

Assessment of a Bolus Syringe Apparatus by Comparison with a Standard Method of Bolus Administration

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The quality of intravenous bolus injections of technetium-99m (^{99m}Tc)-labeled methylene diphosphonate (MDP) was compared between the bolus syringe and a currently used method of bolus administration† in 13 patients undergoing routine bone scanning. No significant difference was found between the quality of the bolus injections using the two systems. However, the bolus syringe is more convenient to use and costs half the price.*

Many dynamic radionuclide studies require an intravenous bolus injection of tracer. Some depend critically on the quality of the bolus. We have compared our current method of bolus administration using an Angiodan[†] and a 20 ml saline flush with the new bolus syringe* given via the same 21-G butterfly needle.

METHODS AND RESULTS

Thirteen patients undergoing ^{99m}Tc-MDP bone scanning for a variety of indications were studied. The radiopharmaceutical was made up in two halves, each of ~280 MBq in ~0.5 ml, one being injected by the standard bolus technique and the other by the Monoject bolus syringe. All injections were given, by the same individual, through a 21-G butterfly needle placed in an antecubital fossa vein.

The Angiodan is simply a connecting tube placed between the butterfly and a 20 ml syringe. The total internal volume of the line is ~2 ml and is initially primed with saline prior to connection with the butterfly needle. The tracer is slowly injected into the Angiodan tube and can then be flushed into the patient with a rapid smooth 15–20-ml bolus of saline coinciding with the start of the computer acquisition.

The design of the bolus syringe uses the same principle with the line being accommodated within the barrel of the syringe as a plastic spiral with a similar volume of about 2 ml (Fig. 1). Fifteen ml of saline are initially drawn into the bolus syringe through a needle via the distal spiral. The needle is next placed in the radiopharmaceutical contained within a shielded vial and the small 1 ml syringe is positioned as in

Figure 1B. The amount of activity required is then drawn up into the spiral by withdrawing the same volume of saline into the 1 ml of syringe. The 1 ml syringe can then be discarded and the bolus syringe placed into the shield ready for use. To administer a bolus, the syringe is attached directly to the butterfly needle and the plunger is rapidly depressed, thereby injecting the bolus of tracer followed by the 15 ml of saline.

The bolus syringe was alternated with the Angiodan with respect to which one was used to administer the first of the two injections in each patient. Both were given through the same butterfly needle. The patient was supine with the gamma camera positioned posteriorly under the chest and upper abdomen. Dynamic one second frames were acquired on a computer for 40 sec for each method of administration, with a delay of 2 min between the two injections in order to define background for the second injection.

The data were analyzed from a 20-pixel region of interest over the right lung. Background was averaged from the 20 frames immediately preceding the second injection and subtracted from the second injection time-activity curve (Fig. 2). "Best fit" gamma function curves were fitted to all the first-pass time-activity curves. The ratio of peak height to area under these curves was calculated for each method, a high ratio representing a tight bolus. Comparison of the ratios (representing bolus quality) was made between each bolus injection technique for all the patients by Student's paired t-test (Fig. 3). There was no significant difference between the quality of the bolus administered by the two methods, with mean ratios of $0.114 \pm \text{s.d. } 0.046 \text{ sec}^{-1}$ and $0.113 \pm 0.040 \text{ sec}^{-1}$ for the Angiodan and the bolus syringe injections, respectively ($p > 0.5$).

DISCUSSION

Although comparison has been made using a 21-G butterfly needle, the same difference, if it existed, between the techniques would be expected if a plastic intravenous cannula was used and a rapid narrow bolus was required. We perform numerous first-pass blood flow studies (1,2) and, in our experience, consider the technique using the Angiodan to be the best currently available to deliver a bolus injection. The principle underlying the use of the bolus syringe is the same

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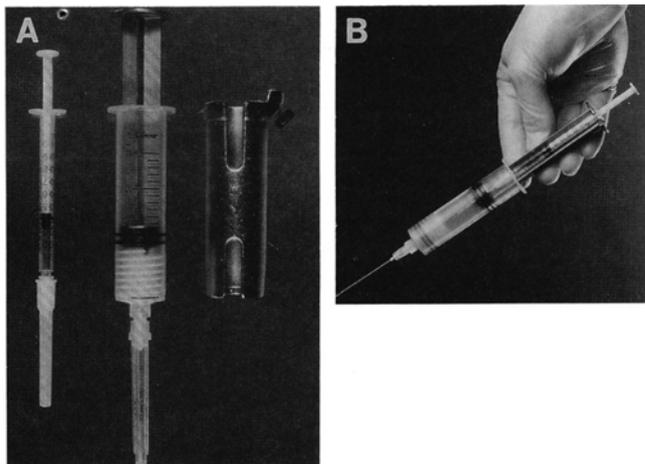


FIG. 1. (A) Components of Monoject bolus syringe (Sherwood Medical). Note plastic spiral distally within the main syringe and tungsten shield. (B) Demonstration of position of 1 ml syringe for drawing up radiopharmaceutical into plastic spiral (see text for details of method of use).

as that of the Angiodan, namely the presence of a line between the needle and syringe. The bolus syringe functioned as well as the Angiodan with respect to bolus quality.

In addition, the bolus syringe system is easy to use for the person injecting, with less risk of radionuclide spill as the syringe is attached directly to the butterfly and contains its own saline bolus, not requiring the attachment of a separate syringe. There is also a smaller radiation dose to the person injecting, the activity remaining within the shielded syringe up until the time of injection, whereas the injector is exposed to the activity within the Angiodan tube prior to administration of the bolus. On the other hand, the procedure for drawing up the activity and saline into the bolus syringe

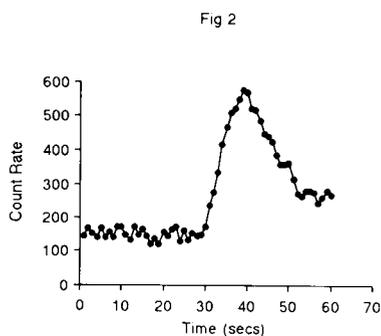


FIG. 2. First-pass time-activity curve recorded over the right lung following injection of the *second* of the two aliquots into which the total dose of ^{99m}Tc -MDP was divided. Note the magnitude and stability of the count rate resulting from the injection, 2 min previously, of the first aliquot. Ordinate: counts per sec.

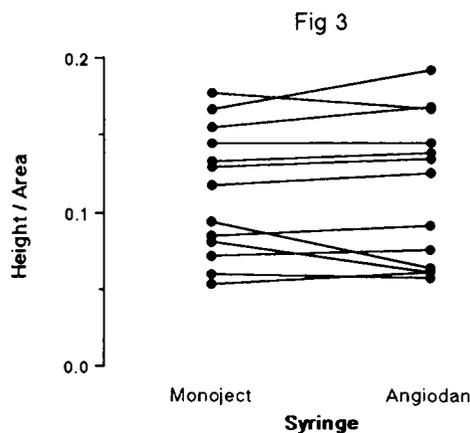


FIG. 3. Comparison of bolus widths between Angiodan and Monoject systems. The higher the ratio, the "tighter" the bolus. The two syringes were alternated with respect to which one was given first. There was no significant difference in height over area between first and second injections. Ordinate: sec^{-1} .

requires care, it is critical that the needle is within the tracer for the whole time that saline is drawn back into the 1 ml syringe when loading the tracer into the spiral (this requires two steady hands). During the learning process the radiopharmacist may be exposed to a higher radiation dose than when drawing activity into a standard syringe. The cost of the new bolus syringe is £3.30 (~\$6.50) plus 15% sales tax, which is about half that of the current method using the Angiodan.

In conclusion, the bolus syringe represents an efficient, economic and convenient way of administering a bolus injection but is initially less convenient for the radiopharmacist.

NOTES

* Monoject Bolus Syringe, Sherwood Medical, St Louis, MO.

† Angiodan, Meadox, Surgimed, Glostrup, Denmark.

ACKNOWLEDGMENTS

The authors thank Sherwood Medical for the supply of Monoject syringes and Mrs. P. York for typing the manuscript.

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