Low-Cost, Small-Animal Shelf for Simultaneously Assessing Several Small Animals with a Whole-Body PET Scanner

Ralph Buchert, Meike de Wit, Anette Raabe, Karl H. Bohuslavizki, Ulrike Schulte, Janos Mester, and Malte Clausen

Departments of Nuclear Medicine, Oncology and Hematology, and Radiation Therapy and Radiation Oncology, University Hospital Eppendorf, Hamburg, Germany

Objective: The purpose of this work was to establish a low-cost device for simple positioning of several small animals within a whole-body PET scanner.
Methods: The device was designed as a stackable shelf for 3 × 3 animals, similar to a stackable shelf for wine bottles. It was constructed from ordinary PVC drain pipe and acrylic panes.
Results: The shelf simplified accurate and reproducible positioning of the animals and, therefore, supported automatic data processing. Deterioration of image quality by attenuation of photons within the shelf itself was rather small.
Conclusion: The small-animal shelf is a useful, low-cost device for simultaneously assessing up to 9 small animals with a whole-body PET scanner.
Key Words: positron emission tomography; small animals; whole-body scanner

J Nucl Med Technol 2000; 28:171–172

PET using 2-[^{18}F]-fluoro-2-deoxy-D-glucose (FDG) is well established in oncology for staging various malignant diseases. In the last few years FDG PET has been used successfully for therapy monitoring. In this context, we planned an animal study investigating the optimal time schedule for FDG PET in therapy monitoring. Since there was no dedicated small-animal PET system (*1–3*) available in our department, we sought to use a conventional full-ring, whole-body PET system installed at our hospital. According to the protocol, 220 rats were to be studied during or after radiation therapy or chemotherapy. We planned to scan each rat up to 40 times with the PET scanner. This large number of single PET studies within a given time period required that several rats be scanned simultaneously.

Simultaneous imaging of several rats side-by-side on the patient bed did not seem appropriate. We designed a dedicated small-animal shelf in which the following criteria were identified as ideal:

- Capacity for about 10 animals;
- Simple positioning of the animals within the shelf;
- Low attenuation of annihilation photons by the shelf;
- Easy hygienic cleaning of the shelf; and
- Exact and reproducible positioning of the shelf within the scanner to support automated data processing.

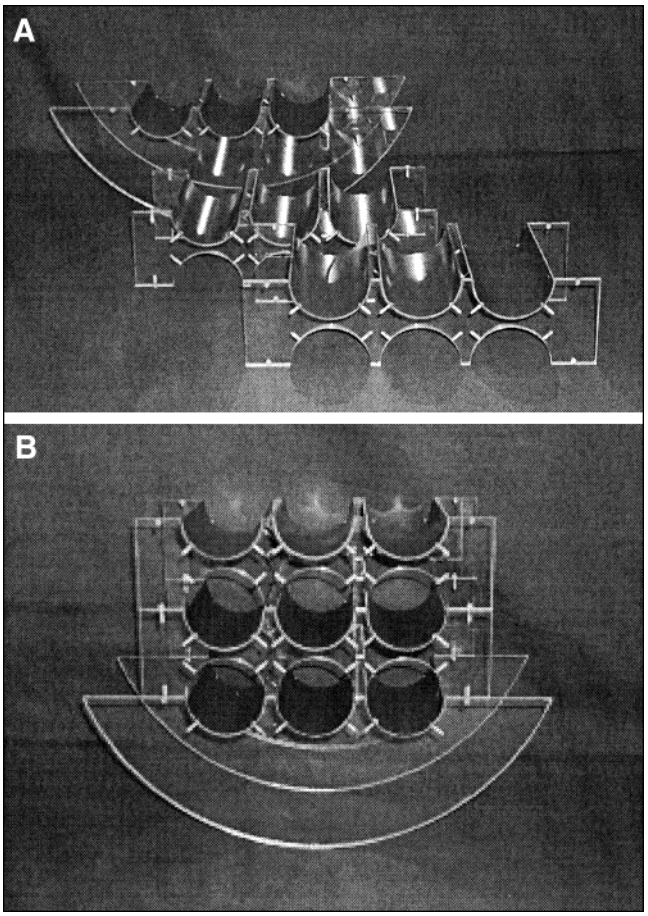

FIGURE 1. Small-animal shelf (A) separated into pieces and (B) assembled.

For correspondence or reprints contact: Ralph Buchert, PhD, Department of Nuclear Medicine, University Hospital Eppendorf, Martinistr. 52, D–20246 Hamburg, Germany; Phone: +49 40 42803–6106; E-mail: buchert@uke.uni-hamburg.de.

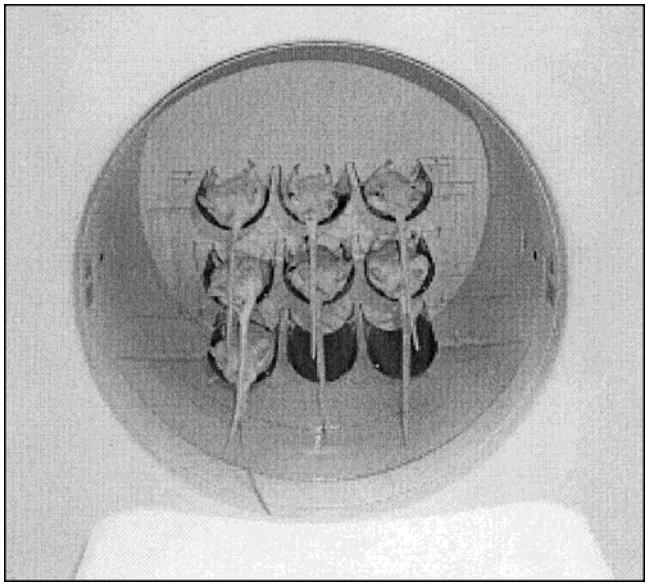

FIGURE 2. Small-animal shelf loaded with 7 rats and placed inside the scanner gantry.

METHODS AND MATERIALS

We designed the small-animal shelf as a stackable device for 3 × 3 animals, similar to a stackable shelf for wine bottles (Fig. 1). Ordinary PVC drain pipe with a diameter of 8.5 cm and a wall thickness of 1.5 mm was cut into 20-cm lengths, which were further cut longitudinally into halves. Three halves were inserted, in parallel, into acrylic panes, tailored for this purpose, and were fixed by plastic screws. Then 3 of these panes were assembled to form a 3 × 3 stack. The acrylic panes were furnished with small pins at the upper edge and correponding holes at the lower edge to ease stackability. The lower edge of the lower acrylic pane was tailored as a circular arc with the same radius as the patient port of the gantry, to allow stable positioning. The length of the circular arc was chosen to center the whole shelf in the transverse field of view. Thus, the center animal was positioned at the center of the field of view. The total cost of the materials of the small-animal shelf was less than $50 (US).

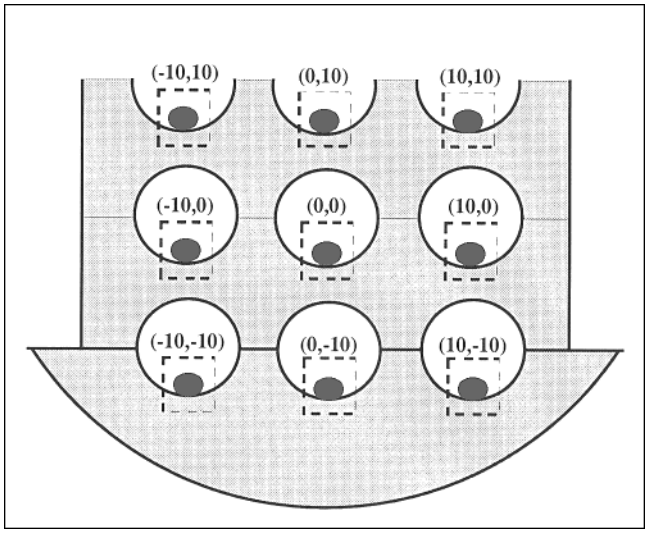

FIGURE 3. The reproducible positioning of the small-animal shelf supports automated reconstruction with fixed x and y offset and zoom.

RESULTS

The small-animal shelf has been used successfully for 1.5 y. The bottom pane of the device can be placed easily in the patient port of the gantry without any fixation. Reproducible alignment can be achieved exactly using the laser device of the PET scanner, normally used for patient alignment. Anesthetized rats can be positioned easily within the shelf, pane by pane, from the bottom to the top (Fig. 2). Additional attenuation of 511-keV photons due to the shelf is rather low, since there are only the halves of the rather thin PVC drain pipe within the field of view of the scanners (mean attenuation 7%, maximum attenuation 35%). The acrylic panes are not within the field of view and, therefore, cannot deteriorate image quality. Cleaning and disinfecting the device does not require any special care since the PVC and acrylic are nonreactive with cleansing agents. Also, plastic screws were used for assembly, instead of glue, and are not affected by disinfectants and cleansing agents.

Images must be reconstructed for each animal separately, using appropriate off-sets and zoom factors, to evaluate PET studies of several small animals acquired simultaneously. This data processing can be automated easily since the small-animal shelf supports both the reproducible positioning of the animals within the shelf and the exact and reproducible positioning of the shelf within the scanner. The x and y coordinates of the animals are the same whenever the animals are studied (Fig. 3). The dimensions of the shelf must be adapted to the particular whole-body scanner used, since the diameter of the patient port varies significantly among different scanner models.

CONCLUSION

Some PET studies with small animals, such as rats, do not require the highest spatial resolution. Therefore, more widely available whole-body PET systems can be used instead of dedicated small-animal scanners. The large transverse field of view of whole-body scanners allows the simultaneous imaging of several animals. The small-animal shelf described here is convenient for this purpose.

REFERENCES

1. Chatziioannou AF, Cherry SR, Shao Y, et al. Performance evaluation of microPET: a high-resolution lutetium oxyorthosilicate PET scanner for animal imaging. *J Nucl Med.* 1999;40:1164–1175.
2. Zhang H, Alyafei S, Inoue T, et al. Performance stability of SHR-2000 high resolution PET for animal research. *Ann Nucl Med.* 1999;13:65–70.
3. Weber S, Terstegge A, Herzog H, et al. The design of an animal PET: flexible geometry for achieving optimal spatial resolution or high sensitivity. *IEEE Trans Med Imaging.* 1997;16:684–689.