Intravenous Injections in Nuclear Medicine: A Comparison of Two Methods

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Two methods of delivering a compact intravenous bolus of a radionuclide were compared in ten patients undergoing imaging of renal transplants. No advantages could be demonstrated using a mechanical OMP injector as opposed to the simpler Oldendorf technique.

Dynamic studies are now a routine component of the many imaging techniques performed in nuclear medicine. For both qualitative and quantitative evaluations, it is essential that the radiopharmaceutical bolus remains as compact as possible between the site of injection and the target organ. Any method adopted for routine use must, in addition to producing a compact bolus, be simple to use, reliable, and reproducible. Probably the most widely used technique and the one used in my department is the Oldendorf technique (*1*). This study evaluates a mechanical method to administer a bolus for sequential scanning of patients following renal transplant, where reproducibility and reliability are of the utmost importance.

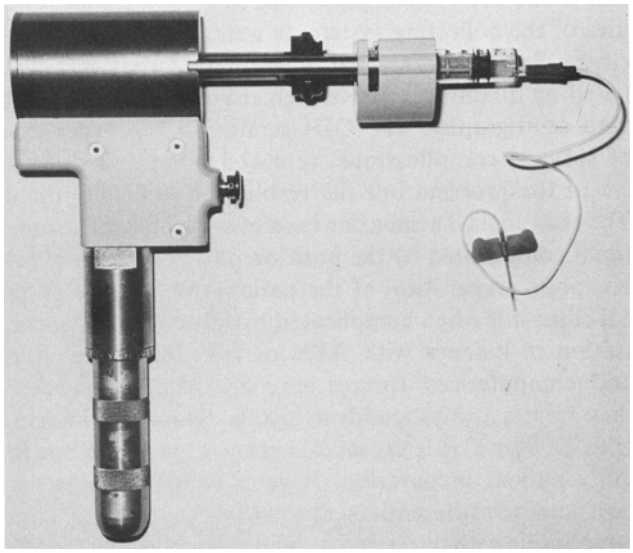

FIG. 1. OMP bolus injector.

Materials and Methods

The Oldendorf Method: After having been prepared both physically and by a thorough explanation of the investigation, the patient lies supine on the imaging table under the gamma camera for the scan.

Either arm is examined for a suitable vein, preferably the brachial in the antecubital fossa. Any tight clothing is removed to avoid venous obstruction and the arm is abducted. A deflated sphygmomanometer cuff with velcro fastening is applied to the upper arm and cuff pressure is increased to about 20–30 mm Hg. The area for the venipuncture is cleaned with an alcohol swab. Blood return is confirmed; then the cuff pressure is increased to above the patient's systolic blood pressure, at which point circulation stops. A standard volume of 1 ml of radioactive preparation is injected using a 23-gauge needle and the cuff is quickly removed. Imaging is performed with a large-field-of-view, 37 photomultiplier tube gamma camera with simultaneous digital data acquisition at 1-sec intervals for subsequent analysis.

The OMP Injector: The OMP Bolus Injector (OMP Laboratories Inc., Killingworth, CT) (Fig. 1) is designed to deliver an intravenous bolus of radioactivity rapidly and automatically at the press of the trigger. On pressing the trigger, carbon dioxide is released from a cartridge, which depresses the syringe plunger and expels the dose into the vein (Fig. 2).

The preparation of the patient is identical to the Oldendorf method except that no sphygmomanometer is required. A small 19-gauge infusion set is assembled in the vein and firmly taped. A syringe of 0.9% sodium chloride (5 ml) is attached to the infusion set and blood is withdrawn—confirming the infusion is correctly in situ. The syringe with 1 ml of radioactive tracer is placed into the clasp of the OMP bolus injector.

It is most important that the injection syringe is firmly connected to the infusion set to avoid separation when the gun is fired. Failure to do this may cause widespread contamination. The trigger is then pressed to fire the bolus injection, at which point imaging is commenced. Finally, the infusion set is disconnected from the OMP injector and then removed from the patient's arm.

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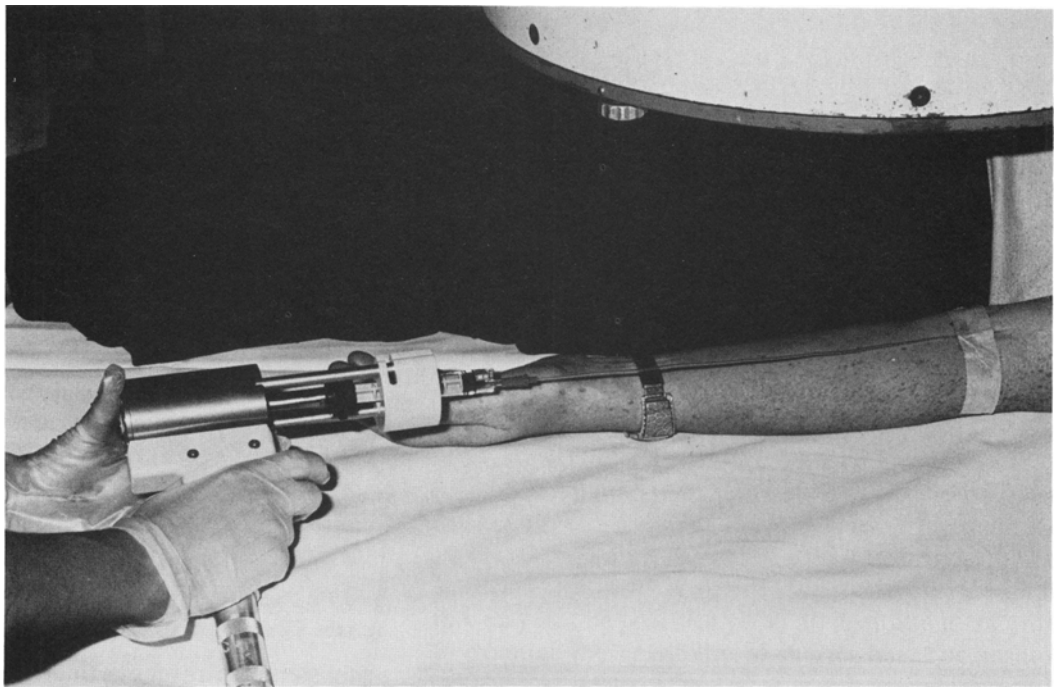

FIG. 2. OMP bolus injector in use.

Patients and Method of Comparison

Ten patients undergoing renal scanning after renal transplants were selected in order to compare the two methods. For the study 15 mCi of Tc-99m-DTPA was injected, images were obtained over 30 min, and data were continuously stored in a small dedicated minicomputer for subsequent quantitative analysis as previously described (*2*). Scans were repeated three times a week for three weeks to detect rejection and other complications of renal transplants. Each patient was given 1 ml of tracer into the same vein on separate occasions using both techniques; thus each acted as his own control.

The efficiency of the two methods was assessed by comparing the width of the iliac arterial curve at half its maximum height (full width, half maximum FWHM). The smaller the FWHM percentage, the more efficient the bolus injection (Fig. 3).

The computer routinely printed out the time–activity curves recorded from the kidney, iliac artery, and background. From this a renal flow index and uptake was calculated in the department (Fig. 4). Results are shown in Table 1. They show that there is no significant difference between the two methods as measured by this particular parameter.

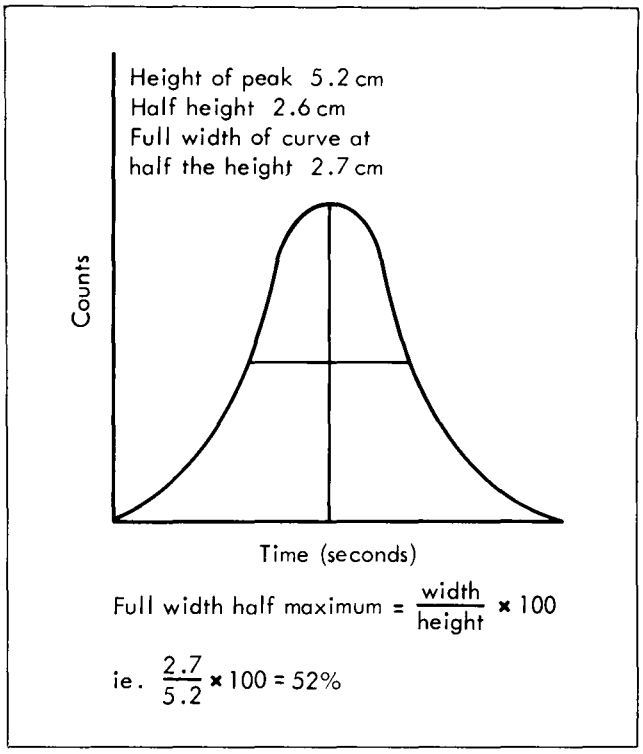

FIG. 3. Diagram shows method of calculating the FWHM.

Discussion

Although the sample group is small, results show that both methods are equally efficient. The following points should be considered when coming to a conclusion as to which method is preferable.

- ☐ The appearance of the OMP injector may be frightening to the patients, especially the very young and the elderly.
- ☐ At present no protective shield is available for use with the OMP injector; consequently, the operator receives a higher radiation dose.
- ☐ The OMP injector method is more time-consuming.
- ☐ There is a risk of radioactive contamination should

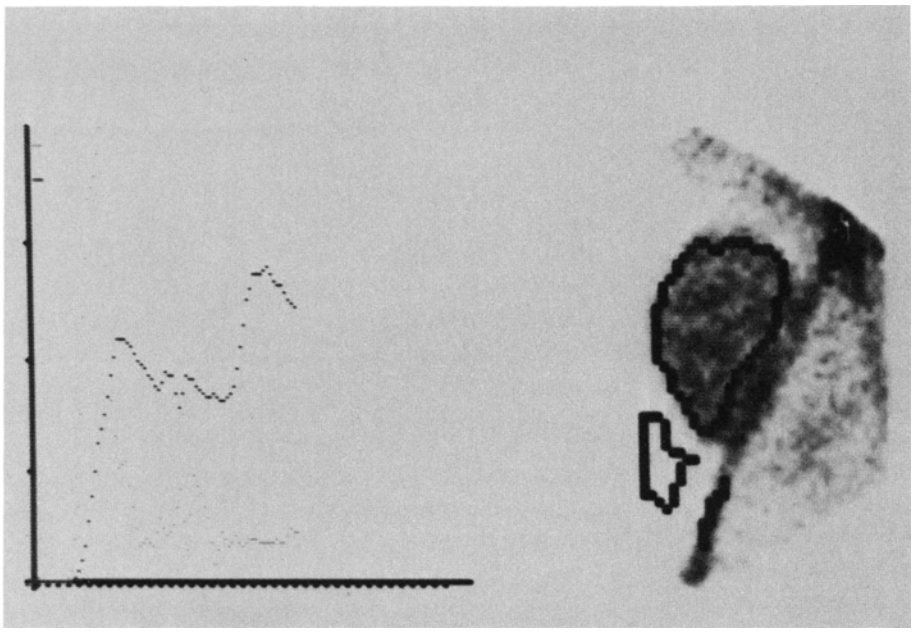

FIG. 4. Flow index of renal transplant scan. Flow index = 354.0; S.D. = ±26.0; uptake (2 min) = 404.0.

TABLE 1. Results of Values for FWHM Percentages for Oldendorf and OMP Injector Techniques in Ten Patients.

	Oldendorf Method	OMP Bolus Injector
Patient	$\frac{\text{Width}}{\text{Height}} \times 100$	$\frac{\text{Width}}{\text{Height}} \times 100$
1	21.4%	9.1%
2	10.6%	10.0%
3	4.5%	9.0%
4	11.1%	4.3%
5	6.7%	26.0%
6	10.2%	19.6%
7	36.4%	8.9%
8	6.1%	5.0%
9	12.1%	12.1%
10	9.5%	25.0%
Mean	12.9%	12.9%

accidental disconnection of the infusion set occur while using the OMP injector.

- The OMP injector is more expensive. Apart from the capital cost, there are additional costs of the infusion set and normal saline and carbon dioxide cartridges.

The one advantage of the OMP injector is that for patients with arteriovenous fistula or with infusion sets administering intravenous fluids, the same arm can be used for the bolus injection since no tight blood pressure cuff is used in this method. This can be extremely important in patients with limited venous access, as is the case with many renal patients.

Thus in our view the disadvantages of the mechanical injector considerably outweigh the advantages, as the potential main advantage of the delivery of a consistently more compact bolus was not demonstrated. This technique could not, therefore, be recommended for routine renal use.

Acknowledgment

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References

1. Oldendorf WH, Kitano M, Shimizu S. Evaluation of a simple technique for abrupt intravenous injection of radioisotope. *J Nucl Med* 1965; 6: 205–209.

2. Hilson AJW, Maisey MN, Brown CB, et al. Dynamic renal transplant imaging with Tc99m DTPA (Sn) supplemented by a transplant perfusion index in the management of renal transplants. *J Nucl Med* 1978; 19: 994–1000.