TABLE 3. Amounts of the Components
Extracted from Water and Plasma

<table>
<thead>
<tr>
<th>Substances</th>
<th>From Water (Per Cent)</th>
<th>From Plasma (Per Cent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GX</td>
<td>75.5 ± 4.1</td>
<td>72.1 ± 7.1</td>
</tr>
<tr>
<td>MEGX</td>
<td>98.1 ± 5.7</td>
<td>101.1 ± 4.1</td>
</tr>
<tr>
<td>Lidocaine</td>
<td>93.1 ± 4.6</td>
<td>92.1 ± 0.9</td>
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graphic conditions were used: injection port temperature 230 C, detector temperature 250 C. The flame was optimized and a carrier gas flow of 100 ml/min nitrogen was used. Quantification of the responses for lidocaine and its metabolites and for the internal standard was obtained by multiplying peak height \times width at \( \frac{1}{2} \) the height. Determinations of compounds extracted from H\(_2\)O and plasma were completed using the internal-standard method.

RESULTS

The analysis of lidocaine and its known metabolites can be effected using gas chromatography. Table 1 illustrates various column packing materials used, column lengths, and quality of separation. The best separations were obtained using a 10 per cent UCW 2-foot \times 2-mm glass column or a 2 per cent carbowax 20M with potassium hydroxide, 2 foot \times 2 mm glass column. A representative chromatogram on the 10 per cent UCW column is shown in figure 2.

Temperatures, linearity of responses, relative retention times, and absolute retention times are indicated in table 2. Lidocaine and MEGX are linear over a wide range of concentrations. Table 3 shows the amounts of each compound extracted from water and plasma. While lidocaine and MEGX can be extracted quantitatively, GX cannot. The average recovery for GX was 72–75 per cent.

SUMMARY AND CONCLUSIONS

A new chromatographic method makes it possible to quantitate lidocaine and to separate and quantitate its major metabolite monoethylglycinexilidide\(^*\) from either plasma or water. The method also provides of semiquantitative estimation of another postulated metabolite, glycexilidide.

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REFERENCES


A Critical Evaluation of Disposable Spinal Anesthesia Needles

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The mechanical coring of a fragment of skin being penetrated by a hollow needle during lumbar puncture carries several rare sequelae which have received scant attention in the medical literature. Suspecting that posts spinal headache was related to the needle's capacity for coring, Brandus \(^1\) microscopically examined 60 reusable 22-gauge spinal needles with stylets. In 30 per cent of the needles examined before skin puncture he found bits of tissue lodged between the stylets and the inner surfaces of the needles. Of the group of needles examined after the skin had been
punctured to a depth of one inch, 75 per cent contained fragments of epidermis. Charlebois, in an earlier study, reported incidences of 75 per cent coring following skin puncture with a 17-gauge Tuchy side-opening needle from which the stylet had been removed and 87 per cent coring when the stylet was in place, the size of the core varying with the fit of the stylet. Charlebois' primary concern was the possibility of depositing in the epidural space a skin core which could result in an abscess, scar formation or an extradural epidermoid cyst. The danger of development of epidermoid tumors in the subarachnoid space has been mentioned by others. Occasionally, in performing lumbar punctures, one has the experience of being certain that the tip of the needle lies in the subarachnoid space, but fluid does
not flow freely or cannot be aspirated through it. In such instances, if the needle is removed and fluid flushed through it, a core of tissue which was occluding the needle may be dislodged. This annoying hindrance and the potential harmful consequences mentioned above prompted a study of disposable spinal needles currently available commercially to determine their quality and potential for coring.

**METHODS**

One hundred 22-gauge disposable spinal needles were obtained from each of four companies in this country which manufacture them for inclusion in commercially prepared disposable spinal anesthesia trays. The tips of the needles were examined under the microscope and placed in three categories: 1) *flush*, in which the stylet and the needle were of equal length from the tip to the heel of the point (fig. 1); 2) *recessed*, in which the stylet was shorter than the needle (fig. 2); 3) *protruding*, in which the tip of the stylet extended beyond the lumen of the needle (fig. 3).

**RESULTS**

It is evident from the results (table 1) that there were defects in all series, ranging from 19 to 94 per cent of the needles examined. After Company D was notified of the preliminary findings, it modified its production techniques and developed the Type II needle, in which the stylet was a near-perfect match. However, the later model had still another fault: in 33 per cent of the ones tested, the stylet was seated insecurely in the hub and it was necessary to apply finger pressure to prevent recession of the stylet, a maneuver which would be awkward during lumbar puncture.

**DISCUSSION**

The major hazard of using an imperfect needle in performing lumbar puncture is the potential for deposition of a core of skin in the subarachnoid space, with subsequent development of an epidermoid tumor. In previous studies, the incidences of coring with hollow needles have ranged as high as 70 per cent. Reports of comparable incidences of coring with epidural needles and reusable spinal needles have been mentioned above.

Dickson pointed out, in 1944, that certain findings are not usually recorded in reports of cerebrospinal fluid examinations. He states that he has "not infrequently encountered squamous cells from the skin surface, together with their accompanying staphylococci, etc., and occasionally even a little cylindrical fragment of skin punched out by the exploring needle."
There is strong evidence that a plug of skin in the subarachnoid space can act as a nidus for the development of an epidermoid tumor, with its insidious neurologic sequelae. Manno and colleagues found an epidermoid cyst attached to the rootlets of the cauda equina of a patient who had had progressive symptoms of sciatica for four years and had a history of spinal anesthesia for an appendectomy. They reviewed the literature and compiled a group of 24 cases of patients (ages 5 to 20 years) treated with multiple lumbar intrathecal injections of streptomycin for tuberculous meningitis and another group of 15 patients who had had lumbar punctures for either diagnosis or spinal anesthesia prior to the onset of symptoms caused by the epidermoids. The times of onset of neurologic symptoms ranged from 18 months to ten years after lumbar puncture. All authors reporting cases in the former group had suggested that the tumors resulted from direct implantation of epidermis into the spinal canal by the lumbar puncture needle during repeated spinal taps and were therefore noncongenital in origin. Supporting this contention was the fact that, of the 24 cases, the tumors were located in the lumbar region in 23 and in the lower thoracic region in one. This contrasts sharply with the random segmentation of congenital epidermoids, which frequently are associated with other stigmata, including spina bifida, diastematomyelia, and rudimentary duplication of the cord, as well as dermal sinuses.

Added evidence for a relationship between these tumors and previous lumbar punctures was presented by Boyd, who reported a patient who, four years after having a normal lumbar myelogram, developed at the site of the dural puncture an epidermoid tumor which was confirmed by repeat myelography and surgical exploration. More recently, Pear added to the literature two more cases, one an intradural and the other an epidural epidermoid. Both were located in the lumbar region, and both patients had histories of prior spinal anesthesia. Pear estimated that 41 per cent of previously reported tumors were iatrogenic, and suggested that a contributing factor was the use of spinal needles with poorly-fitting stylets or no stylets at all. Furthermore, he thinks that these tumors should be considered in the differential diagnosis of cauda equina lesions, particularly when there is a past history of lumbar puncture.

Implantation was studied in the laboratory by Van Gilder and Schwartz, who placed 0.5-mm square pieces of autogenous skin in the subarachnoid and epidural spaces of 18 newborn albino rats. On sacrificing the animals at intervals from 65 to 171 days, they found tumor proliferation in 89 per cent. There was a slow but progressive increase in size with time, the findings were believed to be consistent with slow development from the tiny epidermal implants.

As a hollow needle penetrates the skin, the point makes an ever-widening crescent-shaped incision; the sharp edge of the back bevel completes the excision and the fragment becomes impacted in the lumen of the needle. The disposable spinal needle with a recessed stylet (fig. 1) is essentially a hollow needle and a potential coring instrument.

The results of this study have shown that many disposable spinal needles distributed to physicians today are defective. Evidently they are the result of poor manufacture or inadequate quality control or both. It is completely within the technical resources available to manufacturers to market a product which is not a hazard to the health of the patient subjected to lumbar puncture.

REFERENCES

CASE REPORTS

Inadvertent Intrasosseous Injection—A Hazard of Caudal Anesthesia

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The administration of a local anesthetic via the sacral canal is associated with a number of possible untoward complications. Dawkins has recently reviewed this subject, in a survey of more than 350 papers. Yet another potential hazard, not previously described in the literature, was experienced by this author and forms the basis for this report.

REPORT OF A CASE

The patient, a 52-year-old white man weighing 80 kg, was in good general health except for a symptomatic fistula in ano. An elective fistulectomy was to be performed with the patient in the prone jackknife position under caudal anesthesia. He was premedicated with meperidine, 75 mg, and pentobarbital, 100 mg, intramuscularly, and prepared for the anesthetic procedure 30 minutes later. Bone landmarks about the sacral hiatus were poor, and many attempts were made before an 18-gauge spinal needle was successfully placed in the sacral canal. No unusual resistance was felt during the final passage of the needle and it was believed to lie free in the caudal canal. However, aspiration produced blood. The syringe was emptied onto the drape and the needle withdrawn approximately 0.5 cm. Repeat aspiration again produced blood. The initial sample was examined and found to be thick and granular, with a velvety feel, unlike venous blood. The second specimen was placed in a test tube and sent to the laboratory for analysis. Blood could not be aspirated after the needle with withdrawn another 0.5 cm, and a test dose of 5.0 ml of 1.5 per cent lidocaine was injected. This was followed in four minutes with 20.0 ml of the same solution. An anesthetic


METHODS

Angora goats weighing 20-38 kg, in which bilateral lumbar laminectomies were being done for an unrelated study, were used. They were anesthetized with thiopentone, 25-30 mg/kg, intravenously, and endotracheal anesthesia was maintained with a mixture of 50 per cent N₂O-O₂ and halothane, 0.5-1.5 per cent. Cannulae were inserted into the carotid artery and the jugular vein. Intraarterial blood pressure and lead II of the electrocardiogram were monitored continuously on an oscilloscope. In each of six animals a segment of the spinal cord was also excised at laminectomy, exposing the bare posterior surface of the vertebral body. An 18-gauge spinal needle was introduced into the vertebral body to a depth of approximately 1 cm. In another animal (goat 7, table 1) the needle was inserted into the vertebral body in the intact animal prior to laminectomy. All seven aspirations produced blood which had the gross appearance of marrow. Following aspiration, 2 per cent lidocaine in doses of 7 mg/kg ("calculated volume," table 1) was injected over a period of approximately two minutes. In the

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