CASE REPORT

Root cause of image shrinking in SPECT/CT gamma camera and its remedial action

Muhammad Bota[1*], Muhammad Shahbaz[1], Zahid Hussain[1]

ABSTRACT

Background: A shrink image was observed during 99mTc whole body bone scan of patients on one of the designated Head of GE Infinia Hawkeye 4 dual head SPECT/CT system. The artifact started appearing during the acquisition of whole body, static, dynamic, and SPECT images. Similarly, during DTPA scan, the problem occurred in some of the frames.

Case Presentation: The artifact appeared because of the problem in one detector. The acquired images appeared nonuniform because of this artifact. The cause of the nonuniformity of images was analyzed which lead to the faulty ADAM board of the detector of head 2.

Conclusion: A defective ADAM board can lead to suboptimal image on display. Appropriate image quality in such a case can be obtained after the rectification of root cause.

Keywords: Artifact, shrink image, ADAM board, SPECT/CT.

INTRODUCTION

A hybrid SPECT/CT system is a fusion of two medical imaging systems which provides anatomical and functional information of human body in fused form. Optimal image quality is important for proper diagnostic use of SPECT/CT images [1]. Artifacts may randomly appear and may compromise the degree of accuracy of images.

CASE REPORT

An emission scintigraphy artifact was observed during the acquisition of 99mTc whole body and DTPA scan on GE Infinia Hawkeye SPECT/CT system. As shown in Figures 1 and 2, DTPA and WB scan were performed on the subject system. The initial frames of DTPA scan were nonuniform, however, when all the frames were collected, the final image produced was uniform (Figure 1). Similarly, during the WB scan, it was observed that the anterior image acquired by Detector (D1) (normal functioning) is a uniform image as compared to posterior image acquired by detector (D2) (defective). Due to non-uniform appearance of images during the scans, the routine calibration and uniformity test of the SPECT/CT were carried out and images of uniformity test on D1 and D2 are shown in the Figures 3 and 4, respectively. The result of the uniformity test shown in the images do not provide any useful information on patient scan (Figure 3). The colored spot in non-uniform image of Figure 3 shows the displacement

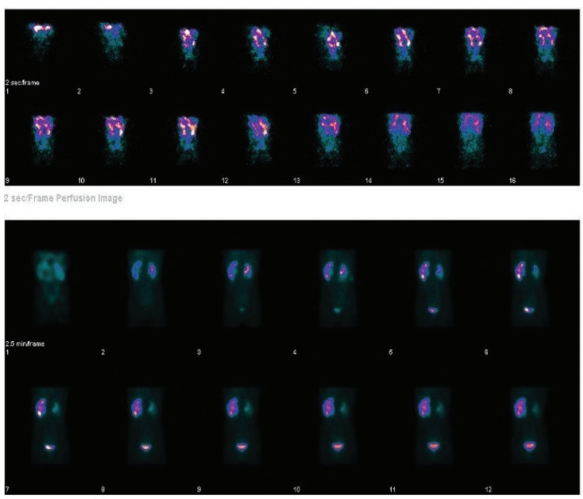

Figure 1. *Non-uniform images acquired during the DTPA scan.*

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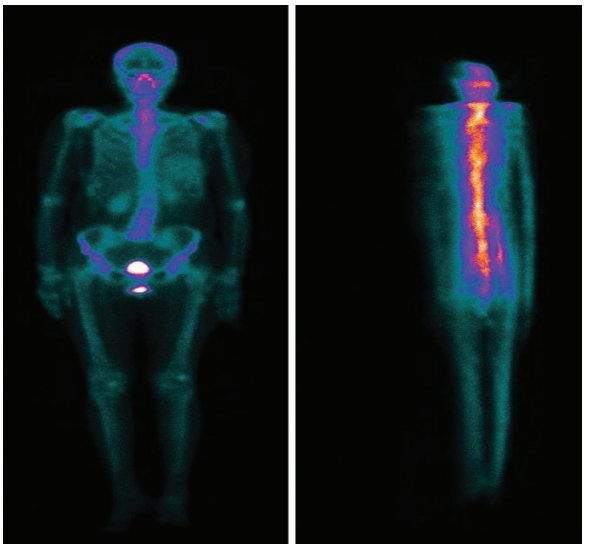

Figure 2. *Non-uniform images acquired during the whole body scan.*

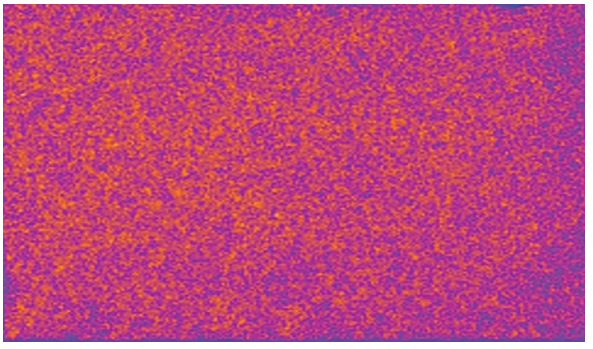

Figure 3. *Image of uniformity test results of Detector 1 before corrective action.*

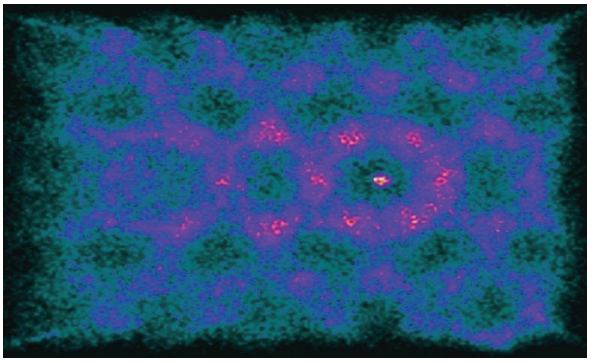

Figure 4. *Image of uniformity test results of Detector 2 before corrective action.*

and concentration of optical coupling grease material of Photomultiplier Tube (PMT) [2].

The large quantity of light signal was absorbed at the concentrated point and count rate became very high which ultimately showed a spot. The machine was systematically checked for defective part or algorithm and after a thorough observation a multilayered electronics IC board (ADAM board) was found faulty. Moreover, an appraisal was carried out to check the confirmation of the findings about the ADAM board. This ADAM board was replaced to the D1 and the same problem of D2 was shifted to the D1. The acquired images after the performance of the uniformity tests repeatedly are shown in Figure 5. However, the non-uniform image of the D2 became uniform after the replacement of the ADAM boards of the both detectors which is shown in Figure 6.

DISCUSSION

The signal processing is a vital component of medical image formation because all the information is carried out through these electronic signals. The positioning signal is a weighted sum of the output signals from PMTs [3]. This system is mainly composed of multilayered electronics integrated circuits called ADAM board. Due to improper processing of the electronic information by the faulty ADAM board, the resulting image is a non-uniform pattern of counts as shown in uniformity images. The shifting of QC patterns from detector 1 to detector 2 after the replacement of ADAM boards of both detectors lead to the conclusion that abnormalities and non-uniformities in images of DTPA and WB were because of the faulty ADAM board. However, design basis of ADAM board may be changed for future perspectives because in the existing designs, there are two ADAM boards processing the data of all the PMTs on single detector. Half of the PMTs' data is processed by each board independently [4]. The ADAM board and relevant system should be designed such that they should process the data of half of the PMTs in normal mode. However, if any problem occurred in one of the ADAM boards, the processing of data should be automatically transferred to second board and each board should have the capacity of processing the whole data from all PMTs of a single detector.

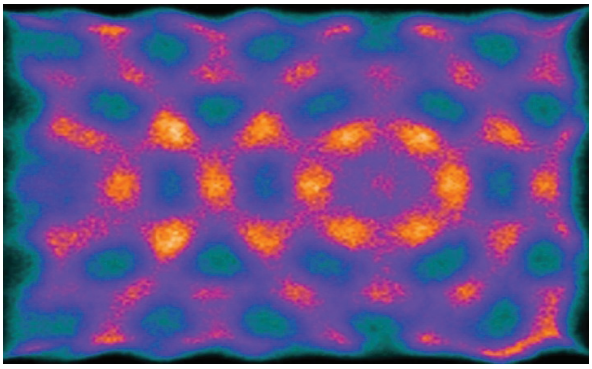

Figure 5. *Image of uniformity test results of Detector1 after replacement of faulty ADAM board.*

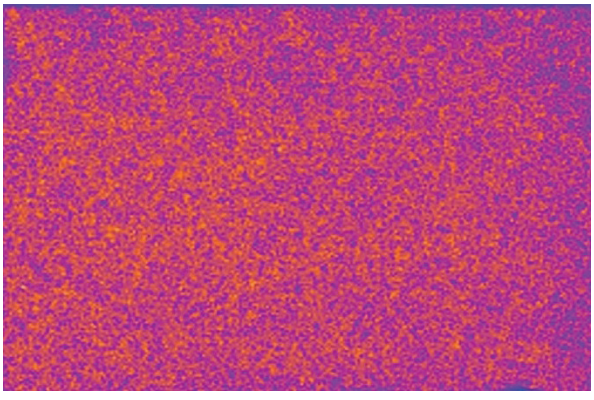

Figure 6. *Image of uniformity test results of Detector2 after replacement of ADAM board.*

CONCLUSION

The appearance of non-uniform patterns and image shrinking on Head2 of SPECT/CT System during different scans like DTPA and WB was due to a faulty ADAM board. This ADAM board is an integral part of the PMTs signal processing, and therefore, the failure of its function to perform properly will lead to poor image quality.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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Consent for publication

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Ethical approval

Ethical approval is not required at our institution to publish an anonymous case report.

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