Spinal Anesthesia Using a 32-gauge Needle

*M. Jack Frumin, M.D.**

A technique for spinal anesthesia in which a subarachnoid tap is done with a needle whose tip is 32-gauge is described. The method was used in 500 patients. The incidence of mild postspinal headache was 0.4 per cent, with an additional 1 per cent of slight transient headache. These results support the leakage theory of the etiology of post-lumbar-puncture headache. The chief complications encountered with this technique were inadvertent dural puncture with 18- or 20-gauge introducer needle (with its own associated incidence of headache) and, rarely, an inability to aspirate or inject fluid through the #32 needle. The technique was useful clinically although it required more time and care than using #22 or #26 spinal needles or single-dose epidural technique.

A WIDELY-ACCEPTED THEORY regarding the cause of postspinal headache invokes continued leakage of cerebrospinal fluid through the meningeal puncture hole created when the needle is inserted into the subarachnoid space. Presumably, as the normal cushion of fluid is lost, the brain changes position, thereby stretching the cranial dura and associated blood vessels. This theory is supported by the positional nature of the headache, coming on or aggravated by the upright position and disappearing with recumbency. Likewise, the incidence of headache is related to the diameter of the needle. This relationship was emphasized by Tourtellotte [1] and was shown clearly in the large series reported by Vandam and Dripps.[2] In other series [3, 4, 5, 6] the reported incidences were below 1 per cent when a 26- or 27-gauge needle was used; incidence was also affected by other factors such as age and sex. A needle of novel design with an extremely small diameter was constructed and a technique for its insertion developed and used by the author in 500 patients. This study was instituted to (a) critically test the leakage theory by creating as small a dural puncture hole as possible and noting the subsequent incidence of headache, (b) determine whether the use of this needle and technique was practicable clinically and (c) determine if headache was significantly reduced or eliminated.

Methods

The technique involves the use of two needles † (fig. 1). Table 1 gives the gauges of these and more conventional needles and the corresponding inner and outer diameters in mm. The outer needle, an ordinary short-bevel 18-gauge, is inserted into the epidural space using any convenient technique. The inner needle consists of two fused portions. The longer, or shaft, portion is 21-gauge, while the tip is 32-gauge. It should be noted that a #32 can pass through a #26 needle. Figure 2 is a photograph of the tips of the components given separately and in combination, the tips of other gauges commonly used, and the stylet used for cleaning the #32. Approximately 17 mm of the 32-gauge tubing is utilized in fabricating the inner needle. About 1 cm of the #32 tubing is present within the #21 shaft to which it is fused with solder, while 7 mm of the tubing projects beyond the end of the shaft of the #21. The tip is then beveled. The #18 and the #21–32 needles are matched in length, so that when the inner needle is inserted full length into the outer needle, 6 mm of the #32 tubing projects beyond the end of the #18 needle (fig. 2). Since the epidural space is less than 6 mm wide, the #32 tip will pierce the dura and

* Associate Professor.

Received from the Department of Anesthesiology, Albert Einstein College of Medicine, Yeshiva University, Bronx, New York 10461. Accepted for publication January 13, 1969. Part of this work was carried out at Mt. Sinai Hospital, New York, New York 10029.

† These needles were constructed by Becton Dickinson Co., Rutherford, N. J., through the cooperation of Mr. Edwin May.

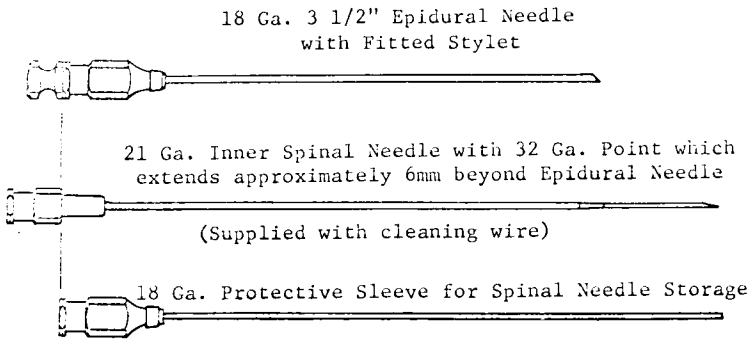

FIG. 1. Schematic drawing of (a) the 18-gauge short-bevel needle for epidural placement; (b) the 21–32-gauge needle for dural puncture; (c) the protective sleeve for the 21–32 combination.

enter the subarachnoid space. In this way, the only structures pierced by the delicate tip are the dura and arachnoid.

A similar needle combination, in which the outer needle was #20 and the inner consisted of a #25 shaft and a #32 tip was also used, less often than the #18–21–32 combination. Occasionally, anesthesia were carried out with inner needles having 31- and 33-gauge tips. A needle with a #34 tip was also fabricated, but was impractical. Although air could be injected through it, the resistance to flow was so great that no liquid could be injected.

The resistance to flow through the 21–32 and 25–32-gauge combination needles is considerably higher than through an ordinary #22 or #25 because of the additional 17-mm length of #32 tubing. This segment can be cleaned relatively easily with a stylet 0.09 mm in diameter (fig. 2). This was done periodically, since the 0.1-mm lumen of the #32 tubing is occluded by even small particles of foreign material; it was important to test the inner needle for patency before use.

No spontaneous flow of spinal fluid occurs when the tip of the inner needle is in the subarachnoid space. Hence, one cannot use this as a sign of proper location of the needle tip. In all but the first 30 cases, correct subarachnoid placement of the #32 tip was tested by aspirating spinal fluid before injecting the anesthetic. Aspiration produces only a droplet of liquid; therefore, in order to see the droplet it is essential to use a syringe with a transparent male slip joint rather than a Luer-Lok metal-tipped syringe. It was also important to remove liquid from the shaft and the hub of the inner needle just before insertion in order not to be misled by the appearance of fluid in the syringe tip.

As an additional check in the last 200 cases, the aspirated droplet was tested for glucose by using a paper strip ‡ currently used for testing urine. This was done to differentiate between spinal fluid containing glucose and other solutions, such as saline or 1 per cent lidocaine, used in locating the epidural space.

No special measures were taken to affect the possibility of headache during the postanesthetic period. Fluids were not forced either orally or intravenously, and no attempt was made to keep the patients lying flat in bed.

Each patient was visited by the author personally at least once during his hospital stay for questioning about headache or other complications. Since Vandam and Dripps [2] showed that 90 per cent of postspinal headaches began before the fourth day and virtually none after the sixth day, an effort was made to observe the patients at least once on the fourth day after anesthesia, or shortly thereafter. One or more additional visits were often made as well before the fourth postanesthetic day. If this

‡ Labstix, Ames Co., Elkhart, Indiana.

TABLE 1. Gauges of Needles Used for Spinal Anesthesia

Gauge	Outer Diameter (mm)	Inner Diameter (mm)
18	1.3	0.9
20	0.9	0.6
22	0.7	0.45
26	0.45	0.25
32	0.22	0.11
33	0.20	0.11

was not possible (usually because of early discharge from the hospital), the surgeon was questioned, the hospital chart consulted, or the patient contacted by telephone. In 85 per cent of the cases, postanesthetic follow-up was completed by direct personal interview in the hospital. Patients not contacted personally or for whom the information obtained from the other sources was considered inadequate were not included in the series reported here.

Results

Incidence of Headache

Anesthesia was uneventful in 455 of the 500 patients in whom the technique was attempted. A headache was considered "typical" if it was brought on by the erect position and disappeared with the horizontal position. None of the 455 patients developed severe or incapacitating typical postspinal headaches, while seven developed slight or mild headaches. In five, headache was slight, i.e., although positional, it lasted only one or two days, and its presence was elicited only upon close, direct questioning and, importantly, interfered very little or not at all with normal activities. In the remaining two patients, headache was mild, *i.e.*, it lasted three to four days, disappeared without treatment and, although positional, did not prevent the patient from sitting, eating or walking. In these two patients a number of attempts had been made to enter the epidural space with the outer needle, and the dura might have been perforated by the #18 needle at the time. The ages of the patients in this series are shown in table 2. The seven who developed slight or mild headaches without apparent dural puncture by the outer needle were 20, 20, 22, 26, 47, 54, and 75 years old. Males comprised 74 per cent and females 26 per cent of the series; the group of seven who developed slight or mild headaches consisted of five males and two females, approximately the same sex ratio as that in the series as a whole.

Other Complications

There were 45 complications. Dura was inadvertently punctured 24 times during attempted epidural placement of the outer needle; 14 times with the #18 and ten with the #20 needle. In these cases, the anesthetic solution was injected through the outer needle into the subarachnoid space. Typical postspinal headache was found in seven of the 24 patients, five after the #18 dural puncture and two after the #20 dural puncture.

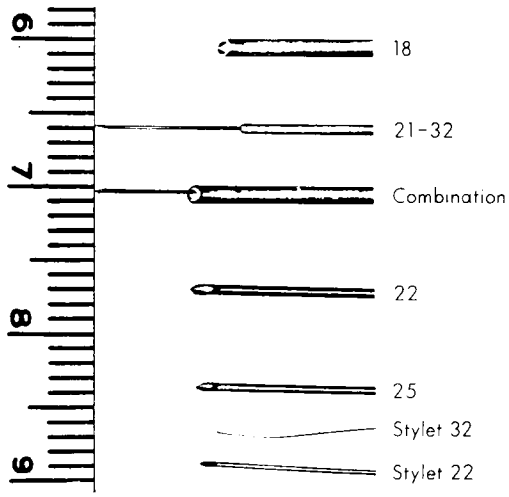

Fig. 2. Photograph of the tips of the #18 and the #21–32 needles separately and in combination; the stylet for cleaning the #32; the conventional #22; the #25 and stylet for #25.

The technique was abandoned in 13 cases; five times because the inner needle became clogged and four times because no fluid could be aspirated despite apparently correct placement of both needles. Clogging occurred early in the series and was later prevented by careful cleaning and handling of the needles and, when necessary, by clearing the tip with the wire stylet. In one case early in the series, the inner needle had not been tested for patency before use. Five separate attempts at dural puncture were made but no spinal fluid could be aspirated. The needle was then found to be blocked. This patient subsequently developed typical mild postspinal headache.

In eight instances, no anesthesia resulted despite apparently correct intrathecal placement of the needle. In the first two cases early in the series, no attempt was made to aspirate spinal fluid. In the remaining six, liquid was aspirated from the inner needle before the anesthetic solution was injected. Possibly there was some liquid in the hub or shaft

TABLE 2. Ages of Patients in the Series

Age (Years)	Percentage of Patients
10–29	10
30–39	10
40–49	13
50–59	21
60–69	28
70–89	18
	100

of the needle, with that fluid appearing in the syringe. One of these failures occurred even after a positive test for glucose.

Discussion

The prime reason for this study was to test critically the fluid leakage theory of postspinal headache. If leakage through the meninges was basically responsible for the headache, then, as the size of the puncture holes becomes very small, the incidence of postspinal headache should be reduced markedly or eliminated.

This was, in fact, the situation found in the present series. Seven headaches occurred in 455 uncomplicated cases, an incidence of 1.5 per cent. This represents a significant reduction from the 6 per cent incidence in 600 cases reported by Vandam and Dripps [2] with the #24 needle, but is approximately the same or slightly higher than incidences reported by Greene [3] and Owen *et al.*[5] with the #26 and by Cann and Wycoff [6] with a #27. If consideration is restricted to mild headache, there were only two cases, an incidence of 0.4 per cent, the lowest yet reported. Interpretation of the five cases reported as "slight" presents some difficulty because they were detected only by close questioning. Furthermore, the discomfort was so slight and transient that headache of this severity may easily have been overlooked in earlier series. Finally, all of the anesthesias and almost all of the follow-ups were carried out by the author, an approach almost certain to reveal more information than when data are supplied by numerous observers.

The earlier evidence supporting this theory was that of Vandam and Dripps,[2] who showed a progressive decline in the incidence of headache from 18 per cent to 6 per cent as needle size decreased from 16- to 24-gauge. The further reduction in incidence to about 1 per cent with the 26- or 27-gauge needle is consistent with this concept. However, it is difficult to evaluate this quantitative reduction in in incidence. The size of the series was not always large enough, the duration of follow-up often not stated, and age and sex often not stated. It was considered important, therefore, to extend the correlation between needle size and incidence of headache to needles smaller than #26 under conditions that permitted proper evaluation of the data.

The other objective was evaluation of the clinical utility of this needle. The incidence of headache in the group of 500 was higher than in the group of 455 uncomplicated cases because of the additional seven headaches in the 24 cases of inadvertent dural puncture with the outer needle. Since this 5 per cent incidence of dural puncture by #18 or #20 needles carries a 10 per cent incidence of headache, one can expect a headache incidence of 0.5 per cent from the epidural tap alone. Although it might seem advantageous, therefore, to use the smaller #20, this advantage was apparently offset by the greater likelihood of inadvertent dural puncture, since it was more difficult to sense the ligamentum flavum. The #20 was used in 16 per cent of the patients (table 3) but accounted for 40 per cent of the cases of inadvertent dural puncture.

The #33 needle represents the ultimate in reduction of needle diameter since watery solutions cannot be injected through a #34 needle. The extremely small difference of only 0.02 mm in outer diameter between the #32 and #33 seems hardly significant in reducing the incidence of headache further. In the present series, 74 per cent of the patients

TABLE 3. Needles Used in 455 Uncomplicated Cases

Outer Needle	Inner Needle Tip	Number of Cases
18 gauge	32 gauge	359
20 gauge	32 gauge	71
18 gauge	33 gauge	5
18 gauge	31 gauge	20
		TOTAL 455

were males, and 67 per cent were over 50 years of age. That these are both low-risk groups with respect to headache may have contributed to the low incidence.

The use of these needles necessitates distinctly more effort and care than are required by the conventional #22 spinal needle. Preliminary epidural tap can be more time-consuming than simple subarachnoid tap. The technique was abandoned in 2 per cent of the cases—five times because the epidural space could not be entered and in four cases because no fluid could be aspirated. Likewise, the aspiration of spinal fluid and the subsequent testing of this fluid for glucose requires additional time. The fine needle tip can readily be blocked by foreign material. The clearing of a blocked tip with a stylet 0.09 mm in diameter is painstaking, requiring a steady hand and good eyesight. The protective sheath of the #14 tubing has facilitated the sterilization procedure and subsequent handling.

It remains a matter of judgment whether a possible slight reduction in incidence or severity of postspinal headache is worth the extra effort required by this technique. Certainly, when the overall incidence of headache is 6 per cent with the #24 and about 1 per cent with the #26, the maximal residual improvement that can be gained will be small. If further experience were to confirm the elimination of severe incapacitating headache, this might constitute an important reason for carrying out this somewhat more complicated time-consuming technique.

The technique of using a larger needle as the introducer for protecting and directing the inner needle is not novel and has been described repeatedly.[1] However, except for our preliminary report,[7] no one has attempted to place the tip of the outer needle deliberately into the epidural space and, furthermore, the outer needle was almost invariably too short to reach the epidural space. In two instances[5, 6] the outer needle was inserted only to but not through the ligamentum flavum. Interestingly, in 1922, Hoyt[8] described a double-needle technique in which the inner needle projected only 6 mm beyond the outer. Consequently, the tip of the outer needle must have been in the epidural space even though Hoyt did not mention either the ligamentum flavum or the epidural space. He does refer to "the common error of carrying the first step too far and piercing the dura with the outer needle." He presented no data about the incidence of headache. It is important to carry out an epidural tap initially with a large outer needle when the fine needles are used because the fine needle would have to traverse the relatively thick ligamentum flavum and might become occluded or damaged. Also, unless one is certain that the tip of the outer needle is adjacent to the dura, the inner needle may still be directed toward bone and be bent or broken.

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