

SPECT Imaging: A Question of Ethics and Economics

TO THE EDITOR: As single photon emission computed tomographic (SPECT) imaging becomes an acceptable modality for the detection of coronary artery disease in nuclear medicine, we, the nuclear medicine scientists and clinicians, are faced with an ethical question which needs to be discussed and resolved. The basic question revolves around the compromise between patient dose and the cost of instrumentation. The majority of the existing SPECT systems are designed with a single gamma camera, rotating around the patient in an arc of 180° to reconstruct transaxial images of the distribution of the tracer in the organ. The current cost of a SPECT system ranges from \$200,000 to \$350,000 depending on the several different options. A typical dose of thallium (²⁰¹Tl) for nuclear cardiology, is ~3 mCi, and its cost ranges from \$60 to \$100, depending on the number of studies carried out per year. Thallium-201 is a long-lived isotope, and even though medically acceptable, it still produces a radiation dose to the patient which must be considered.

A single gamma camera SPECT system is not very efficient for the collection of radiation information from the thallium injected into the patient. The detection efficiency for the SPECT systems can be doubled by adding a second gamma camera or even tripled by adding a third gamma camera to rotate around the patient simultaneously. A three-camera SPECT system would add approximately \$100,000 in cost but would increase the sensitivity by a factor of three. This increased sensitivity would then allow reduction in dose of thallium to 1/3 of the amount currently used, or ~1 mCi of ²⁰¹Tl for nuclear cardiology studies in the same data acquisition time. The resulting radiation dose to the patient would also be reduced to 1/3 of the current dose thereby benefitting the patient without degrading the information obtained from the current SPECT systems. The question then arises, is the radiation dose to the patient "worth" the \$100,000 extra cost in instrumentation? Aside from the ethical question, it is instructive to analyze the economy of a more expensive SPECT system with lower doses, and therefore cost, of thallium. Over its lifetime, a typical SPECT system will produce approximately 5,000 patient studies. The added cost of two more gamma cameras in the SPECT system would be approximately \$20 per patient. Therefore, the question becomes, is the additional \$20 cost per patient study in a nuclear cardiology SPECT system justified in view of the reduction in thallium costs and in patient dose by a factor of three?

Justification for a high sensitivity, three-camera, SPECT system might be made on purely financial grounds which do not involve an ethical judgement about radiation dose by the clinician or the scientist. Table 1 outlines the costs of a single camera SPECT system amortized over a 5-yr period for several differing patient loads or studies per year. Table 2 outlines a hypothetical three-camera system costs amortized over a 5-yr period for the same number of studies per year as in Table 1. For the one gamma camera SPECT system, the initial cost of equipment is less than that for the three gamma camera SPECT system. However, the cost of thallium is significantly higher over the 5-yr operation for the single camera SPECT system than the three-camera SPECT system. A comparison of the 5-yr costs for the two systems (Table 3) shows that there is a net benefit financially to the

TABLE 1
Cost Analysis of Single Gamma Camera SPECT System and ²⁰¹Tl Supply for Nuclear Cardiology Amortized Over 5-yr Period

| | | | |
|--------------------------------------|-----------|-----------|-----------|
| Number of studies/yr | 500 | 1,000 | 1,500 |
| Number of studies/5 yr | 2,500 | 5,000 | 7,500 |
| Cost of ²⁰¹ Tl (3 mCi/pt) | \$ 60 | \$ 60 | \$ 60 |
| Cost of ²⁰¹ Tl for 5 yr | \$150,000 | \$300,000 | \$450,000 |
| Cost of SPECT | \$250,000 | \$250,000 | \$250,000 |
| 5-yr costs for TI+SPECT | \$400,000 | \$550,000 | \$700,000 |
| Cost per patient | \$ 160 | \$ 110 | \$ 94 |

TABLE 2
Cost Analysis of Hypothetical Three-Gamma Camera SPECT System and ²⁰¹Tl Supply for Nuclear Cardiology Amortized Over 5-yr Period

| | | | |
|--------------------------------------|-----------|-----------|-----------|
| Number of studies/yr | 500 | 1,000 | 1,500 |
| Number of studies/5 yr | 2,500 | 5,000 | 7,500 |
| Cost of ²⁰¹ Tl (1 mCi/pt) | \$ 20 | \$ 20 | \$ 20 |
| Cost of ²⁰¹ Tl for 5 yr | \$ 50,000 | \$100,000 | \$150,000 |
| Cost of the three-camera SPECT | \$350,000 | \$350,000 | \$350,000 |
| 5 yr costs for TI+SPECT | \$400,000 | \$450,000 | \$500,000 |
| Cost per patient | \$ 160 | \$ 90 | \$ 67 |

TABLE 3
Comparison of 5-yr Total Costs for ²⁰¹Tl Supply and SPECT System for One-Camera and Three-Camera SPECT Systems

| | | | |
|------------------------------|-----------|-----------|-----------|
| Number of studies/yr | 500 | 1,000 | 1,500 |
| A. Cost of TI+1 Camera SPECT | \$400,000 | \$550,000 | \$700,000 |
| B. Cost of TI+3 Camera SPECT | \$400,000 | \$450,000 | \$500,000 |
| Reduction in cost with B \$ | 0 | \$100,000 | \$200,000 |

nuclear medicine department or patients in reduced cost of imaging per patient with a three-headed SPECT system as compared to a single camera SPECT system. We are then faced with the final question, is it ethical to use a single gamma camera SPECT system, or should we as scientists and nuclear medicine physicians insist that the instrumentation manufacturers produce more sensitive multicamera systems which can reduce the patient cost and dose without degrading the clinical data obtained?

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