

Streak Artifacts due to Change in Reconstruction Parameters in CT in PET-CT Image Acquisition

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Abstract

An artifact in CT can be either patient related, machine related or due to change in image processing techniques. The patient related and image processing related artifacts can be resolved or corrected by being alert, proper instruction to the patient and applying software correction techniques.

We encountered an artifact on the thoracic and abdominal region of Trans axial computed tomography (CT) images in the PET-CT (Positron emission computed tomography) scan of each patient throughout the day. Which were showed near spiral streaks across Tran's axial images.

The streak artifact is software or reconstruction-based artifact caused due to CT acquisition parameters mismatch. We describe a rare cause of the streak artifact that appeared on a Tran's axial CT image because of change in CT parameters like scan type, rotation time, recon mode, recon type, pitch, noise index and all.

Keywords: Streak Artifact; Hardware; Computed Tomography; Trans-Axial; Reconstruction Parameters

Introduction

Positron emission computed tomography (PET) combined with computed tomography (CT) is an imaging technique used in oncology, cardiology and neurology. CT is essential for attenuation correction for PET data, anatomical information and localization of the PET radiotracer uptake within the patient's body. There is an important role in ensuring the CT acquisition parameters in PET-CT scan to optimize to provide the minimum possible radiation dose to the patient with good image quality.

Artifacts and image quality are two sides of the same coin. An artifact in a computed tomography (CT) image can be difference in the Hounsfield unit (HU) seen in the image obtained as opposed to what we expected [1].

An artifact in CT can be either patient related, equipment (Hard ware) related or due to change in image processing. Most of the patient related and image processing related artifacts can be corrected or avoided by being

alert, properly instruct to the patient and also applying software corrections [2-4].

Case Report

Our department has a positron emission computed tomography (PET-CT) scanner (Model discovery IQ 5 ring, s/n 083045206656219). We encountered an artifact on the thoracic and pelvic region of Tran's axial CT images in the PET-CT scan of each patient throughout the day. Which were showed near spiral streaks across Tran's axial images? On careful examination and in particular viewing CT images in bone and abdominal window, it became apparent that the streaks in the Trans axial slices were spiral at thoracic and pelvic region. The remaining slices did not show this kind of artifacts. The artifact persistent on the CT scan even after cleaning of the mylor window with warm water or disinfect solution. We felt that the possible reason for the artifact could be due to defect in the collimation of X-rays.

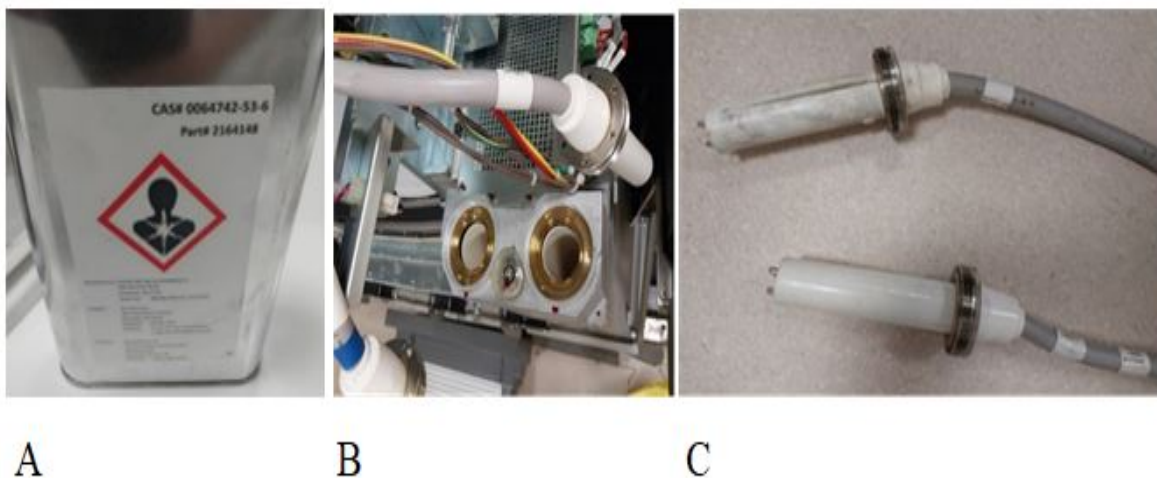


Figure 1: a) Dielectric Oil b) placement zone c) HV cathode cables

We immediately made a call to service engineer and find insufficient dielectric oil [Figure :1(a)] and while opening CT gantry for filling the dielectric oil to the CT tubes he found breakdown at the HV cathode cable [Figure 1c]. Immediately placed an order for the spare part and replaced it on an emergency basis. After that service engineer done all CT QA and QC calibration procedures but later we again found the same artifacts on the CT Trans axial images

of all CT and PET-CT scan-based patients. Then GE engineer suspected on the CT acquisition, reconstruction methods and we decided to review the CT parameters like scan type, rotation time, recon mode, recon type, pitch, noise index and all. Our review revealed difference in CT reconstruction type and rotation time.

In the earlier protocol the standard recon type and rotation time was 0.6sec with standard recon mode which

was now changed to soft recon type, IQ enhance recon mode with rotation time of 0.7sec.

IQ enhance (IQE) enables faster anatomical coverage using faster helical scanning at similar artifact index level compared to slower helical scanning without IQE. This coverage speed equivalent to that of wider detectors (32slice equivalent) at same table speed.

Discussion

Streak artifacts occur near materials like metals or bone primarily as a result of beam hardening and scatter. This artifact looks like dark streaks between metal, bone, iodinated contrast, barium and other high attenuation materials and also bright streaks are seen adjacent to the dark streaks [5].

X-rays lose their energy or harden more quickly as they pass through metal or bone than they pass through muscles or organs. These streaking artifacts can appear in Trans axial images of computed tomography due to electrical fluctuations and collimation defects.

This artifact is also called as Compton scatter and scatter causes X-ray photon to change in direction and energy. Due to this could end up in a different detector than they should be in.

The use of metal artifact reduction of CT for attenuation in combined PET-CT is always recommended. Nowadays iterative metal artifact reduction software was installed in PET-CT machines. Which is suppress the streak artifacts by decreasing the HU in areas in which values have been overestimated and by increased HU in areas of underestimation [6].

A higher KV scan can also be attempted by technologists to produce a harder X-ray beam and, consequently, fewer beam hardening artifacts. There is a trade-off, though, since a higher KV will result in a lower scan's tissue contrast.

If your reconstruction techniques and reduction software are current and also doing the scans with highest KV but streak artifacts are still appearing. It's probably time to call in a service engineer to diagnose underlying causes and also check acquisition reconstruction parameters.

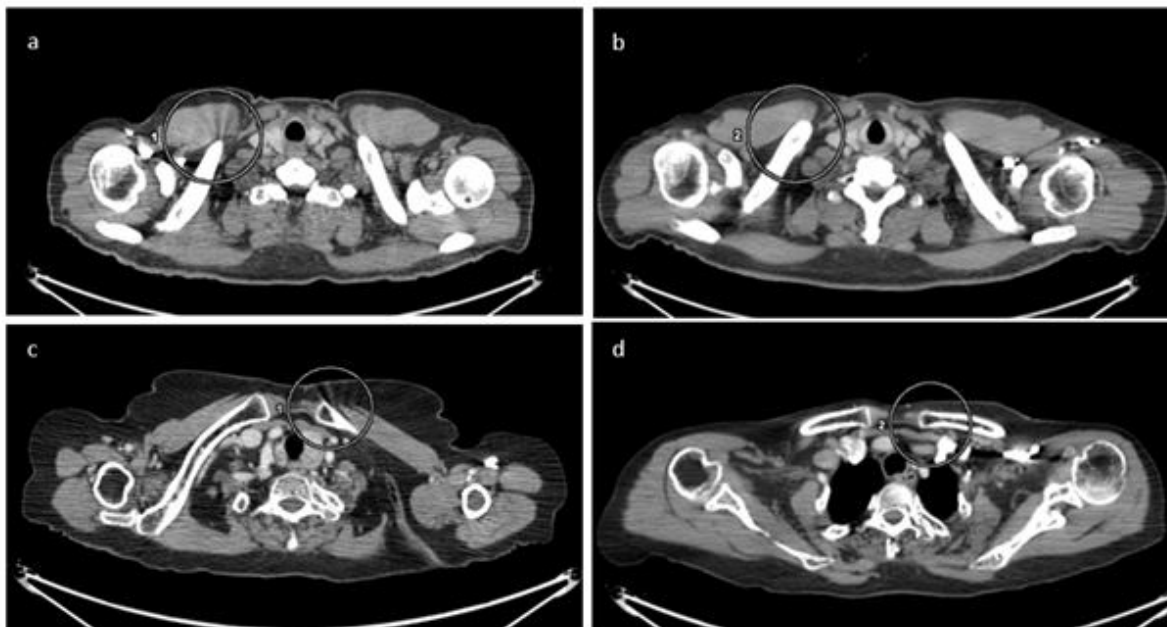


Figure 2: (a)&(c) axial images of two different patients showing streaking artifacts at clavicle bone (encircled) and (b)&(d) axial images of same patients after changing parameters

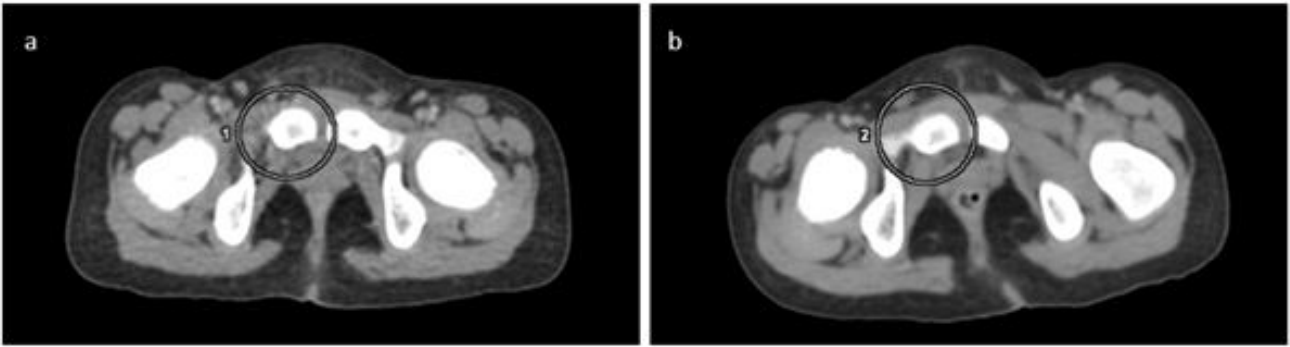


Figure 3: (a) axial image of another patient showing streaking artifact at right pubic bone (encircled) and (b) axial image of the same patient after changing parameters

Conclusion

The streaking artifacts on trans axial CT images due to an unusual cause such as improper acquisition parameters which does not require expensive replacement of

the detector module, CT hardware parts and also not much of significant down time. This type of artifacts can be avoided by maintaining locking system of the standard protocols prescribed by the manufacturer.

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