Neurologic Complications Following Spinal Anesthesia with Lidocaine:

A Prospective Review of 10,440 Cases

Otto C. Phillips, M.D., Herbert Ebner, M.D.,† Alfred T. Nelson, M.D.,‡ Milton H. Black, M.D.§*

A group of 10,440 patients received lidocaine for spinal anesthesia. No patient developed a major central nervous problem, such as arachnoiditis or cauda equina syndrome. Eight patients had symptoms of abducens paralysis, which disappeared before they left the hospital; 367 patients (3.5 per cent) suffered from positional headaches; 284 patients complained of backache. The one death in the series was not related to any specific characteristic of the drug. There were 30 patients with transient peripheral nerve symptoms, and eight patients had symptoms of peripheral nerve problems which persisted after discharge from the hospital. Two of these had nerve root involvement due to spinal anesthesia and two had exacerbation of lumbar disc disease with symptoms that antedated spinal anesthesia. The results of this study suggest that lidocaine is as safe for spinal anesthesia as other accepted drugs.

SEVERAL CHARACTERISTICS of lidocaine (Xylocaine®) suggested that it might be valuable for spinal anesthesia: its potency,[1] brief latent period,[2,3] lack of tissue irritation,[1,3] and chemical stability after autoclaving[4] or prolonged storage. The use of lidocaine for spinal anesthesia was first mentioned in 1948 by Gordh, who simply stated that a 2 per cent solution produced rapid and satisfactory analgesia for cystoscopy and perineal procedures.[5] Both higher and lower concentrations subsequently were tested clinically, and in 1954 Berne reported his experience with the 5 per cent solution presently marketed.[6]

* Chief, Division of Anesthesiology, the Western Pennsylvania Hospital, Pittsburgh, Pennsylvania.

† Chief of Anesthesia, Providence Lying-In Hospital, Providence, Rhode Island.

‡ Chief of Anesthesia, The Greater Baltimore Medical Center, Towson, Maryland.

§ Captain, Medical Corps, United States Army. Chief, Anesthesia Service, 27th Surgical Hospital, APO San Francisco 96325.

Accepted for publication September 9, 1968.

A series of articles describing the clinical applicability of lidocaine for spinal anesthesia followed.[7-12] Although acceptance of this drug as effective and safe has grown steadily during the past decade, properly conservative medical opinion suggested that only procaine and tetracaine have been used long enough to assure lack of neurotoxicity.[13] The purpose of this study was to conduct a prospective survey of an extensive series of patients who received lidocaine for spinal anesthesia. It was anticipated that in this way the safety of the drug could be established or refuted.

Methods

Three hospitals, the Magee-Womens' Hospital, Pittsburgh, Pennsylvania, Providence Lying-In Hospital, Providence, Rhode Island, and The Hospital for the Women of Maryland, Baltimore, Maryland, participated in the study. Lidocaine, tetracaine (Pontocaine®) and dibucaine (Nupercaine®) were used. We knew in advance, however, that lidocaine would be used most frequently.

All needles and syringes on the spinal trays were used for this purpose only and were not part of the general hospital supplies. They were cleaned with water and ether, no detergents or cleaning solutions being used. The spinal anesthetic drugs were in solution in ampules and were autoclaved with the other items on the tray. When vasopressor drugs were used, they were injected into the deltoid muscle at the beginning of the preparation for the spinal block. Hands were washed and gloved, but were not given a surgical scrub. The back was cleaned with tincture of Zephiran®; care was taken to keep this solution away from the spinal tray. If paresthesia occurred, the needle was redirected before in-

jection of the solution. If a bloody tap occurred, the anesthetic was injected only after the fluid had cleared.

Data pertinent to the immediate anesthetic period were recorded at the time. The next day, the patient was seen by a member of the anesthesia department and asked if she (or he) had any problems that might be related to anesthesia. Whenever a complaint or problem was elicited, the patient was checked daily by one of the anesthesiologists. Those patients with complications that persisted to the time of discharge from the hospital were given neurologic examinations and seen by consultants in neurology or physiatry.

In the pattern of the classic survey by Dripps and Vandam,[14] each patient was sent a written inquiry after leaving the hospital. This included a stamped, addressed card to encourage and expedite a response. The patients were asked:

> Have you had any problems related to the anesthesia—Yes or No? If Yes, please describe.
>
> Would you recommend spinal anesthesia to a friend—Yes or No? If not, why?

If there was no response to the first follow-up, a second inquiry was sent. If there was still no response, the patient was called on the telephone. A physician talked to all patients who said they had residual problems. If a problem obviously was not related to anesthesia, this was explained to the patient and discussed with the referring obstetrician or surgeon. If anesthesia could have been a factor, the patient was invited to the hospital for personal interview and examination.

Results

During the three-year period from 1964 to 1966, 11,802 spinal anesthesias were given. Lidocaine was used for 10,440 of these (88 per cent). Tetracaine was used for 1,356 cases, dibucaine for six. The data that follow all relate to the 10,440 patients for whom lidocaine was used.

In this series there were 10,287 female and 153 male patients; 9,636 were white, 804 non-white; 9,039 (86 per cent) were in the age group 16–35 years (mean 25.2 years) (table 1).

TABLE 1. Ages of Patients

Age (Years)	No. of Patients	
Less than 15	85	
16–20	1,577	
21–25	3,498	9,039
26–30	2,586	(86 per cent)
31–35	1,378	
36–40	686	
41–45	157	
46–50	59	
51–55	37	
56–60	31	
Other or not indicated	346	
TOTAL	10,440	

Lidocaine spinal anesthesia was used for vaginal delivery in 8,997 patients and for abdominal delivery in 709; thus, it was used for obstetric procedures in 9,706 (93.1 per cent) of the cases (table 2). The doses of lidocaine ranged from 40 mg or less to 100 mg. In 8,665 cases (83 per cent), however, the doses were 41–50 mg. The operative procedures lasted less than 30 minutes in 4,622 cases and 31 to 60 minutes in 5,082. Thus, the duration was an hour or less in 9,704 (93 per cent) and more than one hour in 736 (7 per cent) of the cases. Anesthesiologists administered 6,612 of the anesthesias, anesthesia residents 829, obstetricians 1,378, obstetric residents 1,419, interns 168, and for 34 identity was not indicated.

Of all the patients, 8,068 (77 per cent) were seen while in the hospital (table 3); 5,197 responded to the first written follow-up,

TABLE 2. Types of Operations

Operation	No. Patients	Per Cent	
Vaginal delivery	8,997	86.2	93.1
Abdominal delivery	709	6.9	
Perineal	370	3.5	
Lower abdominal	67	0.6	
Upper abdominal	2	0.0	
Not indicated	295	2.8	
TOTAL	10,440	100.0	

TABLE 3. PATIENT FOLLOW-UP

Personal Interview	8,068 (77%)
Follow-up	9,323 (89%)
Written I 5,197	
Written II 2,871	
Telephone 1,255	
No post-discharge follow-up	1,117
TOTAL PATIENTS	10,440

2,871 to the second, and 1,255 nonrespondents were contacted by telephone. Thus, 9,323 (89 per cent) of the patients either responded or were contacted after leaving the hospital. Twenty-three per cent of the patients, therefore, did not have personal interviews, and 11 per cent were not contacted after leaving the hospital. It was obviously important to determine whether these were the same patients; this would have indicated a sizeable segment of the study with no postanesthetic contact.

Of the 2,372 patients who did not have personal interviews while in the hospital, 1,709 responded to the first written follow-up, 436 to the second written follow-up, and 184 were contacted by telephone. Thus, 10,397 patients (99.6 per cent of the entire series) were either interviewed while in the hospital or contacted after leaving. In addition, the nurses and physicians were alerted to the survey and were prompt to report any problems. It is unlikely, therefore, that any serious neurologic problems evaded our attention.

No patient in this series had a major central nervous system problem, such as arachnoiditis or cauda equina syndrome (table 4). Eight patients had symptoms of abducens paralysis, which disappeared before they left the hospital; 367 patients (3.5 per cent) suffered from positional headaches, which were confirmed by anesthesiologists as lumbar puncture headaches and so recorded; 284 patients complained of backaches.

There was one death in the series, a healthy 25-year-old, unmarried primigravida. Fifty milligrams of lidocaine were given just before 11:00 p.m. The attendant monitoring the case was relieved at this time, and during transmission of pertinent data and transcription to the chart the patient evidently was unobserved for

TABLE 4. Postanesthetic Sequelae

Sequela	No. Patients
Central nervous system	0
Ocular (double vision)	8
Headache	367 (3.5 per cent)
Backache	284
Death	1
Peripheral nerve symptom	38
Motor weakness	23
Hypesthesia	12
Paresthesia	3

TABLE 5. Persistent Peripheral Neuropathy

Diagnosis	No. Patients
Nerve root involvement	2
Positional trauma	2
Compression radiculopathy (disc)	2
Sacroiliac strain	1
Trochanteric bursitis	1
TOTAL	8

TABLE 6. Traumatic Lumbar Punctures

Type of Trauma	No. Patients
Multiple puncture	656
Bloody tap	302
Paresthesia, right	71
Paresthesia, left	16
Paresthesia, midline	6
TOTAL	1,051 (10.0 per cent)

TABLE 7. Immediate Complications

Complication	No. Patients	Per Cent
None indicated	9,913	94.9
Hypotension	308	3.0
Shivering	178	1.7
Nausea	27	0.3
Respiratory inadequacy	14	0.1
TOTAL	10,440	100.0

a brief interval; cardiac arrest occurred. Circulation was promptly restored by oxygenation and external cardiac massage, but the patient died two days later. Post-mortem examination disclosed a myocardial infarction. The spinal cord and meninges contained no evidence of an inflammatory process, and no gross intracranial bleeding or petechial hemorrhages were found in the brain. This death was not related to any specific characteristic of the drug.

There were peripheral nerve symptoms in 38 patients; motor weakness in 23; hypesthesia in 12; paresthesia in three. These symptoms did not appear to be associated with traumatic lumbar puncture and, except in two cases, they had not been present prior to anesthesia and delivery. In 30 patients the symptoms disappeared prior to discharge from the hospital, which was within five days for most obstetric patients.

Neurologic examinations of the eight patients who had persistent symptoms of peripheral nerve problems were carried out before and after discharge from the hospital (table 5). Two of these patients had nerve root involvement, believed due to the spinal anesthesia. It is noteworthy that, although both patients had atraumatic punctures, both had felt pain upon injection of the drug, suggesting that the point of the needle had moved into close proximity to a nerve root. Two patients had isolated peripheral neuropathies due to positional trauma. One patient had sacroiliac strain and one had trochanteric bursitis, both without neurologic findings. Two additional patients had neurologic symptoms from injury at the root level. They also had lumbar disc disease, with symptoms that antedated the spinal anesthesia. Since accentuation of the signs and symptoms followed spinal anesthesia, it is believed that the local anesthetic drug contributed to the irritation of the nerve roots.

A nerve lesion was identified and located by mapping out the distribution of sensory and motor nerve deficit. Symptoms relating to a single nerve could result only from a peripheral nerve injury, such as pressure or stretching. More diffuse or multiple neurologic deficits could have resulted from several distinct peripheral lesions, but it was more likely to be caused by injury at the root level in the subarachnoid space. This was the basis for the diagnoses in the two cases with nerve root involvement due to spinal anesthesia and in those two with exacerbation of lumbar disc disease.

There were 1,051 (10.0 per cent) traumatic lumbar punctures, defined as any except where a simple, one-attempt puncture without paresthesia was accomplished. There were 656 instances of multiple puncture, 302 bloody taps, and 93 paresthesias, 71, 16, and 6 in the right leg, the left leg, and the midline, respectively (table 6). Several facets of the study might explain the lack of neurologic lesions identified with such a large number of traumatic punctures. First, the criteria were

TABLE 8. Patient Acceptance of Spinal Anesthesia

Would recommend spinal		8,775 (94 per cent)
Would not recommend spinal		548
Reason:		
Headache	96	
Backache	91	
Painful lumbar puncture	36	
Advice of friend	26	
Prefer to be asleep	21	
Peripheral nerve complications	3	
No reason given	275	
Total postanesthetic contacts		9,323

TABLE 9. Complications of Spinal Anesthesia in the Dripps and Phillips Series

	Dripps	Phillips
Procaine–tetracaine	8,690 (93 per cent)	1,356 (12 per cent)
Lidocaine	0	10,440 (88 per cent)
Other	587 (7 per cent)	6
TOTAL	9,277	11,802
Central nervous system Sequelae (arachnoiditis, cauda equina syndrome)	0	0
Peripheral neuropathy	66	30
Residual motor weakness	2	2

TABLE 10. Complications of Spinal Anesthesia in the Dripps and Phillips Series

	Dripps	Phillips
Neurologic exacerbation	9 (3 disc)	2 (both disc)
Age (mean)	40.6 years	25.2 years
Sex: Female	5,214 (56 per cent)	10,287 (99 per cent)
Male	4,063 (44 per cent)	153 (1 per cent)
TOTAL	9,277	10,440
Headache	1,524 (16.4 per cent)	367 (3.5 per cent)
Needle size:		
16	839 (9 per cent)	—
19	154 (2 per cent)	—
20	2,099 (29 per cent) } 82 per cent	28
22	4,955 (53 per cent) }	377 (3 per cent)
24	630 (7 per cent)	1,170 (11 per cent)
25	—	3,953 (39 per cent) } 82 per cent
26	—	4,421 (43 per cent) }
Not indicated	—	491 (4 per cent)

stringent, and many of the blocks usually would not have been classified as traumatic. In addition, most of the lumbar punctures were given to accomplish terminal anesthesia for vaginal delivery. There was seldom time for protracted efforts, and the technique often had to be abandoned if not quickly accomplished. Finally, the majority of the spinal taps were done with 25- and 26-gauge needles. It is hard to proceed against resistance with these fine-caliber needles without bending them, so injury to disc cartilage or vertebral periosteum is unlikely.

Among the immediate postanesthetic complications (table 7), hypotension developed in 308 of the patients; according to our definition, this indicated a drop in systolic pressure of 25 per cent or more below the preanesthetic level. Shivering, the next most common side effect, occurred in 178 cases. Twenty-seven patients became nauseated and 14 had respiratory inadequacy necessitating respiratory assistance.

Of the 9,323 patients contacted after leaving the hospital (table 8), 8,775 (94 per cent) indicated that they would recommend spinal anesthesia; 548 that they would not. Of those complaints reasonably related to the spinal anesthesia, 96 patients objected to headache, 91 to backache, 36 to painful lumbar puncture, 26 were influenced by the advice of a friend, 21 preferred to be asleep and three had had peripheral nerve complications. No reasons were given by 275 patients—they just didn't want spinal anesthesia again.

Discussion

Evaluation of the safety of a drug can be accomplished only by comparing it with other drugs used for the same purpose. In the survey by Dripps and Vandam,[14] tetracaine and procaine were used for 8,690 patients (93 per cent). In the present study, lidocaine was used for 10,440 patients (88 per cent) (table 9). We thus have data of comparable magnitude, gathered according to similar protocols. Comparison of the two series provides a reasonable basis for assessing the toxicity of lidocaine as compared with procaine and tetracaine, though the conclusions obviously are not as valid as if the studies had been made by the same investigator.

In neither group was a major central nervous sequela (arachnoiditis, cauda equina syndrome) demonstrated; this experience included 10,052 spinal blocks with procaine and tetracaine and 10,440 with lidocaine—a total of 21,079 spinal anesthesias. Sixty-six patients in the Dripps series and 30 in the Phillips study had transient symptoms of peripheral neuropathy. Two patients in each series suffered

root damage resulting in residual motor weakness.

Several differences between the two groups were demonstrated (table 10). Nine patients in the Dripps series had exacerbation of neurologic disease following spinal anesthesia, while this occurred in just two patients in the present study; three of these problems were related to disc compression in the former series, two in the latter. Possibly the difference in neurologic exacerbation might be explained on the basis of age. The mean age in the Dripps series was 40.6 years (the average age of the patients suffering neurologic disease with exacerbation was actually 57 years), while that in the present series was 25.2 years; we might anticipate a higher incidence of neurologic disease in the older age group surveyed in the former study. Ninety-nine per cent of our patients were female, whereas only 56 per cent of Dripps series were female.

In our survey, 3.5 per cent of the patients suffered post-lumbar-puncture headaches, whereas 16.4 per cent of the Dripps series had this complication. This is certainly related to needle size and not a characteristic of the drug used. Blocks were given to 82 per cent of the patients in our series with 25- or 26-gauge needles, and in the Dripps series 20- and 22-gauge needles was used. This serves primarily to confirm the dramatic relationship between needle size and incidence of spinal headache. It is interesting that, although 367 of our patients had this problem, only 96 indicated that they would not recommend spinal anesthesia because of the headache.

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