tc-MDP, a study of 225 consecutive WBBS across nine sites in Canada showed a 15% rate of RPE (18). The RPE rate did not change significantly after an educational intervention (post-intervention RPE rate - 20%). Notably, they reported that the RPE did not limit clinical interpretation in any of the total 450 studies. Another study of 2435 $^{99m}$Tc-MDP bone scans performed between 1987 and 1994 reported ipsilateral axillary node visualization with RPE in 2% of the scans (12). In the present study, RPE was documented in the scan reports of 118/31,679 (0.37%) $^{99m}$Tc-MDP WBBS studies. A repeat study was recommended in three of the 96 patients with RPE documented in their reports. Our findings are similar to that of the Canadian study showing no impact of $^{99m}$Tc-MDP RPE on the clinical interpretability of 450 scans (18).

Mitigation of the effects of RPE is a relatively unexplored domain. Several techniques such as hot/cold compresses, injection of hyaluronate or steroids, as well as surgical interventions have been proposed to manage RPE (2). However most have relied on the information gained from extravasation of chemotherapy drugs or iodinated contrast media and extrapolated it to RPE. These extrapolations typically fail to account for the widely different mechanisms of tissue injury with cytotoxic agents and iodinated contrast media (1,7,19). While some of these approaches may be useful for therapeutic radiopharmaceuticals, they are likely not required for diagnostic RPE (2). It has previously been recommended that RPE with a $^{99m}$Tc-labeled radiopharmaceutical does not require an active intervention (8). In the present study, three patients
with RPE who had a prior iodinated contrast media extravasation on the same day were recommended treatment with cold compresses and limb elevation at home. Cold compresses produce vasoconstriction and limit local inflammation and edema and are effective to prevent contrast media extravasation related local injuries (7). The volume of RPE in these patients was minimal compared to the volume of extravasated contrast media. Therefore, it was deemed appropriate to follow the guidelines related to contrast media extravasation (6,7). Physiologically, the low bolus volumes of diagnostic RPE (~0.5-1 mL) are unlikely to cause volume-related adverse effects which are commonly seen with contrast media (~50-200 mL) and chemotherapy infusions (20). The best technique to mitigate RPE related adverse effects, however rare, is to prevent RPE. The major source of adverse events in our study was the RP injection at the same site of a prior intravenous contrast media injection. It may be useful to enquire if the patient has had a recent intravenous contrast injection (or extravasation) and avoid using that site if injection at another site is feasible and appropriate.

Our study has certain limitations. We chose to identify RPE by searching the scan reports instead of visually reviewing the images of 31,679 WBBS studies. We recognize that this approach has the possibility of missing studies where a RPE occurred but was not documented in the report. We did not perform any dosimetry estimations in the current study as we did not have the time activity curve data nor was it directly contributory to our primary objective. Prior studies have proposed methods for estimating local radiation absorbed dose as a surrogate for adverse clinical events (21). Since our approach was to directly look for any adverse clinical events in the patients with RPE, additional information, if any, provided by the dosimetry calculations would have been minimal. We assessed the short-term and long-term adverse events based on a comprehensive review of the medical records of patients, instead of interviewing each patient individually. While our approach may have the potential to miss out on minor details, it is unlikely that a clinically significant adverse event would not have been documented in the medical records. It is also possible that a fraction of patients did not have follow up at our center and that an adverse outcome could have been missed by chart review. As one of our secondary objectives, we chose the ‘repeat scan’ rates as
a surrogate for diagnostic image quality. Although a repeatability experiment would have been ideal with imaging performed ‘with RPE,’ and ‘without RPE’ to assess the impact of RPE on image quality, it was out of the scope of the present study. Nonetheless, the ‘repeat scan’ rate is a useful ‘real-world’ metric as the interpreting physicians are likely to order a repeat scan if the image quality is sub-optimal for clinical interpretation.

Despite these limitations, our study still includes the largest cohort of $^{99m}$Tc-MDP WBBS studies performed over 12 years and reviewed for RPE related adverse clinical events with a comprehensive follow-up. Our approach of assessing short-term and long-term adverse events ensured that any anticipated acute and chronic radiation related injuries were accounted for. Future studies can include visual review of images, comparing it with scan reports to determine the RPE rates. Quantitative techniques, including dosimetry potentially could be employed to assess the ‘severity’ of RPE and correlate it with image quality and occurrence of any adverse events. However, given the rarity of adverse events, such efforts would seem to be of limited yield. The impact of specific interventions, including educational sessions and audits on the RPE rates should also be explored as well as the frequency of RPE with other nuclear medicine studies, though we expect that the results will be similar to our observations.

**CONCLUSION**

Adverse clinical events, both acute and chronic are exceedingly rare in patients with $^{99m}$Tc-MDP extravasation during a whole-body bone scintigraphy. The vast majority of RPE were not associated with any clinical symptoms and did not require any active intervention. Those few RPE with symptoms appeared to be related to injections following intravenous contrast administration extravasations.
ACKNOWLEDGEMENTS

None

DISCLOSURE

No potential conflicts of interest relevant to this article exist.

KEY-POINTS

QUESTION: Is $^{99m}$Tc-MDP extravasation in patients undergoing whole-body bone scintigraphy associated with adverse clinical events?

PERTINENT FINDINGS: In this retrospective study of 31,679 $^{99m}$Tc-MDP whole-body bone scans performed over 12 years, we showed that a radiopharmaceutical extravasation was documented in 118 patients. Of the 96 patients with available medical records, none had a long-term local adverse clinical event attributable to the extravasation. Short-term adverse events were noted in three patients, of which two likely resulted from prior intravenous contrast media extravasation.

IMPLICATIONS FOR PATIENT CARE: Adverse clinical events are rare in patients with $^{99m}$Tc-MDP extravasation while undergoing whole-body bone scintigraphy. No long-term local clinical adverse event attributable to the radiopharmaceutical extravasation was observed.
References


Figure 1 – Study workflow.

38,746
99mTc-MDP bone scans performed (June 2010 – January 2022)

7,067 scans excluded (non whole-body scans – e.g. regional studies)

31,679
99mTc-MDP whole-body bone scans

118
Studies with documented radiopharmaceutical injection extravasation in the scan report

22 scans excluded (medical records not available)

96
Studies performed in 96 patients with medical records available

Review of medical records

Short-term adverse events (within two weeks of study) Long-term adverse events (till last follow-up)
Figure 2 – 68 year-old woman with left breast cancer. Whole-body bone scan was performed for restaging. 23.1 mCi $^{99m}$Tc-MDP was injected intravenously in the right ante-cubital fossa, shortly after which the patient complained of swelling and tenderness in her arm. The distal pulses and sensation in the right upper extremity were intact. She had infiltration of iodinated contrast earlier in the day in the same arm while undergoing a contrast-enhanced computed tomography scan. She was recommended treatment with cold compresses and arm elevation at home, and experienced complete recovery when evaluated at the next visit (four weeks). The whole-body bone scan images in anterior (A) and posterior (B) projections show the site of extravasation around the right elbow (red arrows). The patient had metastases to the right occipital bone and the right iliac bone adjacent to the sacro-iliac joint (solid black arrows). A prior fracture site in the left elbow is also visualized (dashed black arrow).
**Figure 3** – 71 year-old man with prostate cancer. Whole-body bone scan was performed for metastatic workup. 22.7 mCi $^{99m}$Tc-MDP was injected intravenously in the left antecubital fossa and around three hours later, the images were acquired in anterior (A) and posterior (B) projections. Note is made of radiopharmaceutical extravasation at the injection site around the left elbow (red arrow). The study showed increased radiopharmaceutical activity in the bilateral shoulder and knee regions, likely due to degenerative changes. No site suspicious for metastatic disease is seen. The scan was deemed to be of adequate diagnostic quality and a repeat study was not required.
Graphical Abstract

31,679
99mTc-MDP whole-body bone scans
(June 2010 - January 2022)

No medical records available

22
99mTc-MDP bone scans
Excluded

118
99mTc-MDP bone scans

Final Cohort

96
99mTc-MDP bone scans in 96 patients (with documented radiotracer injection infiltration in the scan report)

Review of medical records for adverse events relevant to RP injection extravasation

Median follow-up: 18.9 months (IQR: 7.8-45.7)

Ante-cubital fossa - most common injection site (79.2%)

Short-term adverse events (within 2 weeks of study)

None
[Unrelated events noted in 8 patients - most commonly carpal tunnel syndrome (in 3)]

3
patients

had an i.v. iodinated contrast infiltration (for cCT) earlier on the same day in the same arm and location

SYMPTOMATIC

3
patients

SEVERE EVENTS
(Requiring admission)

None

2
mild discomfort at injection site

1
swelling, tenderness at injection site

Resolution of symptoms within 1 week
Table 1 – Primary clinical indication for the $^{99m}$Tc-MDP whole-body bone scans in which radiopharmaceutical extravasations were reported

<table>
<thead>
<tr>
<th>Primary clinical condition for bone scan</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate carcinoma</td>
<td>34</td>
<td>35.4</td>
</tr>
<tr>
<td>Breast carcinoma</td>
<td>31</td>
<td>32.3</td>
</tr>
<tr>
<td>Hepatocellular carcinoma</td>
<td>10</td>
<td>10.4</td>
</tr>
<tr>
<td>Renal cell carcinoma</td>
<td>4</td>
<td>4.2</td>
</tr>
<tr>
<td>Lung carcinoma</td>
<td>3</td>
<td>3.1</td>
</tr>
<tr>
<td>Rectal carcinoma</td>
<td>2</td>
<td>2.1</td>
</tr>
<tr>
<td>Neuroendocrine carcinoma</td>
<td>2</td>
<td>2.1</td>
</tr>
<tr>
<td>Ovarian carcinoma</td>
<td>2</td>
<td>2.1</td>
</tr>
<tr>
<td>Colon carcinoma*</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Urinary bladder carcinoma</td>
<td>1</td>
<td>1.0</td>
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<tr>
<td>Melanoma</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Esophageal carcinoma</td>
<td>1</td>
<td>1.0</td>
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<tr>
<td>Pancreatic carcinoma*</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Osteosarcoma</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Rhabdomyosarcoma (cheek)</td>
<td>1</td>
<td>1.0</td>
</tr>
<tr>
<td>Paget’s Disease</td>
<td>1</td>
<td>1.0</td>
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</tbody>
</table>

*One patient had both breast and pancreatic cancer, and one had both breast and colon cancer.
Table 2 – Long-term local adverse events (irrespective of etiology) in patients with RPE documented on their $^{99m}$Tc-MDP whole-body bone scintigraphy report

<table>
<thead>
<tr>
<th>RP injection site</th>
<th>Short-term symptoms*</th>
<th>Long term symptoms on follow-up</th>
<th>Site</th>
<th>Duration between scan and symptom onset (months)</th>
<th>Diagnosis</th>
<th>Intervention</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>R wrist</td>
<td>No</td>
<td>Pain, tenderness</td>
<td>Both hands (L&gt;R)</td>
<td>6</td>
<td>Carpal tunnel syndrome, arthritis</td>
<td>Corticosteroids</td>
<td>No</td>
</tr>
<tr>
<td>L ACF</td>
<td>No</td>
<td>Paraesthesia</td>
<td>L arm</td>
<td>0.6</td>
<td>None</td>
<td>None</td>
<td>No</td>
</tr>
<tr>
<td>L ACF</td>
<td>No</td>
<td>Numbness</td>
<td>Both hands</td>
<td>33.6</td>
<td>Carpal tunnel syndrome</td>
<td>Surgery</td>
<td>Yes</td>
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<tr>
<td>L ACF</td>
<td>No</td>
<td>Paraesthesia</td>
<td>L arm</td>
<td>47.4</td>
<td>Cervical radiculopathy</td>
<td>None</td>
<td>No</td>
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<tr>
<td>L ACF</td>
<td>No</td>
<td>Weakness</td>
<td>L upper limb</td>
<td>0.6</td>
<td>Brain metastases</td>
<td>Corticosteroids</td>
<td>No</td>
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<tr>
<td>L ACF</td>
<td>No</td>
<td>Swelling, pain</td>
<td>L arm</td>
<td>0.7</td>
<td>Thrombophlebitis</td>
<td>Antibiotics</td>
<td>Yes</td>
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<tr>
<td>R ACF</td>
<td>No</td>
<td>Pain, weakness</td>
<td>R arm</td>
<td>2.8</td>
<td>Carpal tunnel syndrome</td>
<td>Corticosteroids</td>
<td>Yes</td>
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<tr>
<td>R Hand</td>
<td>No</td>
<td>Rash, Itching</td>
<td>R arm</td>
<td>1</td>
<td>Eczema/ contact allergy</td>
<td>Corticosteroids</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*Short term symptoms – within two weeks of $^{99m}$Tc-MDP whole-body bone scintigraphy; ACF – Ante-cubital fossa; L- Left; R – Right; RP - Radiopharmaceutical