Erratum

Due to a production error, Figure 5 in the article, "Intermodality, Retrospective Image Registration in the Thorax," by Yu et al. (December 1995, 2333–2338), was printed incorrectly. The image and page have been reprinted.

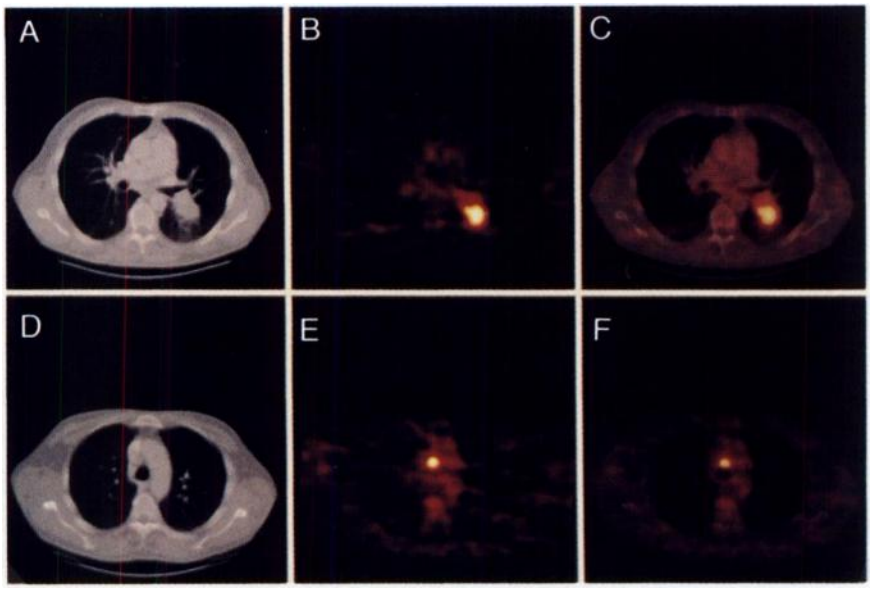

FIGURE 5. Two axial slices are shown. (A, D) CT scans. (B,E) PET scans and (C,F) are the merged images for the two slices, respectively.

Patient 3

This patient is a 51-yr-old man with a left lung mass suspected of being a bronchogenic carcinoma. Figure 5A shows a CT section at the level of the pulmonary hila. A mass is readily visible in this image. The corresponding PET mission image in Figure 5B demonstrates a region of increased FDG uptake in approximately the same region. The combined PET-CT image in Figure 5C demonstrates that only a portion of the mass shown in Figure 5A is likely to be an actively growing tumor. Another CT section from the same patient is shown in Figure 5D. No pathology is readily evident on this image. The corresponding PET image in Figure 5E demonstrates focal uptake of FDG consistent with nodal metastasis.

Looking at the PET study alone, however, it is difficult to determine the exact location of the metastatic node due to lack of anatomical information. Figure 5F makes exact localization of the metastatic node in a pretrachial location obvious.

DISCUSSION

We have developed an image segmentation technique which, in conjunction with the surface-fitting algorithm, yields an accurate registration of thoracic PET and CT. This technique, which involves the generation of surfaces from the chest wall, is potentially less susceptible to mis-registration than methods using external fiducials since the pleura are in intimate contact with the thoracic cage. The rib cage is very reliable for surface definition since it is a relatively rigid structure and moves only minimally during quiet respiration. In addition, the large difference between the attenuation coefficients for soft and lung tissue make the pleural surface easily discernable.

The accuracy of this technique was evaluated by two basic approaches: quantitatively through a phantom study used by evaluation of the resulting clinical image. The phantom study indicated that this technique was accurate to within 2~3 mm in all directions. Although the clinical examples in this report were acquired using a standard CT scanner (1 cm interslice spacing), the phantom data were obtained with a helical CT scanner. The phantom data were acquired in this manner because helical CT is the current modality of choice for these types of studies at our institution. Thus, the accuracy of the registration technique demonstrated by the phantom study is representative of our current, clinically applied method. It is expected that the accuracy of this technique with standard CT is slightly worse.

We evaluated the registration of the clinical images by several means. One method was to overlay the CT contours used in fitting onto the resliced PET transmission images. This overlay should align with the 50% isocontour in the resliced PET images. In all cases, the images appeared well aligned.

Another method of evaluation was to apply the dual-color scale merging procedures described in the Results section to the CT and resliced PET transmission study rather than the emission study. This method is more subjective than the contour overlay method just discussed, but it is useful because the two image sets are compared directly to each other rather than comparing a representative of an image set (a contour) to an image set.

Finally, the quality of the fit can also be evaluated by examination of the final images. Tumors seen on PET should overlay regions of density on CT. Similarly, areas of inflammation, consolidation of pulmonary collapse should be aligned between the two studies. We found that this was usually the case. We discovered, however, that features near the diaphragm were often displaced in the restrol-caudal axis relative to the same feature in the other modality. We associate this axial displacement with diaphragmatic motion during normal respiriation. This motion is probably