Contamination **a major problem in** nuclear medicine imaging: How to investigate, handle and avoid it?

Authors' full names, highest academic degrees, and affiliations:

Narvesh Kumar M.D.[1], Shashwat verma D.N.B.[1], Rani Kunti R. Singh D.N.B.[2], Deepanksha

Datta M.B.B.S.[1], Subhash Chandra Kheruka[1], Sanjay Gambhir M.D.[1]

[1] Department of Nuclear Medicine, SGPGIMS, Lucknow, Uttar Pradesh, India.

[2]Department of Radiodiagnosis, Vivekananda Polyclinic and Institute of Medical Sciences, Lucknow, Uttar Pradesh India.

First Author and Corresponding Author:

Dr. Narvesh Kumar M.D. (Senior Resident)

Department of Nuclear Medicine, SGPGIMS

Raebareli Road, Lucknow-226014, Uttar Pradesh, India

Phone number: +91-8765583930

Fax number: +91- 522-2494610

Email address: kumarnarvesh@gmail.com

The word count of the manuscript: 2174(Including references)

Disclaimer, if any: Nil

Contamination a curse to nuclear medicine imaging

Title: Contamination **a major problem in** nuclear medicine imaging: How to investigate, handle and avoid it?

Keyword: Collimator contamination, Tc99m-MDP, motion artifact, bone scan

Introduction:

Radioactive contamination and image artifacts can be introduced any time during a nuclear scan. Contamination leads to unwanted radiation exposure to the patients, the care-givers and radiation workers and also creates interruption of the acquisition schedule *(1).*

We report a case of collimator contamination and motion artifact during a bone scan study. The purpose of this article is to describe the pattern of collimator contamination, so as to enhance the knowledge of nuclear medicine technologist and physicians to identify such artifacts.

Case Study:

A 55 yr old gentleman, a known case of carcinoma prostate, underwent whole body bone scan for detection of skeletal metastases. 740MBq of Tc99m-MDP was injected intravenously and scheduled for the delayed imaging; whole body anterior and posterior planar images from the skull to feet were acquired on the dual-head SPECT system (HAWKEYE 4, GE Healthcare Technologies).

Images reveal three abnormal foci of radiotracer outside the body contour, near the right foot predominantly in the posterior projection. Well-defined linear tracer activity was also noted, arising from the above mentioned extra-corporeal tracer foci, the most prominent of the linear uptake was noted in the centre of body and other faint linear uptakes were visible at medial aspect of right thigh. Also blurring of the head region was noted in both anterior and posterior images due to movement of the patient during the acquisition (Figure 1).

A repeat spot image of head- neck and thoracic region in 'head first supine' position was acquired to correct patient-induced motion artifact. As we changed the orientation of the patient from feet- first supine to head -first supine, the foci of radiotracer which were seen outside the body contour, near the right foot were now seen in the right upper thoracic region around 1st and 2nd ribs. Though false-positive, this finding could be reported as metastatic disease, if not scrutinized adequately (Figure 2).

The patient was then removed from the camera and images of the collimator alone were acquired, with both collimators facing each other. The brighter foci of tracer were well evident in

Contamination a curse to nuclear medicine imaging

the 'collimator imaging' (posterior > anterior) and hence called as Contamination of the collimators (Figure 3).

Discussion:

Contamination can be categorized as direct patient-related contamination, like clothing, hair, and those indirectly-related to the patient like the surrounding like camera detectors, floors, sink and dustbins etc. Patient contamination can be identified easily in the image acquisition, but surrounding contamination cannot be easily identified, hence daily wipe tests are mandatory (*2*).

During acquisition and reporting of a nuclear scan multiple technical errors or contamination can affect the interpretation, like urinary contamination, injection artifacts, prosthetic implants, patient motion and extra-corporeal contamination like contamination of patient clothes, table, collimator etc. (*1*). The possibility of false positive results due to technical errors or contamination should always be kept in mind, especially if the lesions are prominent in a single projection (*3*).

In this study, we observed the contamination of the collimators possibly occurred due to urinary spillage during DRCG study done just prior to the bone scan acquisition. As seen in our study, the detector or collimator contaminations are associated with limited area of involvement and appear as a line throughout the whole body scan images (*3*). They are different from the direct patient contamination, in which the later shows change in the location of radiotracer with movement of patient, while the location of the radiotracer remain focal and static in the former (detector/ collimator).

Motion artifact is also a common source of error in the image acquisition and interpretation. Most of the time, the patient motion can be easily detected by cine display, sinogram and summed planar images. During image acquisition, it should be ensured that the patient is in comfortable position to avoid any discomfort induced motion artifact. Furthermore, if needed an arm support, patient holding straps and sand bags may be used to reduce patient movement during acquisition (*4*).

Contamination and other artifacts are unwanted accidents for the nuclear medicine technologist and physicians, and require cleaning (de-contamination) with interruptions in work flow and additional radiation exposure to the patients.

Conclusion:

Contamination a curse to nuclear medicine imaging

Nuclear medicine technologist must have thorough knowledge and experience to identify contamination as he is usually the first to identify such problems. Nuclear medicine physician is also expected to have a sound knowledge to identify alike sources of error and should be able to differentiate between the false positive findings from the true pathological abnormality. A training programme and proper designation of duties of the personnel in nuclear medicine facility is of utmost importance to avoid as well as manage any radioactivity-related accidents. Any identified artifacts must be further investigated and documented so as to detect its source and thus prevent its future occurrence.

Contamination a curse to nuclear medicine imaging

References:

1. Mosman Elton A, Peterson Luke J, Hung Joseph C, Gibbons Raymond J: Practical Method for Reducing Radioactive Contamination Incidents in the Nuclear Cardiology Laboratory. *J Nucl Med Technol* 1999, 27:287-289.

2. Kasner DL, Spieth ME: The day of contamination. *J Nucl Med Technol* 2003, 31(1):21-4.

3. Assadi M, Ebrahimi A, Eftekhari M, et al. A simple way to distinguish bed clothing contamination in a whole body bone scan: a case report. *Journal of Medical Case Reports*. 2007;1:173.

4. Naddaf SY, Collier BD, Elgazzar AH, Khalil MM. Technical errors in planar bone scanning. *J Nucl Med Technol*. 2004; 32 (3):148-53.

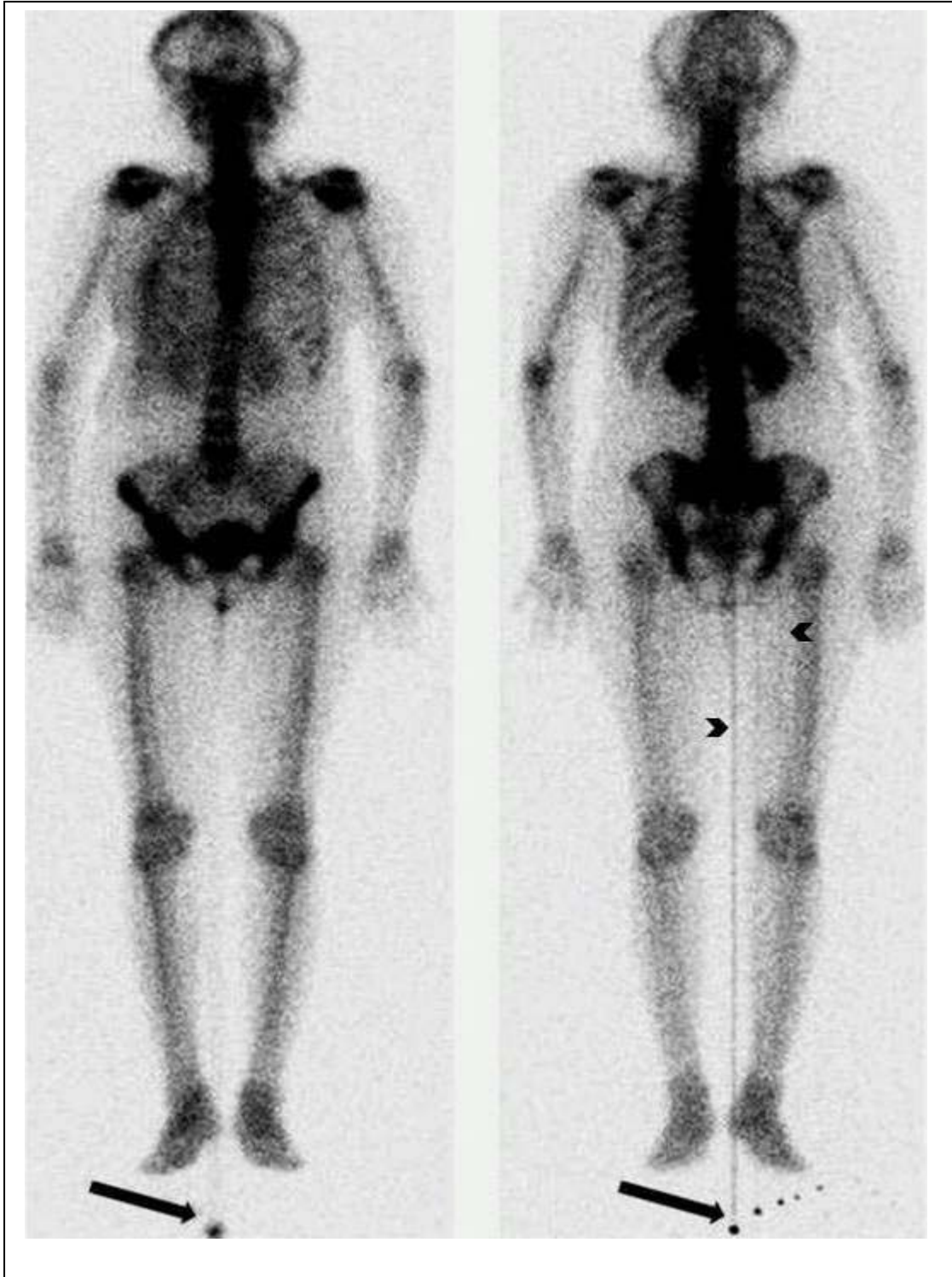**Contamination a curse to nuclear medicine imaging**

Figure 1: Whole body bone scan anterior and posterior images revealed foci of contamination adjacent to right foot (Black arrow) and motion artifact in the head-neck region. Well-defined linear tracer activity was also noted, arising from the above mentioned extra-corporeal tracer foci, the most prominent of the linear uptake was noted in the centre of body and other faint linear uptakes were visible at medial aspect of right thigh (Black Arrow heads).

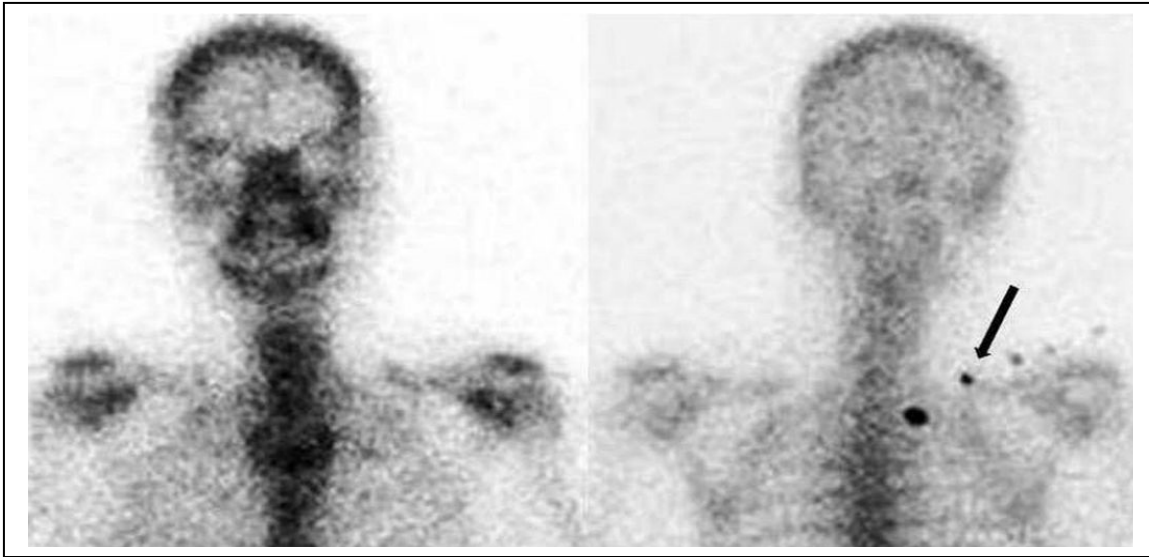**Contamination a curse to nuclear medicine imaging**

Figure 2: Spot static anterior and posterior images in 'head first supine position' of head and thoracic region did not reveal any motion artifact, But contamination which was earlier noted adjacent to right foot, was noted in the right upper thoracic region, in the spot images (Black arrow).
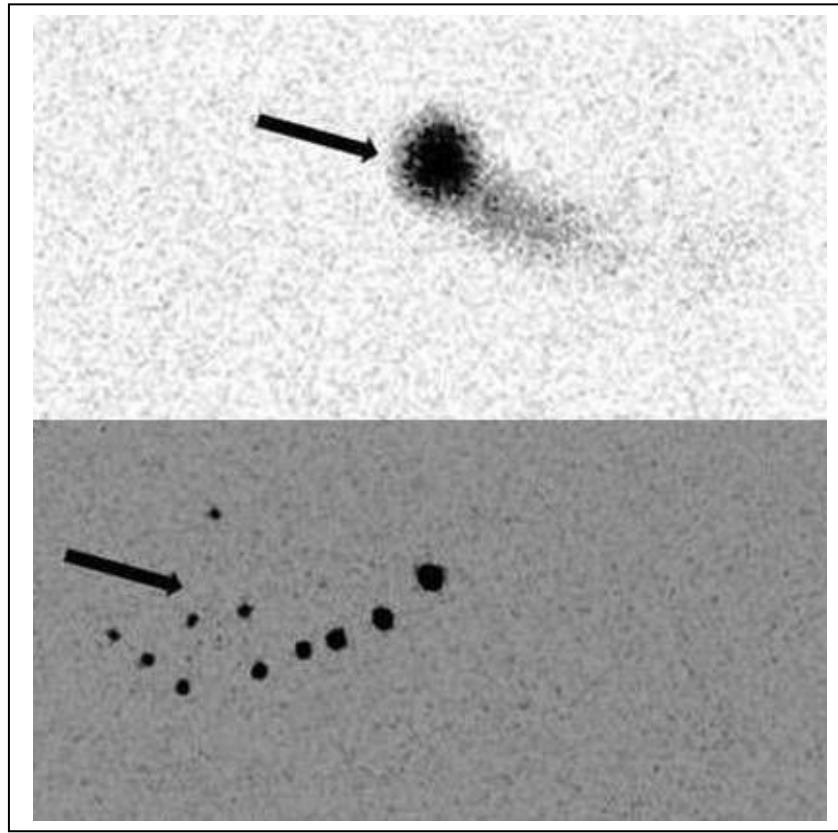
Contamination a curse to nuclear medicine imaging

Figure 3: Anterior and posterior images (without the patient and table) revealed multiple foci of tracer (contamination – Black arrow) on the collimator, more prominent in the posterior image.

Contamination a curse to nuclear medicine imaging