Author: G. Currie, J. Wheat and R. Pearce
Author Address: gcurrie@csu.edu.au
jwheat@csu.edu.au
Title: Planar Image Fusion
Year: 2007
Journal: Internet Journal of Nuclear Medicine
Volume: 4
Pages: Texas, USA
ISSN: 1539-4638
URL:
http://www.ispub.com/ostia/index.php?xmlFilePath=journals/ijnuc/vol4n1/fusion.xml
Keywords: fusion, scintigraphy, planar, xray
Abstract: Image fusion of SPECT and PET data has been shown to improve diagnostic accuracy in a variety of clinical circumstances. While the use of SPECT/CT and PET/CT image fusion has been well documented in the literature, the potential role of planar image fusion is not well documented. This brief report presents several circumstances in which planar image fusion might be useful in clinical practice.

PLANAR IMAGE FUSION.

Geoffrey M Currie[1], M MedRadSc, M AppMngt, MBA, PhD

Janelle M Wheat[1], B AppSci, M MedRadSc, DHlthSc

Russell D Pearce[2], B AppSc

[1] School of Biomedical Sciences, Charles Sturt University, Wagga Wagga, Australia.

[2] Gosford Nuclear Medicine, Gosford, Australia.

Correspondence:

Geoff Currie

School of Biomedical Sciences

Locked Bag 588

Charles Sturt University

Wagga Wagga 2678

Australia

Telephone: 61 2 69332822

Facsimile: 61 2 69332866

Email: gcurrie@csu.edu.au

Foot line: Planar image fusion

ABSTRACT

Image fusion of SPECT and PET data has been shown to improve diagnostic accuracy in a variety of clinical circumstances. While the use of SPECT/CT and PET/CT image fusion has been well documented in the literature, the potential role of planar image fusion is not well documented. This brief report presents several circumstances in which planar image fusion might be useful in clinical practice.

INTRODUCTION

Physiological imaging using single photon emission computed tomography (SPECT) is a valuable tool in the diagnosis of many diseases but may be limited, on occasion, by poor anatomic localization (*1*). This limitation might be overcome using image fusion, a process of data superimposition using multiple image types; typically computed tomography (CT) or magnetic resonance imaging (MRI) for anatomic data superimposed with SPECT or positron emission tomography (PET) for functional data (*1*). It is not uncommon for the combined image fusion data to provide additional clinical information that was not evident from either anatomic or functional datasets; interpreted in isolation or in tandem without fusion.

Image fusion of SPECT and PET data has been shown to improve diagnostic accuracy in many clinical circumstances (*2*). There are two main methods of performing SPECT/CT image fusion. The first employs hybrid scanner technology where a CT scanner is integrated in the gamma camera gantry to allow sequential imaging of anatomy and physiology. An alternative approach would be to perform image fusion on data acquired on individual dedicated SPECT and CT systems.

While the use of SPECT/CT and PET/CT image fusion has been well documented in the literature, the potential role of planar image fusion (e.g. planar scintigraphy and radiograph) is not well documented. This brief report presents several circumstances in which planar image fusion might be useful.

METHODS

All planar image fusion was performed using Merge version 2.0, a fully functional freeware program readily downloadable over the internet. Merge 2.0 is a simple graphic utility designed to merge graphic images, including batch merging to a reference image. While these features were initially conceived for manipulation of graphics and watermarking images more easily, they readily lend themselves to merging planar scintigraphy with radiographs and applying an anatomic reference image to a dynamic scintigraphic data set.

RESULTS

Scintigraphy to Xray

Perhaps the most useful application of planar image fusion is the merging of bone scans with xrays. Combining the high spatial resolution of xrays with the physiologically sensitive bone scan assist on overcoming the limitations of each. Figure 1 presents an ?? year old male with a history of ?????. The xray was reported as ??????? The bone scan shows ???? and the fusion adds ???.

Russ, can you give me a brief history of Robert Nicholl? Or send the xray and nuc med report for me to fill in the blanks?

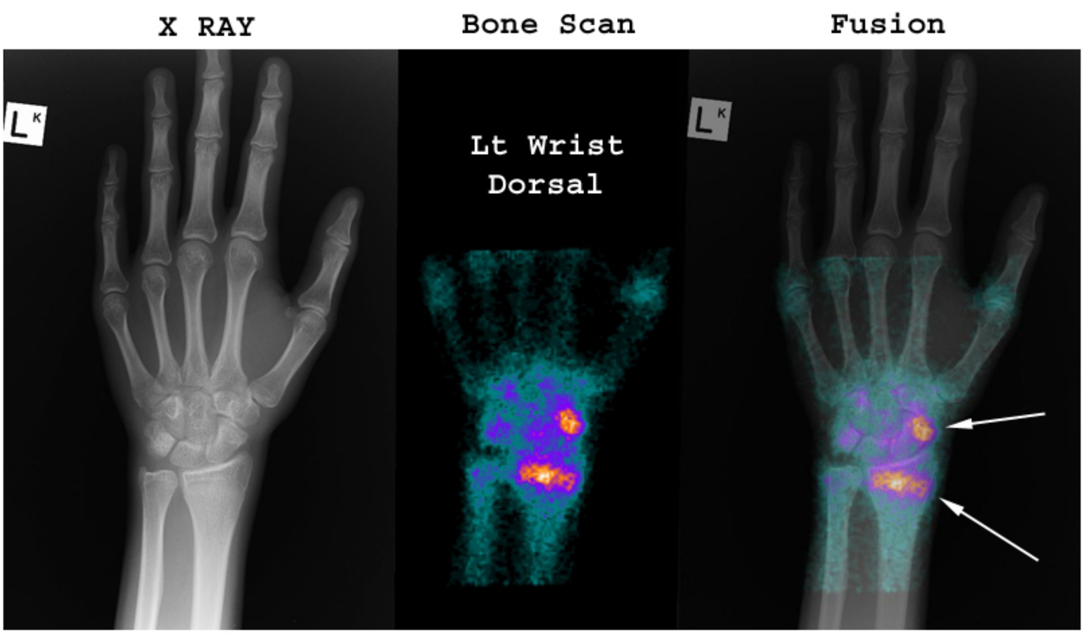

Figure 1:

Scintigraphy to Scintigraphy

It is not uncommon for MIBG and DTPA to be summed for better localization of adrenal glands. Summation of DTPA and MIBG images requires rigorous adherence to protocol. On the final day of imaging and after all other images have been collected, a posterior lumbar spine image is typically acquired for MIBG. Subsequently and without the patient moving, DTPA is administered and an identical image acquired. As a result, the DTPA image is only summed with a single image.

Image fusion would permit DTPA to be administered more conveniently. Indeed, the patient may be administered DMSA and return hours later for imaging to avoid the confounding sometimes associated with DTPA clearance. The DTPA or DMSA image need not be acquired on the same gamma camera or even using the same acquisition parameters (e.g. matrix) (Figure 2). Moreover, DTPA or DMSA images may be acquired in multiple projections and merged with corresponding MIBG projections acquired, not just in the final imaging session, but across all imaging session. This might include the merging the DTPA or DMSA planar image with the whole body MIBG sweep (Figure 3).

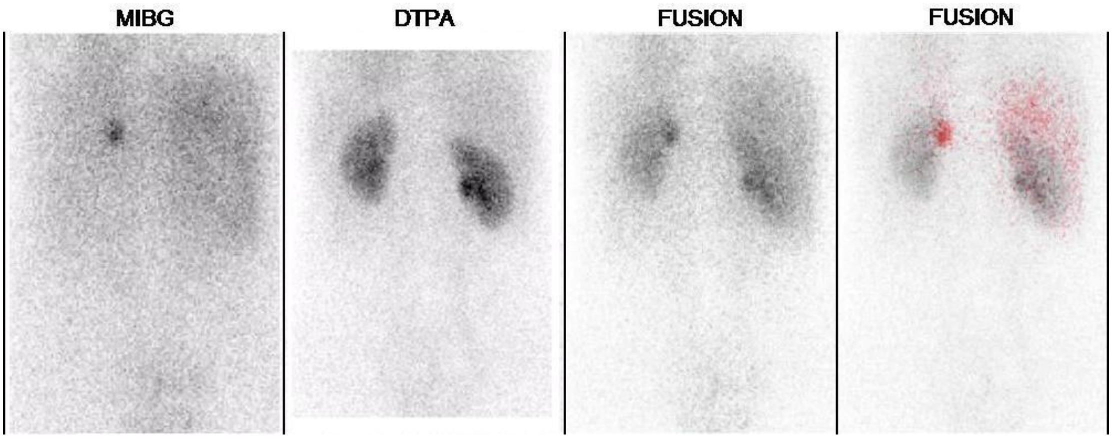

Figure 2: A 29 year old female investigated with 123I MIBG for possible pheochromocytoma. Highlighted by this successful fusion is the advantage of merging over summation with not only different size images between MIBG and DTPA but also a different X,Y aspect (0.67 for MIBG and 0.71 for DTPA).

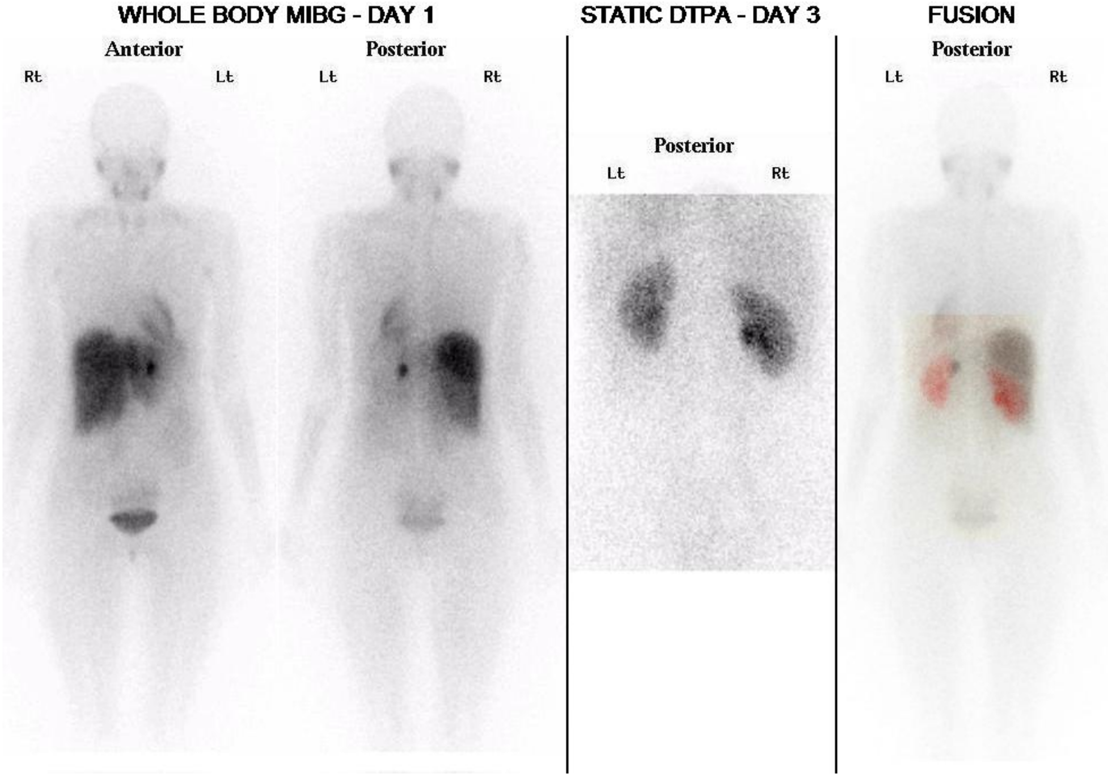

Figure 3: The whole body fusion study of the patient in figure 2.

Similar applications might include, without being limited to:

- merging blood flow, blood pool and delayed bone images,
- merging whole body gallium, whole body thallium and whole body bone images,
- merging previous scans with current scans,
- merging lung ventilation and perfusion studies,
- merging white blood cell studies with bone or gallium studies.

Scintigraphy to Photograph

On occasion it is difficult to conceptualise the imaged biodistribution to the original object. While the patient might be standing before us, connecting an area of increased tracer accumulation directly to a point of pain or discomfort may be imperfect. Merging planar scintigraphy with a photograph of the patient, however, may provide more of a promotional tool for referring doctors than a tool for improving diagnostic utility. Certainly if colour images are visually appealing to referring doctors, then having a photograph of their patient merged with the scintigraphy study (localized static or whole body) might increase referrals. More importantly, any number of research studies performed in Nuclear Medicine departments might be assisted by fusion of planar images with photographs. This might be particularly useful if the research involves specialists from outside the Nuclear Medicine domain (Figure 4).

A key limitation of merging scintigraphy with photographs is the ‘pin hole’ effect. Like the pinhole collimator, the photograph may distort (parallax error) towards the edge of images. While not generally perceptible to the eye in photographs, high resolution digital photographs taken close to an object or of large objects may be obviously misaligned post fusion. This is despite every effort to ensure the photograph is taken in the same plane as the scintigraphic image.

Figure 4: The use of 99mTc pertechnetate to investigate flow patterns in grape vines provided interesting results. The fusion study allowed, in particular, the non Nuclear Medicine personnel initiating the research to better understand and interpret findings. An obvious reveal on the fusion study was the correlation of lack of leaf accumulation to those leaves tapped flat to the gamma camera, inhibiting transpiration driven accumulation.

CONCLUSION

Planar image fusion may provide a useful tool to improve diagnostic utility and / or interpretive certainty. Planar image fusion is easy to perform with cost neutrality. A number of fusion solutions may provide superior results or greater flexibility than traditional ‘summation’ of data sets.

REFERENCES

1. Kneöaurek K, Ivanovic M, Machac J &Weber D 2000, Medical image registration, *Europhysics News*, vol. 31 no. 4.
2. Forster GJ, Laumann C, Nickel O, Kann P, Rieker O & Bartenstein P 2003, SPET/CT image co-registration in the abdomen with a simple and cost-effective tool, *Eur J Nucl Med Mol Imaging*, vol. 30, no. 1, pp. 32-39.