Sequestration of Radiopharmaceutical in Spinal Needle Dead Space during Cisternography

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Residual radioactive tracer, which may remain in the spinal needle after dose administration for a radionuclide cisternogram, is a problem. Several techniques to avoid this problem are considered. The percentage of dose sequestered in the needle as a function of spinal needle internal volume and initial tracer volume are also calculated.

Intrathecal administration of radiopharmaceuticals for diagnostic evaluation is well documented (*1–6*). Dead-space volume as a source of dosage error is also recognized (*7–9*).

When performing radionuclide cisternography, residual radioactive tracer may be left in the spinal needle after the intrathecal injection; we have seen two such faulty administrations occurring over a 30-month span. For children, in whom the volume of tracer injection may be small, the residual quantity of radiopharmaceutical represents a significant percentage of the agent originally drawn up for administration.

Materials and Methods

Approximate volumes of aqueous fluid that may be sequestered within standard intravenous and spinal needles (Becton-Dickinson Co., Rutherford, NJ) used in our department were measured. We determined the incremental difference found upon expression of fluid and subsequent withdrawal of residual needle volume, noting meniscus levels. Internal volumes of needles, which included the needle shaft and that portion of the needle hub not occupied by the syringe luer taper with stylet removed, were expressed as mean ± estimate of the error of measurement, in which N equals three per group.

Results and Discussion

Table 1 shows the approximate volumes of fluid that may be sequestered within standard spinal needles and intravenous needles for comparison. If, for example, a 20-gauge, 3½-in spinal needle is used, and a tracer volume of 0.2 ml is injected without flushing the needle, about 30% of the tracer dose would be sequestered in the needle, and not delivered to the patient. Table 2 relates the amount of sequestered tracer material in the needle to the initial tracer volume.

There are several ways to overcome this problem, but all present practical disadvantages.

Flushing the needle by injecting a small amount of air will remove the retained radiopharmaceutical, but this requires temporarily disconnecting the syringe from the needle (with likely leakage of radioactive tracer and CSF) unless a three-way stopcock and a second syringe are used. Connecting a stopcock and two syringes to a spinal needle without dislodging the needle tip from the spinal canal represents some mechanical difficulty. Likewise, some physicians believe that simple flushing of the syringe with spinal fluid from the patient presents a mechanical difficulty.

A better technique is to ensure that the volume of tracer to be injected exceeds 0.5 ml by appropriately diluting the radiopharmaceutical, then making allowances for the less than 10% loss in the needle. Following the lumbar puncture procedure, the syringe and spinal needle should be counted for residual radiopharmaceutical activity in a dose calibrator.

Two additional considerations are noted. First, the inner diameter of the syringe luer taper represents another dead space. Second, an appropriate sterile diluent,

TABLE 1. Approximate Volumes of Fluid Sequestered within Standard Spinal Needles

Needle	Internal Volume with Stylet Removed*
18-gauge, 3½ in.	0.09 ± 0.01 ml
20-gauge, 1½ in†	0.04 ± 0.01 ml
20-gauge, 3½ in.	0.06 ± 0.01 ml
22-gauge, 3½ in.	0.05 ± 0.01 ml

* Mean ± estimated error of measurement with three measurements per group.
† Regular needle used for intravenous injection.

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TABLE 2. Percent of Dose Sequestered in Needle as a Function of Spinal Needle Internal Volume and Initial Tracer Volume

Initial Tracer Volume in Syringe	Spinal Needle Internal Volume	Percent of Dose Sequestered in Needle
0.05 ml	0.05 ml	100
0.1 ml	0.05 ml	50
0.2 ml	0.05 ml	25
0.3 ml	0.05 ml	16⅔
0.4 ml	0.05 ml	12½
0.5 ml	0.05 ml	10
0.05 ml	0.06 ml	100
0.1 ml	0.06 ml	60
0.2 ml	0.06 ml	30
0.3 ml	0.06 ml	20
0.4 ml	0.06 ml	15
0.5 ml	0.06 ml	12
0.05 ml	0.09 ml	100
0.1 ml	0.09 ml	90
0.2 ml	0.09 ml	45
0.3 ml	0.09 ml	30
0.4 ml	0.09 ml	22½
0.5 ml	0.09 ml	18

usually normal saline, which is *free* of benzyl alcohol or other preservatives, should be used to expand the volume of tracer above a certain minimum volume in order to decrease the percent of total dose retained in the needle and syringe.

While sterile, preservative-free normal saline is commonly used as a diluent for radiopharmaceuticals entering the CSF, others have emphasized that central nervous tissue is extremely sensitive to the composition of the medium in which it is bathed (*10*). These investigators suggest the use of artificial CSF, which is made isotonic by a physiologic mix of ions and proteins, and is buffered to a specific pH.

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