Standardized Annotation of Nuclear Medicine Images

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There are no generally accepted standards for annotating nuclear medicine images. This is a potential problem whenever hardcopies from other centers are being evaluated, reinterpreted or compared to actual images of the same patient. Proposals for image annotation are elaborated to support image evaluation by a third party. In this paper, examples are given of lung scintigraphy, thyroid scintigraphy, bone scintigraphy both in planar and SPECT techniques, renal function scintigraphy, myocardial perfusion scintigraphy, and PET. They are presented to stimulate discussion in the nuclear medicine community.

Key Words: image annotation; standardization; minimum requirements; DICOM 3.

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There are no generally accepted standards for annotating nuclear medicine images. This has the potential to become a problem whenever hardcopies from other departments, clinics or institutions must be evaluated, reinterpreted or compared to actual images of the same patient. Image annotation is independent of the image quality, even images of the best quality may be insufficient for interpretation if essential information is missing. Incomplete annotation of images may render interpretation difficult or even impossible. The main task of the working group Standardized Image Documentation of the German Society of Nuclear Medicine was to define guidelines for the minimum requirements of nuclear medicine image annotation (*1–3*). This group has gained experience over the last 4 y. Their proposals have been discussed at several national conferences (*4*,*5*). The members of the working group are cooperating with representatives of other national nuclear medicine societies.

The examples presented here should be discussed extensively to generate a consensus about them. Only proposals generally accepted by the nuclear medicine community have a significant chance to be implemented by the manufacturers of nuclear medicine computers. The standardization of image annotation should be separated strictly from standardization of nuclear medicine procedures themselves. The latter is an independent process of national nuclear medicine societies, such as the Society of Nuclear Medicine. The elaborated proposals for image annotation should neither limit the freedom of individuals nor the industry to define individual layout or extensions of image annotation.

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EXAMPLES OF IMAGE ANNOTATION

The examples presented of typical nuclear medicine studies have resulted from consensus conferences held at meetings before the last 4 national congresses of the German Nuclear Medicine Society (*2*,*4*,*5*). We submit them here for a broad-based discussion within the nuclear medicine community. They were designed to cover the requirements of everyday, routine studies. The minimum required annotation necessary for interpreting the image content by third parties was one of the declared intentions of our task group, and individual extensions of these minimum requirements by particular institutions should be permitted.

Several pieces of data should be documented clearly on all nuclear medicine studies: patient identification; date of birth; date of the study; and institution in which the study was performed. The injected amount of radioactivity and the tracer used are probably the most important study-related data. The color bar or gray scale should be displayed, along with upper and lower limits. When parameters derived from regions-of-interest (ROIs) are presented, documentation of the positions of the underlying ROIs should be displayed. When image sequences are acquired, the time and duration of individual images should be documented throughout, as should the views of the respective images. The working group did not intend to favor one specific method of annotating the individual image views. Numerous methods of annotating image views have developed among European nuclear medicine physicians alone.

All examples of images were annotated in 2 ways, a DICOM 3.0-conform annotation displayed in plain characters and a more traditional annotation presented in *italic characters*. The following specific requirements should be fulfilled, in addition to the above mentioned basic requirements, for the most frequently performed types of studies

Lung Studies

Ventilation and perfusion studies should be distinguished clearly by appropriate annotation (Figs. 1 and 2). The annotation may be completed by labeling the side (left or right) of the patient as well as the position of the patient, both at the time of injection (supine, upright, etc.) and during acquisition (supine, upright, etc., and ant, post, LAO, etc.).

Thyroid Studies

Annotation of the neck should be displayed. Technetium-99m or ^{123}I uptake should be documented in percent, if available. The group recommends completing the annotation by including the matrix size, the display of the reference scale, and the time interval between injection and acquisition. It may be helpful to identify palpable nodes within the image (Fig. 3).

Bone Studies

Whole-body bone scans should be documented with at least 2 views, both at 2 intensity levels. The first view should be optimized for the ribs and the second for the spine (Fig. 4). The total counts of the respective views also may be annotated as a quality control measure.

Myocardium Studies

For myocardial perfusion SPECT (Fig. 5) or combined perfusion/viability studies (Fig. 6), the whole left ventricular myocardium must be displayed. Short-axis, horizontal and vertical long-axis slices should be presented for all studies. An optimized arrangement of geometrically identical slices of the respective studies within the same image is recommended. Moreover, information on the position of the patient during acquisition and anatomical annotation of the slices is required. Special techniques, such as gating and attenuation correction, should be annotated within the images.

Kidney Function Studies

Split renal function is the main data that should be documented within the image. If clearance data are presented, the method used and age-dependent lower limits should be given in renal scintigraphy. After diuretics, the documentation of the time of application, the curve and the effect of the diuretics in percent is essential (Fig. 7).

Tomographic Studies

In tomographic studies, both the direction of the slice sequence and an anatomical annotation of the slices should be presented within the images (Figs. 8–12). The interpretation of images may be supported by the use of pictograms. PET studies may be displayed as maximum intensity projections (MIPs) for overview (Fig. 10).

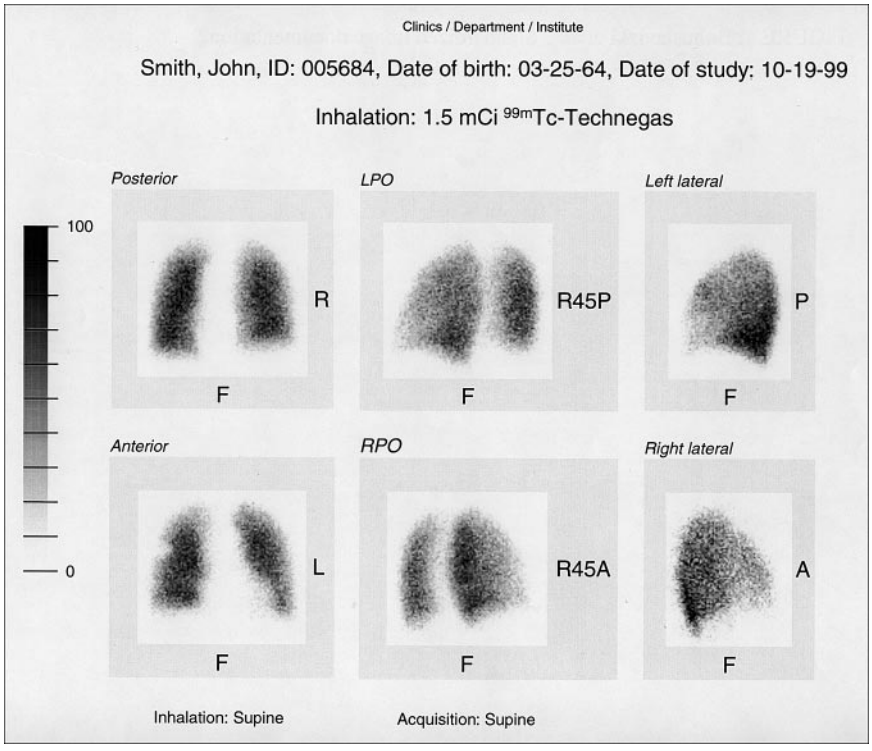

FIGURE 1. Ventilation scintigraphy of the lung.

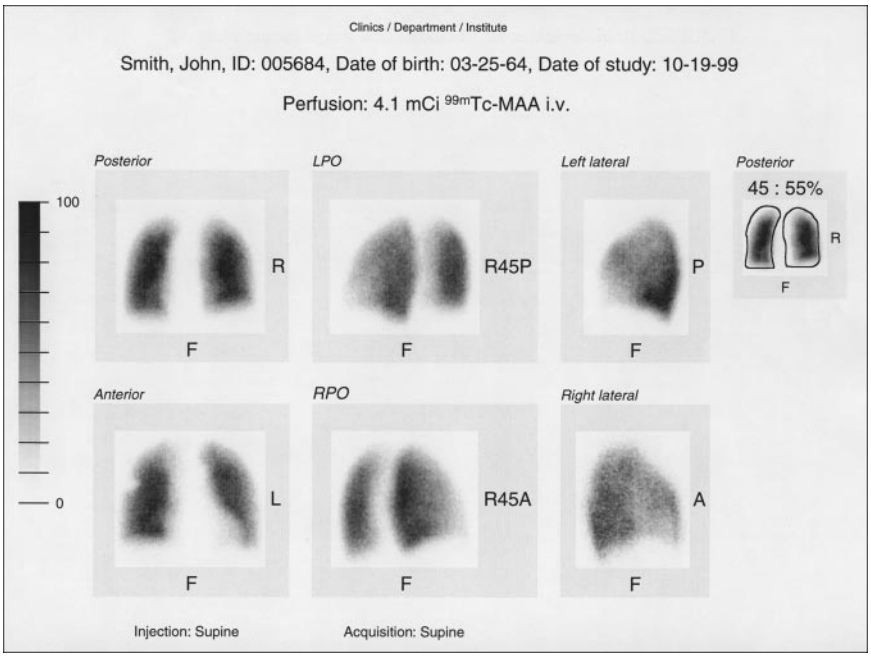

FIGURE 2. Perfusion scintigraphy of the lung.

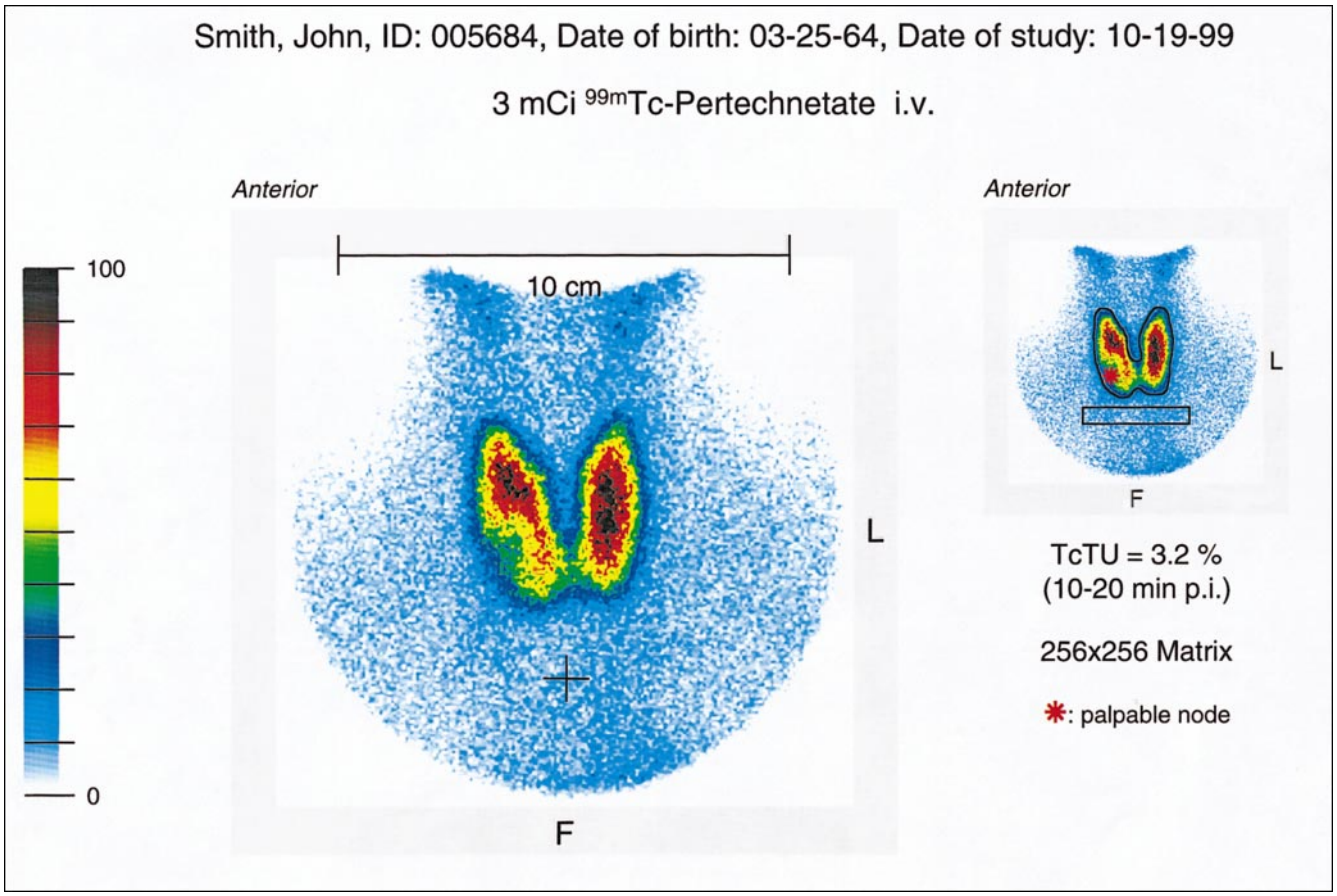

FIGURE 3. Diagnostic thyroid scintigraphy.

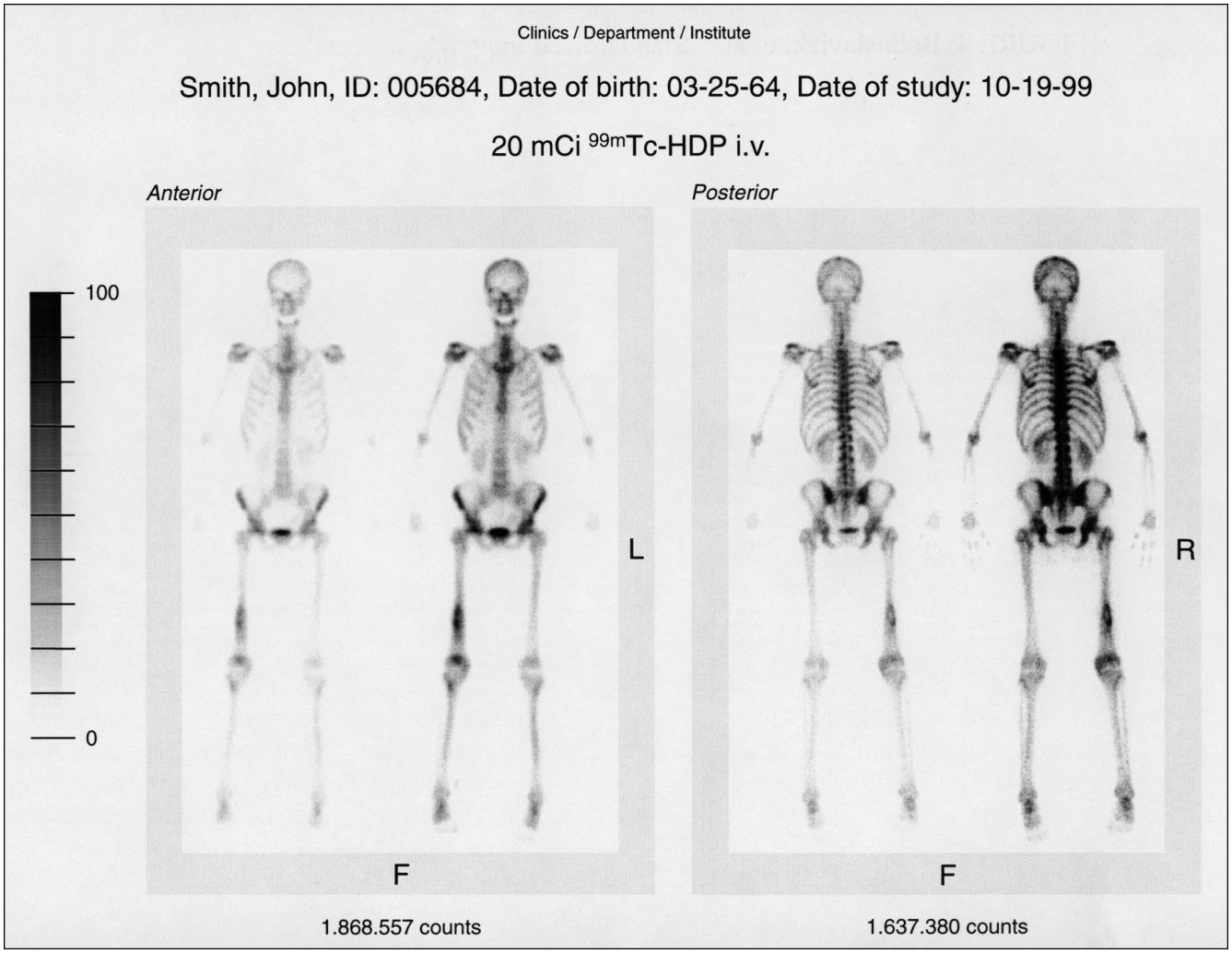

FIGURE 4. Whole-body bone scan.

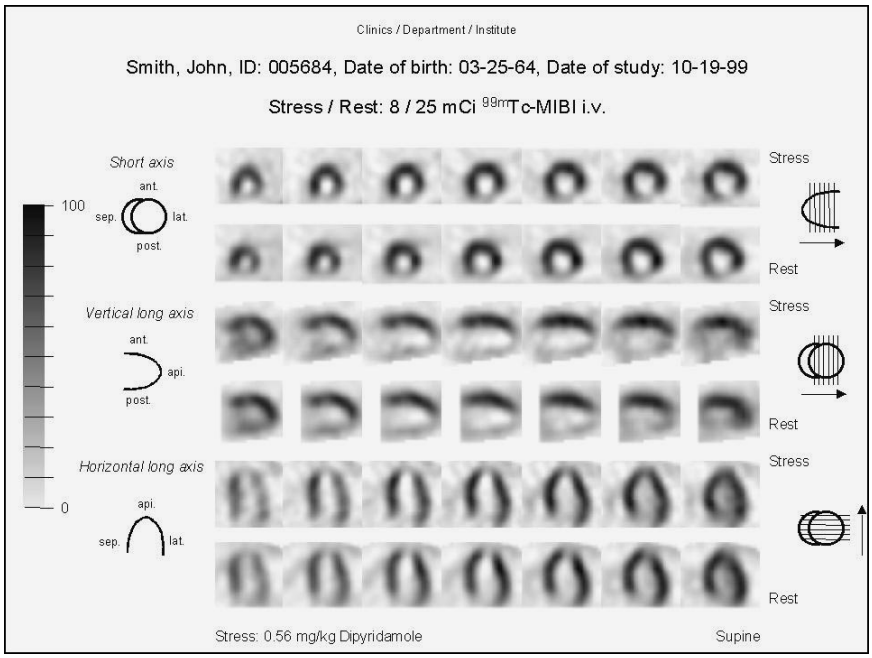

FIGURE 5. Myocardial perfusion stress/rest study.

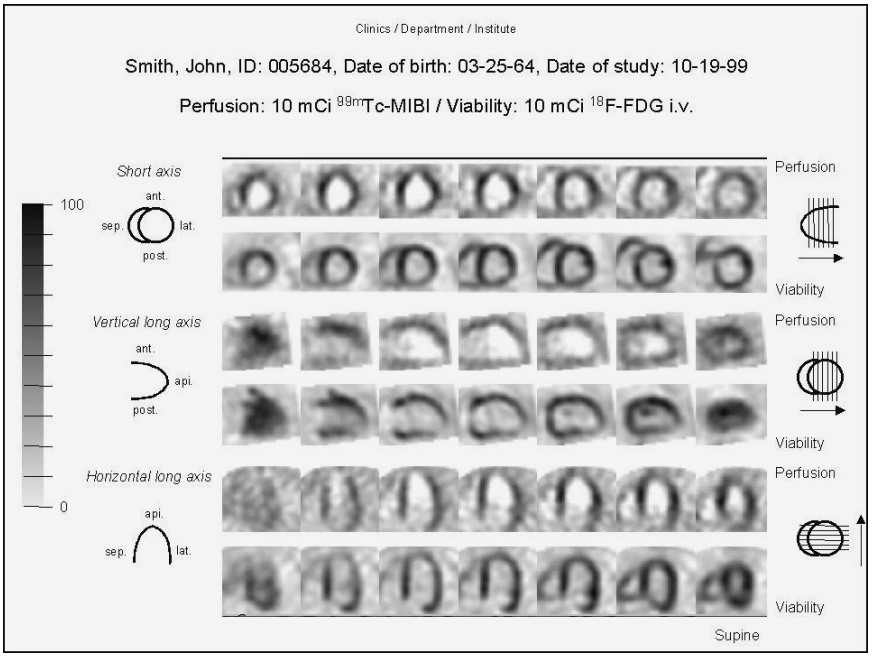

FIGURE 6. Myocardial perfusion/viability study.

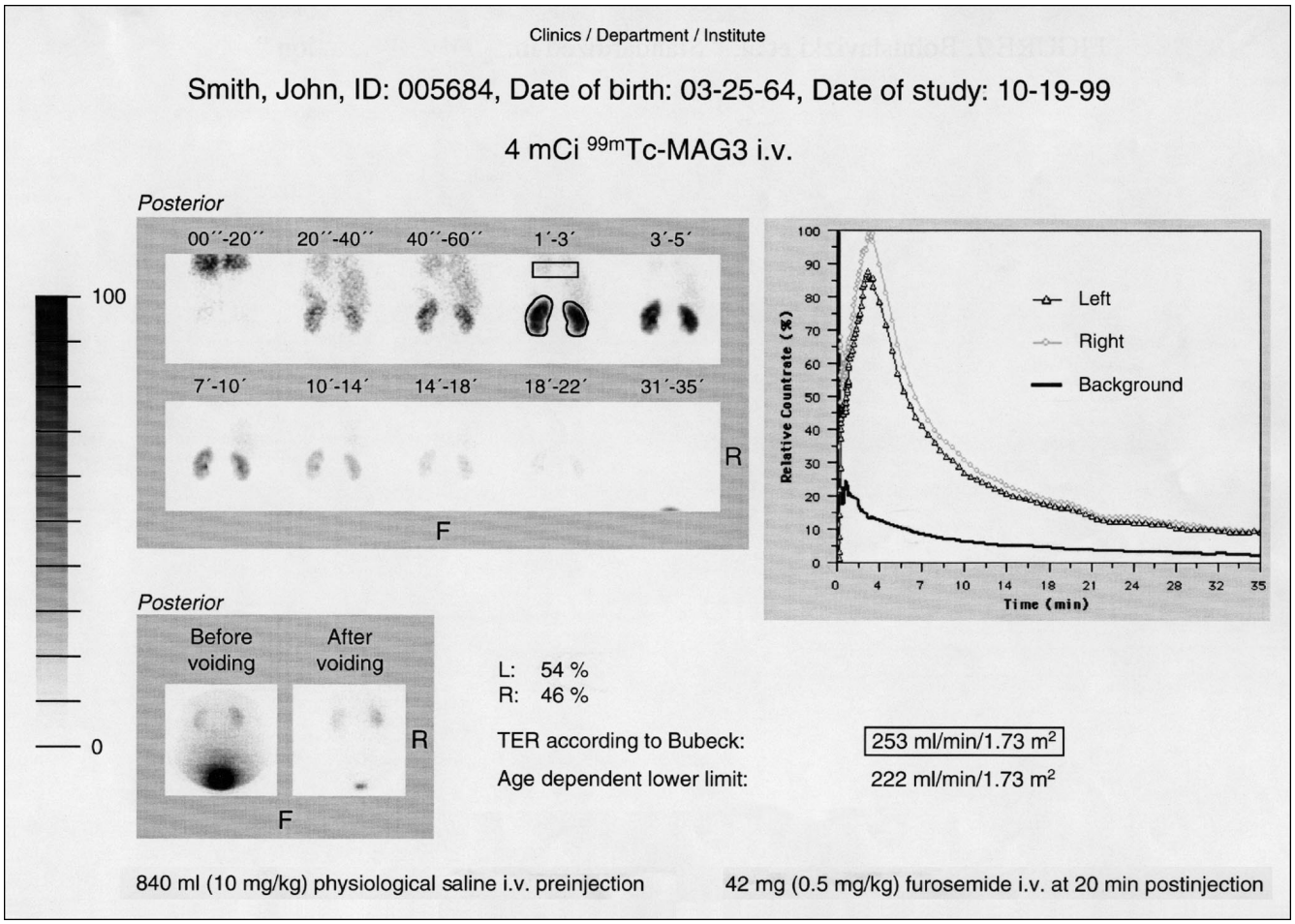

FIGURE 7. Renal function scintigraphy.

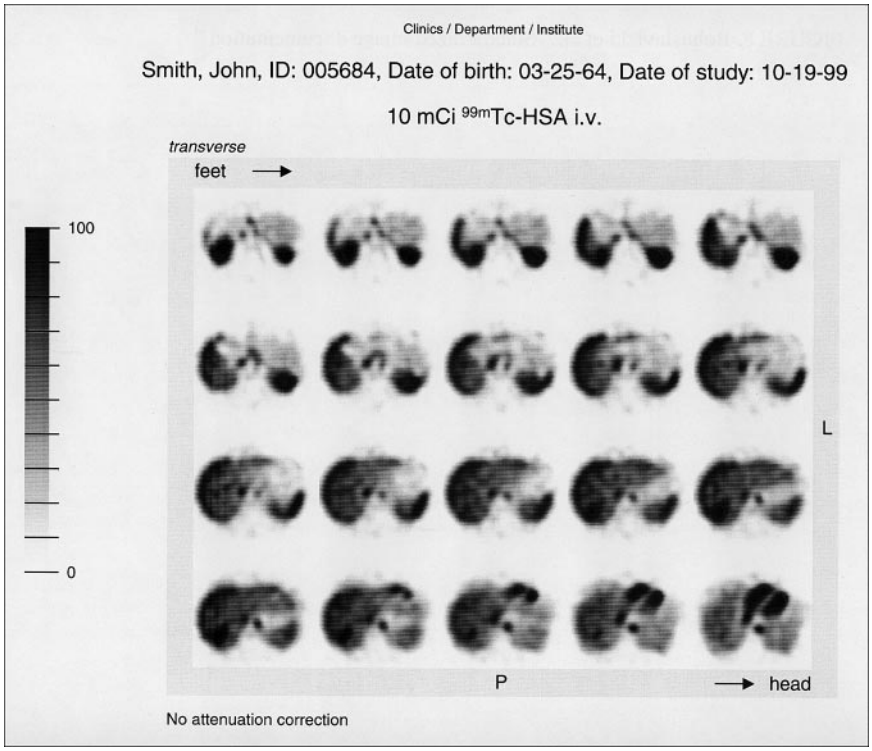

FIGURE 8. Transverse slices of blood-pool scintigraphy.

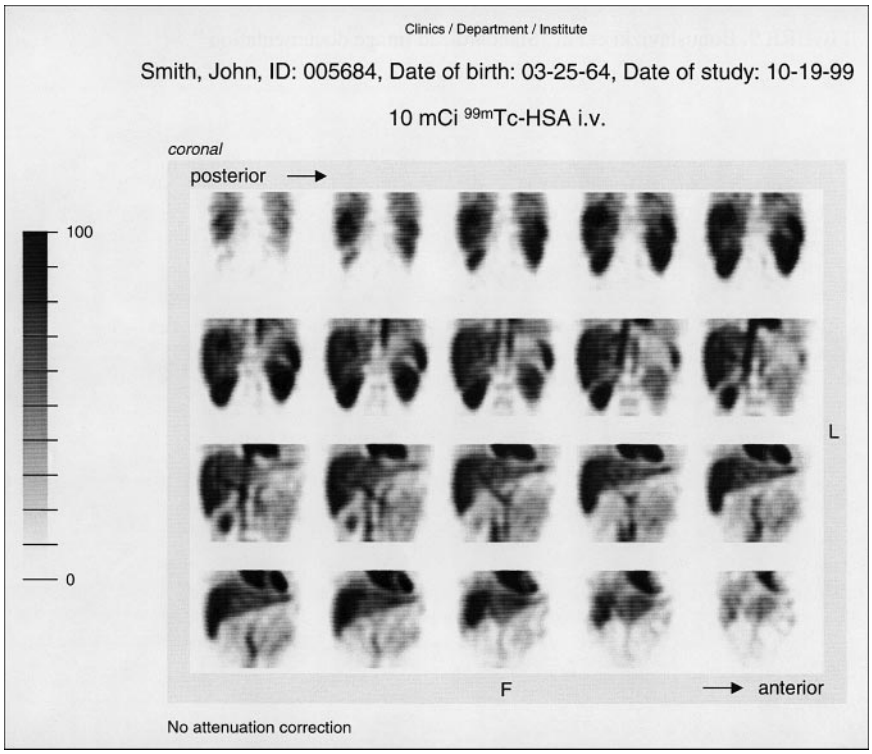

FIGURE 9. Coronal slices of blood-pool scintigraphy.

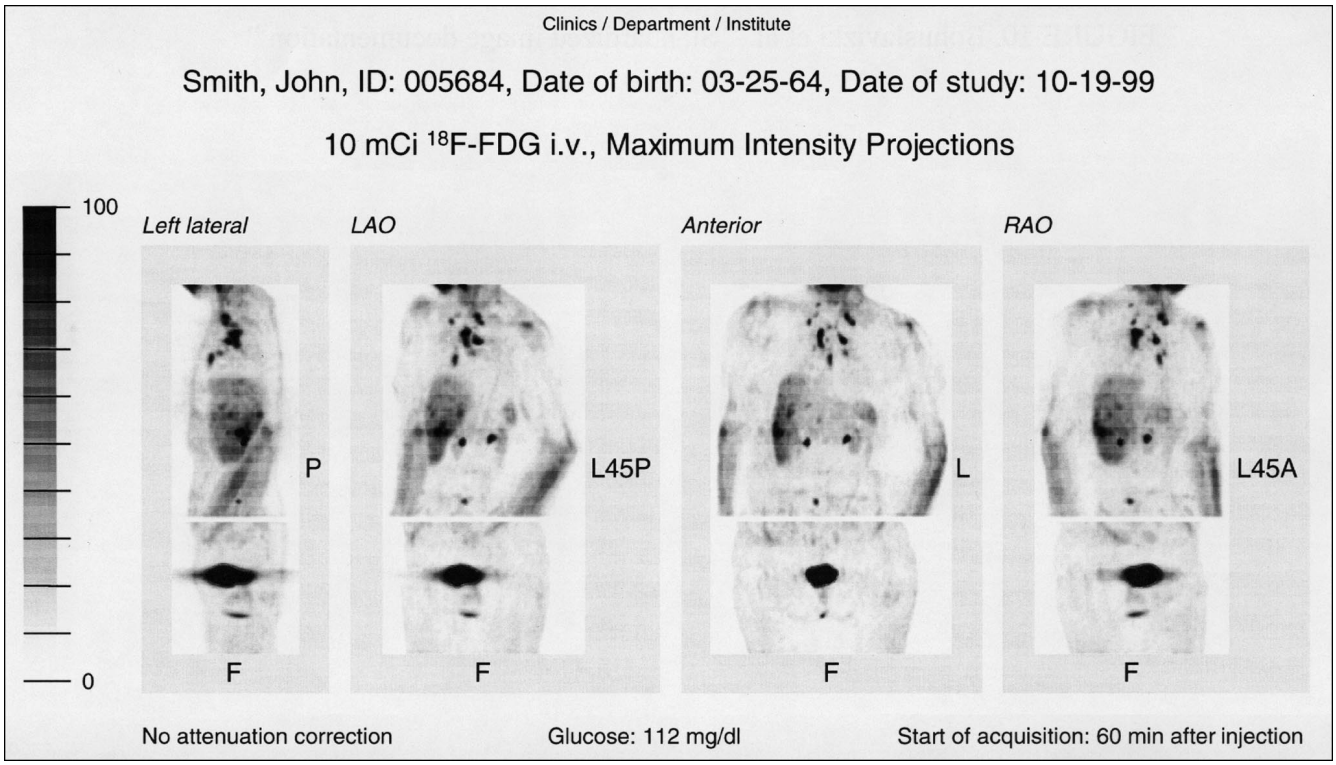

FIGURE 10. Maximum intensity projections of an oncological PET study.

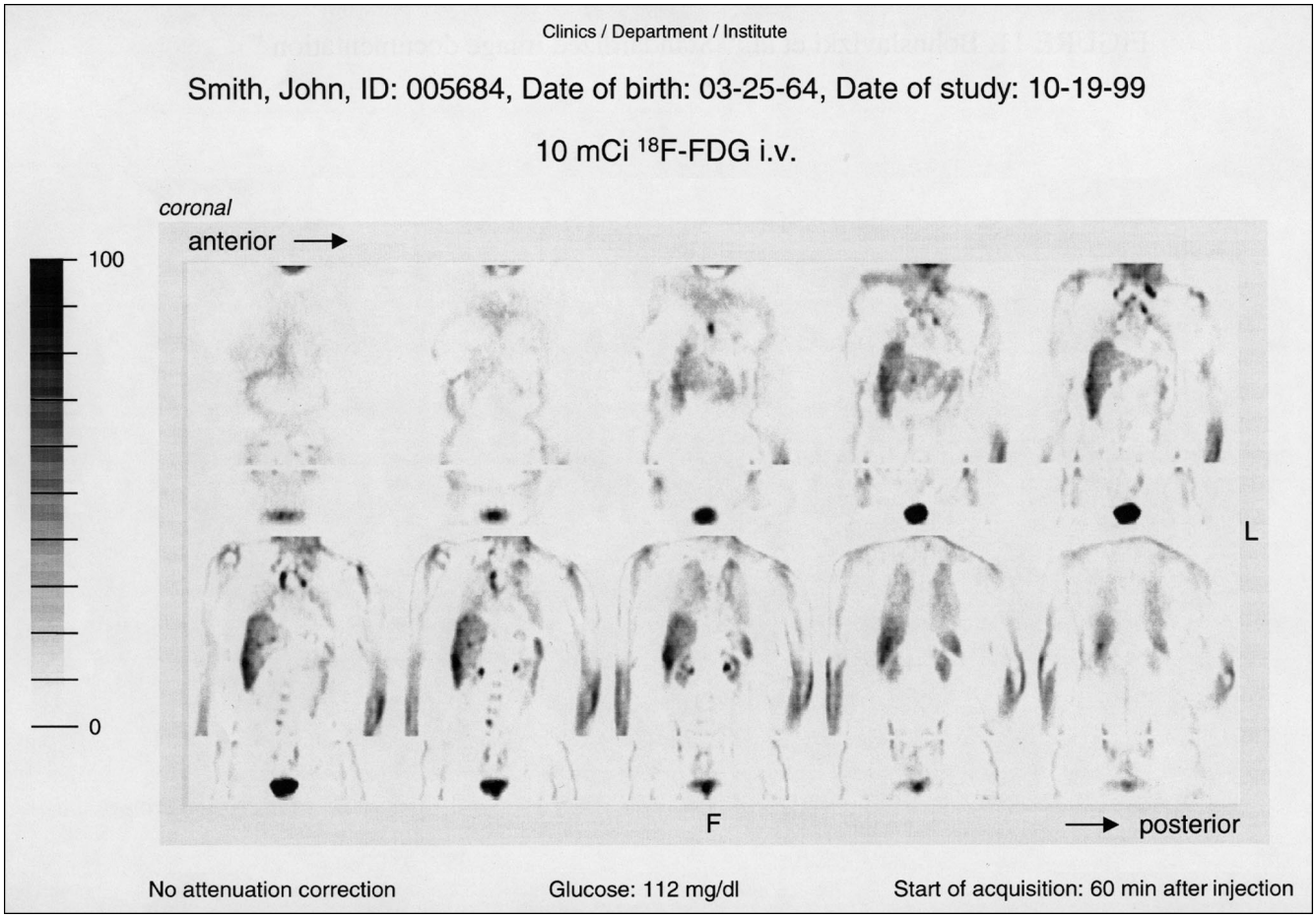

FIGURE 11. Coronal slices of an oncological PET study.

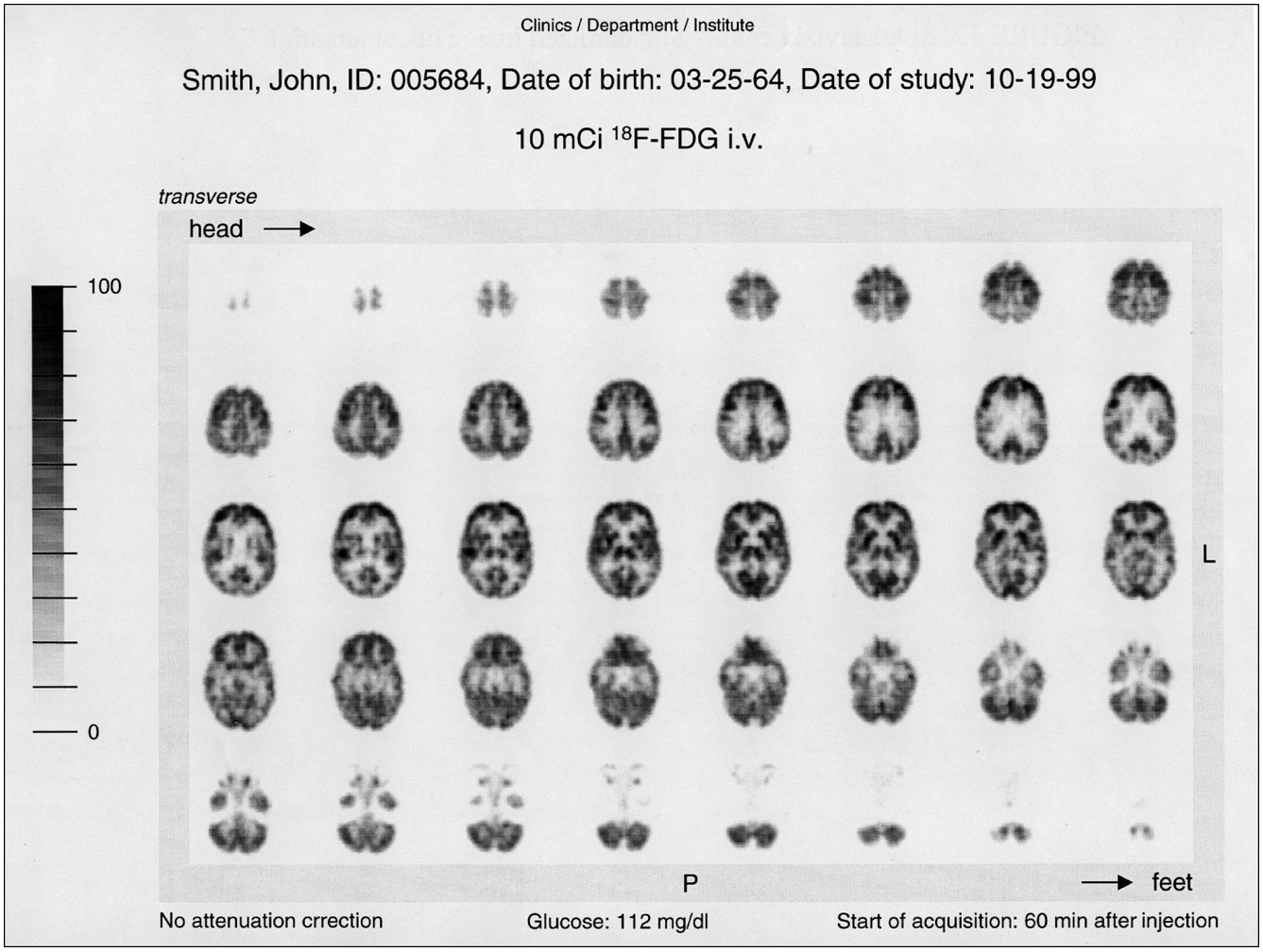

FIGURE 12. Transverse slices of a brain PET study.

CONCLUSION

Standardized annotation of nuclear medicine images is mandatory to ease image reading by a third party. The suggestions given here should be discussed extensively among nuclear medicine professionals to generate a consensus about them.

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