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Performing an additional lateral decubitus PET/CT scan to resolve a respiratory motion artifact

SHORT RUNNING FOOT LINE:

PET/CT respiratory motion management

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ABSTRACT

Respiratory motion artifacts may affect whole body ^{18}F-FDG PET / CT scans interpretation, especially when lesions are localized between the liver and lung. We report a case of a patients affected by breast cancer who underwent PET/CT after therapy; a focal 18F-FDG uptake of not univocal interpretation was observed between liver and pleura. A subsequent acquisition on the right lateral decubitus showed the pleural location of lesion , thus improving the diagnostic accuracy of the PET/CT finding.

Key Words: PET/CT; lung; liver; artifact management; Respiratory motion.

INTRODUCTION

Bone, liver, lung and brain are common metastatic sites in breast cancer and are often evaluated by 18-fluorine-fluorodeoxiglucose positron emission tomography/computed tomography (18F-FDG PET/CT) for a metabolic characterization(*1*).

CASE REPORT

A 50-year-old woman with a history of left breast cancer previously treated with mastectomy and axillary lymph node dissection underwent 18F-FDG PET/CT for suspected splenic and lung metastases. PET/CT images were acquired 60 min after an intra-venous injection of 3.5 MBq/kg of 18F-FDG on a Discovery 690 tomograph (GE; Milwaukee, Wis; 64-slices, low dose CT: 40 mAs, 120kV; 2.5 min/bed; 256x256 matrix, 70-cm field of view) and revealed a focal increase in uptake between the liver and the pleura of not clear origin, suspicious of metastatic disease (*Fig. 1*).

Subsequently, a second segmental acquisition was performed on the right lateral decubitus, which allowed to displace the liver away from the chest wall and showed that the lesion originated from the pleura (*Fig.2 A-B*). A subsequent high-dose CT scan confirmed the pleural location(*Fig.2 C*).

DISCUSSION

Respiratory motion on PET/CT scans can cause missing or dislocation of the lesion along diaphragm, determining a systematic decrease in standard uptake value (SUV) measurements(*2*). Also small lesion detection can be interferred due to the diaphragmatic motion that causes an internal organ shift introducing image artifacts, causing an image blurring and consequent lower ability to detect (due the partial volume effect) and to locate lesions. The region between the liver and the lung is particularly sensitive to motion artifacts with frequent difficult/wrong attribution to specific

anatomical territories. Another limitation, as previously mentioned, of PET/CT is the low spatial resolution (about 5 mm) of conventional scanner, that may cause quantitative distortions and reduced sensitivity due to partial volume effect (*3*).

The main technical solutions available to manage respiratory motion artifacts in PET/CT studies are hardware and/or software technologies provided by several vendors with different definitios (Respiratory Gated, Motion Free, End Expiration, Banana Artefact Management and Data Driven Gating), which show a benefit in terms of both image quality ,quantification and diagnostic sensitivity. However, patient compliance, long acquisition times and availability of these techniques represent major limitations (*4*).

In this case report, we applied a different acquisition method to manage this artifact. After the whole body acquisition, the patient was positioned on right lateral decubitus and a segmental scan was acquired. This permitted to separate the pleura from the liver, showing that the lesion was pleural, increasing diagnostic and quantitative accuracy : the SUV_{max} increased from 7 in WBS to 7.5 in the modified acquisition posture(*Fig.2 A-B*). Evaluating the SUV_{max} , the delayed time between the two acquisition was 6 minutes, this is a factor to take into account.

CONCLUSION

This case illustrates a possible way to manage PET/CT scan artifacts during free breathing and consequent difficult and unclear anatomic definition of anatomical pertinence of focal uptake in peripheral lung regions or, alternatively, in pleura or liver.

This approach is very simple, cost-free and available in all labs even though not equipped with last generation of PET/CT scanners.

DISCLOSURE

No potential conflict of interest relevant to this article was reported.

REFERENCES

1. Robertson IJ, Hand F, Kell MR. FDG-PET/CT in the staging of local/regional metastases in breast cancer. *Review The Breast.* 2011;20:491-494.
2. Liu C, Pierce LA, Alessio AM, Kinahan PE. The impact of respiratory motion on tumor quantification and delineation in static PET/CT imaging. *Phys Med Biol*. 2009;54:7345-7362.
3. IAEA human health reports no. 9 Vienna. *Quantitative nuclear medicine imaging: concepts, requirements and methods*. 2014. http://www.iaea.org/Publications/index.html
4. De Ponti E, Morzenti S, Crivellaro C, Elisei F, Crespi A, Guerra L. Motion management in PET/CT: technological solutions. *Curr Radiopharm*. 2018;11:79-85.

FIGURE LEGENDS

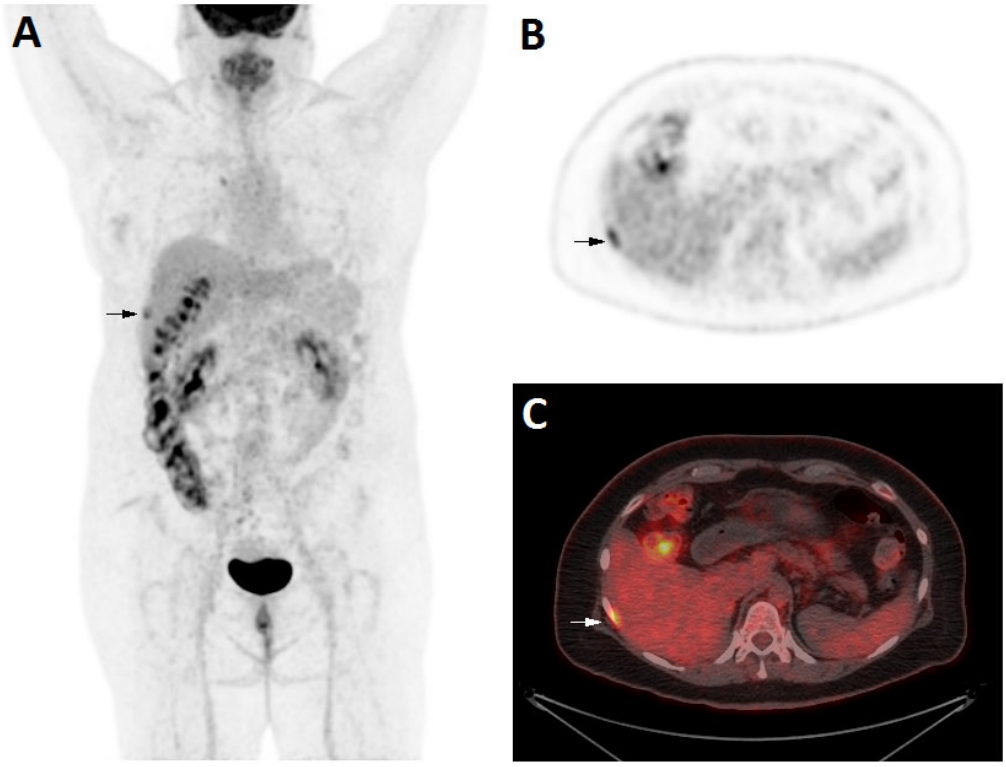

FIGURE 1. Anterior maximum-intensity projection (A) and axial (B) ^{18}F-FDG PET and fused PET/CT (C) images show focal hypermetabolic activity on the right side between liver and pleura (C).

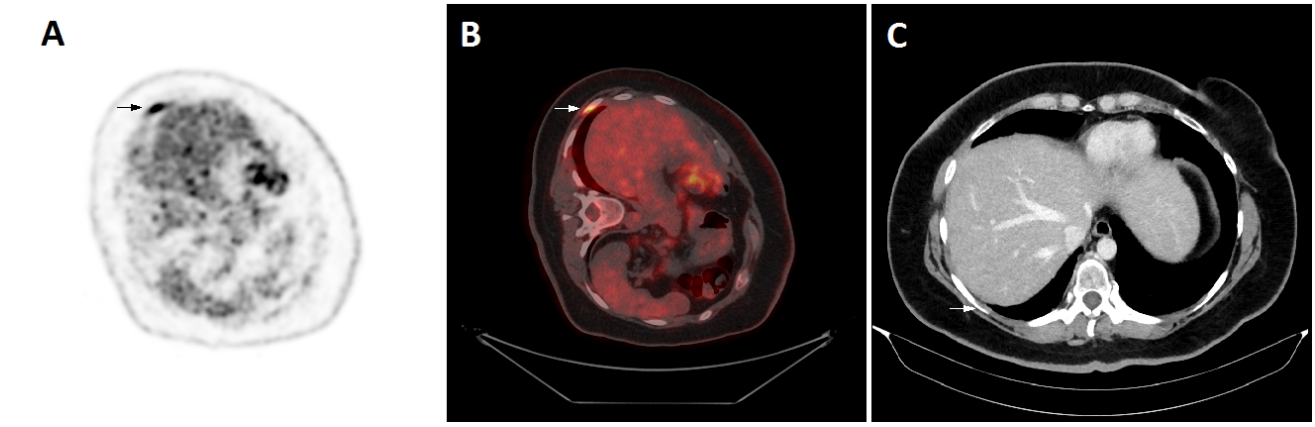

FIGURE 2. Axial maximum-intensity projection (A) and fused PET/CT (B) axial images on the right side showing that the lesion was pleural. Subsequently high-dose CT scan confirmed the pleural location (C).