Anesthesiology
69:123–125, 1988

Scanning Electron Microscopic Examination of Resterilized 29-gauge Spinal Needles

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The cause of postdural puncture headache is a persistent leakage of cerebrospinal fluid through the puncture hole created in the dura. For this reason, smaller needles have been adopted for use in spinal anesthesia. The smallest commercially available needles today, 29-gauge (Becton Dickinson, Rutherford, NJ), are recommended to be resterilized and re-used several times. We determined whether these needles would withstand multiple use and difficult cleaning processes.

MATERIALS AND METHODS

The study included 24 patients, aged 16–29 yr, scheduled for orthopedic surgery. The clinical study was approved by the Ethics Committee of the Surgical Hospital. All patients received a spinal anesthesia at mid-line in the LIII-IV interspace with plain 0.5% bupivacaine 3 ml, with the patients lying in the lateral horizontal position. In random order, half of the patients were blocked using a 26-gauge disposable spinal needle (Becton Dickinson, Rutherford, NJ), while, in the remaining half of the patients, the puncture was performed with a 29-gauge needle (Becton Dickinson, Rutherford, NJ). A disposable introducer was used with both types of the needles. The aspiration of cerebrospinal fluid was always used as a sign of proper location of the needle tip. All blocks were done by the same anesthetist (MKT). The sensory and motor blocks were tested at 15-min intervals during 1 h, and then at 30-min intervals until the recovery of the L1 spinal segment. All patients were interviewed on the first postoperative day. Side effects (*e.g.*, headache, backache, micturition difficulties, nausea, and vomiting) and recovery from the block were recorded. After 3 weeks, a questionnaire was sent to all patients to find out whether postdural puncture headache had occurred.

All 29-gauge needles, recommended for re-use, were examined in a light microscope before being used on a patient. Three unused 29-gauge needles were studied by scanning electron microscopy (ScEM).

All 29-gauge needles were cleaned and sterilized before the use. Three of these 29-gauge needles were resterilized after one use and examined by ScEM. Three other needles were resterilized and re-used. After three punctures, and resterilizations they were studied by ScEM. One 29-gauge needle (no. 5), which was bent during the puncture attempt, was studied by ScEM, too. For comparison, six disposable 26-gauge needles were studied by ScEM: three of them being examined without being used on a patient, while three others were examined after the single use. Impurities found in the needles were analyzed by semiquantitative EDS-analysis (energy dispersive spectrometry).

Immediately after use, the 29-gauge needles, with the stylets taken out, were soaked for 30 min in a detergent solution (pH 7.0, Tisko, Farmos Group, Finland) flushed through with the same solution and then rinsed with copious quantities of tap water. The needles were then flushed with 80% denaturated ethyl alcohol using a pressure pump, and dryed with pressurized air after which they were sterilized in hot air (160° C). The needles and stylets were stored separately on gauze padding in small metal boxes. The stylet was inserted into the needle by the anesthetist just before the following use. The disposable 26-gauge needles submitted to ScEM examination were only rinsed with copious amounts of tap water after the clinical use.

RESULTS

The two patient groups were comparable. The level of blockade and its duration were equal in both groups (table 1). When the 29-gauge needles were used for the dural puncture, the aspiration of cerebrospinal fluid was reported to be difficult in eight of the 12 situations, compared to one case with the 26-gauge needles. The resistance to flow of local anesthetic through the 29-gauge needles was considerably higher than through the 26-gauge needles. In one case with a 29-gauge needle (no. 5), after several puncture attempts, the needle hit bone and bent near the hub. The stylet was removed

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Key words: Anesthetic techniques: spinal. Sterilization: spinal needles.

TABLE 1. Characteristics of the Patients and the Spinal Blockade. Numbers are Means ± SD

	26-guage Needle	29-gauge Needle
Number of patients	12	12
F/M	3/9	2/10
Age (years)	23 ± 5	23 ± 4
Height (cm)	176 ± 8	178 ± 8
Weight (kg)	71 ± 9	72 ± 8
Level of spinal block (number of segments)	15.5 ± 2.9	14.8 ± 3.7
Time to recovery of L1 segment (min)	190 ± 30	168 ± 37
Duration of motor block (min; time from puncture to start of recovery)	200 ± 32	182 ± 41

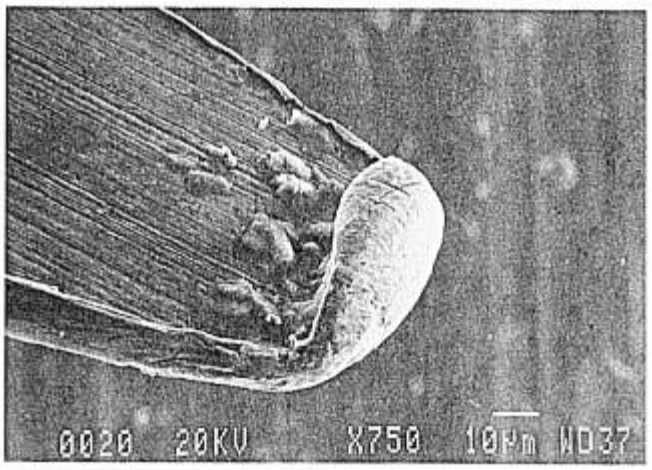

FIG. 1. The bent stylet of 29-gauge needle no. 5 with lumps of impurities after one use and resterilization.

and could not be reinserted. Examination of the stylet tip showed it to be bent (fig. 1). The block was finally made with a 26-gauge needle after two attempts with the patient in sitting position. This patient, a 16-yr-old girl, developed typical postdural puncture headache that was immediately relieved after an epidural blood patch on the third postoperative day. One patient in each group had micturition difficulties in the 24-h postoperative period, and two patients in each group complained of mild backache. In the questionnaire, one patient in each group reported having had nonspecific mild headache that passed without treatment.

Before patient use, light microscopy showed that all 29-gauge needles were without fault. This was confirmed on three of the needles by ScEM. The tips of the needles were in satisfactory condition after single (26 + 29-gauge) or triple (29-gauge) use.

All needles contained impurities after the use (fig. 1, 2). The impurities were in the shape of lumps, balls, or flakes. Crystals (probably sodium chloride) were found only in one of the 26-gauge needles. The impurities were similar both qualitatively and quantitatively, regardless of the gauge of the needle and the number of times used.

The needles were of alloy steel containing iron, chromium, nickel, copper, and silicon. These elements, except silicon, were excluded in the qualitative analysis of impurities. The most commonly found element of the impurities was calcium (table 2).

DISCUSSION

In this study, the characteristics of spinal blockade were equal, regardless of which needle size was used for the puncture of the subarachnoid space. The level and duration of the blockade was similar to that reported in an earlier study with young patients.[1] The single postdural puncture headache that occurred was in the 16-yr-old girl, on whom several puncture attempts had been made first with a 29-gauge needle and then with a 26-gauge needle. A larger population for study is required to arrive at firmer conclusions regarding the incidence of postdural puncture headache.

The cleaning process used here was according to a method generally accepted for this purpose,[2] and fulfilled the recommendation printed on the needle package by the manufacturer ("wash, rinse, dry, sterilize before initial and each subsequent use"). The particles found in the needles could not have resulted from the cleaning process, as the same kind of impurities were in both types of needles. The 29-gauge needles went through the entire preparation process, whereas the disposable 26-gauge needles were only rinsed with water.

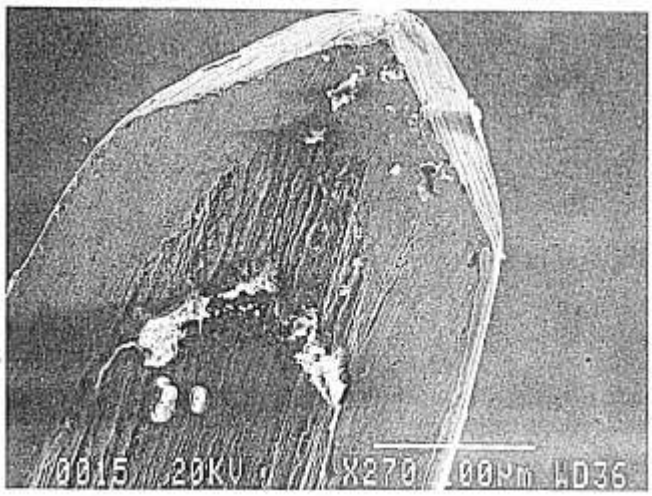

FIG. 2. Shown is 29-gauge needle no. 2 after three punctures and resterilizations, showing flakes and balls of impurities.

TABLE 2. EDS-analysis of Impurities in the Needles

Needle Number	Number of Uses	Site of Impurity	Type of Impurity	Elements in Impurities
29-gauge				
1	3	Inside	Flakes	Ca,* Si,‡ S‡
2	3	At the tip	Flakes and double ball	Ca,* S,* Si,‡ Mg‡
3	3	Inside and at the edge	Balls	Ca,* S,† Cl,‡ K,† Na†
4	1	Inside	Ball and flake	Si,* Mg*
5	Bent	At the tip and stylet tip	Lumps	Ca,* S,* Si,† Mg,† Na‡
6	1	Inside	Flake and ball	Ca,† S,† Na,† K,† Cl†
7	1	Inside	Ball	Ca,* S*
26-gauge				
D	1	Inside and at stylet tip	Lumps	Ca,* S,* Si*
E	1	Inside	Lump	Si,† S,† Cl,† Ca†
		At stylet tip	Crystals	Na,† Ca,† K,† Cl,† S,‡ Si,‡ Mg‡
F	1	Inside, at the tip and stylet tip	Lumps	Ca,† S,† K,† Na,† P,† Mg,‡ Si,‡ Cl‡

Ca = calcium; S = sulphur; Si = silicon; Mg = magnesium; Na = sodium; K = potassium; Cl = chlorine; P = phosphorus.
* Heavily.
† Moderately.
‡ Slightly.

One 26-gauge needle showed crystals that could have arisen from salts in the tap water. The shape and content of impurities discovered in both needles suggest biological tissue origin.

Although harmful consequences of the material observed on the needles could not be demonstrated in this study, it is conceivable that multiple use of spinal needles may cause minute particles to reach the subarachnoid space of the patient when injecting the local anesthetic. It is possible that these particles may well be responsible for a considerable number of cases of meningeal irritation or meningismus that have been attributed to many other causes.[3] Foreign bodies detached from the spinal needles may create a potential hazard by inducing irritation in the subarachnoid space or causing neurologic sequelae.[2]

The cleaning and sterilizing process used here, and which is also in general use elsewhere, did not prevent the presence of particles of organic origin in the spinal needles. Therefore, we conclude that re-use of 29-gauge spinal needles should be avoided, and these needles should thus be considered as disposable ones.

ADDENDUM

After the study had been completed, three other 29-gauge needles were submitted for cleaning in an ultrasonic instrument cleaner (KeySonic, KeyMed Ltd, UK) containing detergent (*p*H 9, Erinox, Noiro Ltd, Finland) before and after a single use. The entire procedure consisted of soaking and flushing with detergent solution, rinsing with tap water, ultrasound cleaning for 20 min, rinsing with distilled water, flushing with absolute ethyl alcohol using a pressure pump, and hot air sterilization at 160° C. Thereafter, the needles underwent ScEM examination with EDS-analysis. The needles contained slightly less impurities, but the shape and element content of them were similar as before. Also, here, the tip of one of the three stylets was shown to be bent in ScEM.

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