Postoperative Ulnar-Nerve Palsy

ARE THERE PREDISPOSING FACTORS?*

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From the Sioux Valley Hospital, Sioux Falls

ABSTRACT: In a prospective study in which we attempted to identify the etiology of postoperative ulnar-nerve palsy, 6,538 patients were followed through surgery and convalescence. In seventeen patients (0.26 per cent), an ulnar-nerve palsy developed at varying times during the postoperative period. Of these seventeen patients, all were re-evaluated at an average of six months and eleven were re-evaluated at an average of three and one-half years after operation. Bilateral nerve-conduction studies were done on all seventeen patients during the initial visit and on five of the eleven who were re-evaluated at an average of three and one-half years. Abnormal slowing of the conduction times was found in both nerves, suggesting a possible predisposition to this condition. Based on the results of the study, it is suggested that many patients may have a subclinical ulnar neuropathy that may become symptomatic as a result of the many maneuvers and manipulations that are associated with surgical procedures.

Our interest in postoperative ulnar-nerve palsy was stimulated by the cases of four patients in whom this palsy occurred after an otherwise uneventful surgical procedure. We found that nerve conduction was abnormal not only on the affected side but also on the opposite side in three of the four patients. When we reviewed the literature on postoperative ulnar-nerve palsy, we found that the opposite extremity had never been studied, nor had a prospective study been performed. In 1894, Bündiger first described the condition, relating it to the position of the extremity while the patient is on the operating table. In 1979, Miller and Camp identified three characteristics of this condition: onset after general anesthesia, persistent neural deficit, and clinical and electrophysiological evidence of a pure ulnar neuropathy. In the published reports on large series of patients who had ulnar-nerve palsy, operative procedures were cited as being responsible for 11 to 16 per cent of all of the palsies. The purpose of this study was to analyze the data from a large series of patients before, during, and after a surgical procedure in an effort to identify factors that may be responsible for this condition.

Materials and Methods

Our study was carried out at the Sioux Valley Hospital in Sioux Falls, South Dakota, from December 1980 through June 30, 1981. All surgical specialties are represented in this general hospital, which serves a large rural population. During the period of study, all patients who were going to

<table>
<thead>
<tr>
<th>TABLE I</th>
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<tbody>
<tr>
<td>ULNAR-NERVE PALSY STUDY — SIoux VaLLEY HOSPITAL SHORT FORM A</td>
</tr>
</tbody>
</table>

1. Name:  
2. OR data (filled in by anesth. staff)*  
3. PAR data (filled in by PAR staff)†  
4. Floor data (filled in by floor nurse)‡  

<table>
<thead>
<tr>
<th>Circle or fill in appropriate data</th>
</tr>
</thead>
</table>
| 1. Name:  
2. OR data (filled in by anesth. staff)*  
3. PAR data (filled in by PAR staff)†  
4. Floor data (filled in by floor nurse)‡  |

* No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article. No funds were received in support of this study.

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TABLE II
ULNAR-NERVE PALSY STUDY — FORM B
(For Use if Patient Develops Palsy after OR in Sioux Valley Hospital)

1. Name:
   Hospital no.:
   Address:
   Age:  Sex:
   Physician:
2. Side affected (right, left, both):
3. Length of hospital stay:
4. Did patient have an operation: (yes, no) If yes, please use Form A to answer questions 5 through 16.

OR data*
5. Operation date:
6. Surgeon:
7. Anesthesiologist:
8. Operation performed:
9. IV in which arm? (right, left, both)
10. BP cuff on which arm? (right, left, both)
11. Identify body position in OR (for example, lateral decubitus position):
12. Forearm position: (pron., supine)

PAR data†
13. BP cuff on which arm?
14. Forearm position: (pron., supin.)

Floor data‡
15. BP cuff on which arm?
16. Position patient assumed while sleeping:

History
17. When did patient first notice symptoms:
   Post-anesthetic recovery room
   First day on the floor
   Other (how long?)
18. Does patient have pain? (yes, no)
19. Is there a Tinel sign? (yes, no)
20. Does patient respond in the affirmative to any of the following?
   — Previous trauma to affected limb
   — Habitual leaning on the elbow (desk, armchair, table, and so on)
   — Recurrent swelling of the elbow
   — Arthritis
   — Diabetes
   — Other

21. Were nerve-conduction studies ordered? (yes, no)
   (If so, please photocopy and attach copy to this form)

* Data from the operating room.
† Data from the post-anesthetic recovery room.
‡ Data from the hospital floor during convalescence.

Also, when it was possible during these visits, conduction studies of the motor nerve were performed not only on the affected side, but also on the opposite side, using the technique of Payan and of Checkles et al. The recordings were made with the elbow flexed to 70 degrees, which is the best position for accurately measuring the velocity of conduction. In addition, ten control subjects who were in the same age range were studied for comparison. The control subjects were selected from a random population and not from the 6,538 patients who were screened for this investigation. Throughout the study, the same individual performed all of the nerve-conduction studies in both the patients and the control subjects.

Results
Seventeen (0.26 per cent) of the 6,538 patients who were screened during the six-month period of study were found to have postoperative ulnar-nerve palsy. Of these seventeen, eight (47 per cent) had had an orthopaedic procedure; six (35 per cent), a bypass of a coronary artery; one, a urological procedure; and two, an arterial bypass graft. There were fifteen men and two women, and the ages ranged from forty to eighty-seven years (mean, 62.4 years). The duration of the procedure ranged from forty to 280 minutes, with a mean of 140.3 minutes (Table III). The duration of hospitalization ranged from ten to 24.6 days, the average stay being 18.9 days. Only the left ulnar nerve was symptomatic in eight patients, only the right was symptomatic in six, and both of the nerves were symptomatic in three. The data from the operating room for the seventeen patients who had palsy showed that six had been in the lateral decubitus position during the procedure, and in all six the ulnar nerve at the elbow of the extremity that was uppermost, and not in contact with the operating table, was involved. The other eleven patients had been supine: eight had had the affected extremity at the side, with the elbow extended and the forearm supinated, and three had had the shoulder abducted 45 to 70 degrees, but the positions of the elbow and the forearm were not recorded. Of the six patients who had had a bypass of a coronary artery, the arterial line was in the affected limb in four patients and in the limb on the opposite side in two. The information on the position of the blood-pressure cuff was incomplete. Excluding the six patients who had undergone a bypass of a coronary artery and the three who had bilateral involvement, the cuff was

TABLE III
DURATION OF SURGERY (Minutes)

<table>
<thead>
<tr>
<th>Surgery</th>
<th>No. of Patients</th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthopaedic</td>
<td>8</td>
<td>40-135</td>
<td>93.8</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>6</td>
<td>120-280</td>
<td>199.1</td>
</tr>
<tr>
<td>Urology</td>
<td>1</td>
<td></td>
<td>175.0</td>
</tr>
<tr>
<td>General</td>
<td>2</td>
<td></td>
<td>80.0</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>40-280</td>
<td>140.3</td>
</tr>
</tbody>
</table>

in all departments, including nurses on the floor and all persons involved with the anesthesia and with the care of the patients in the recovery room, were familiarized with this condition and its usual presenting signs and symptoms. If a patient was found to have symptoms of ulnar-nerve palsy during the postoperative period, Form B (Table II) was used to record the symptoms, data relating to their onset and severity, and any related factors.

According to the protocol of the study, all patients were to be re-evaluated at approximately six months and again at approximately 3.5 years after operation; unfortunately, all patients were not available for evaluation at these times. During the follow-up visits symptoms were evaluated and any findings relative to strength and atrophy of the muscles, decreased sensation, and loss of function were recorded.
on the same side as the palsy in two patients and on the opposite side in three. The location of the cuff was not recorded for three patients.

Considering all seventeen patients, eleven went directly from the operating room to the recovery room and the six who had had a bypass of a coronary artery went directly to the intensive-care unit. In the recovery room, of the eleven patients for whom information was available, the blood-pressure cuff was placed on the arm of the affected extremity of four patients and on the other arm of seven patients. While in the hospital room, one patient was positioned for several days in the prone position, while the other sixteen were managed in the usual manner, being turned every four hours during the night and every two hours during the day. The precise position of the elbow in terms of degrees of flexion was not recorded during the early postoperative period or while the patient was in the hospital room.

The recorded symptoms of ulnar-nerve palsy in the seventeen patients were tingling in seven, numbness in ten, and pain in five. Five patients had two of these symptoms. The time of onset of the symptoms ranged from immediately after the operation to a maximum of 3.3 days later in the eleven patients who had not had a bypass of a coronary artery and from one to five days postoperatively in the six patients who had had open-heart surgery. The mean time for all seventeen patients was 3.3 days.

Frequently the patients did not mention the symptoms of the ulnar-nerve palsy because of their preoccupation with the primary illness. However, when they were questioned later they admitted to numbness or other symptoms and were able to recall precisely when the symptoms had started, even though the palsy was not detected until later.

When the seventeen patients were re-examined at an average of six months (range, two to seven months) after surgery, three had no symptoms and were classified as normal; six still had symptoms, but they had improved; in five the symptoms were unchanged; and in three they were worse. One of the three patients whose symptoms became more severe during the early postoperative period had decompression of the nerve at the elbow two months after the original procedure, with complete resolution of the symptoms four months after the decompression. At the time when this patient died of cancer eighteen months after the decompression, he was still asymptomatic. The other two patients who had symptoms that became worse during the early postoperative period still had symptoms at six months postoperatively. All of the fourteen patients who had had symptoms initially and were still alive had some residual weakness of the intrinsic muscles, and six of them had obvious atrophy of the muscles. However, these six declined surgical decompression. Considering all seventeen patients, eight had a sensory loss, with two-point discrimination at more than five millimeters, and nine had normal sensation or less than five millimeters of two-point discrimination.

Nerve-conduction studies were performed at the level of the elbow in both extremities of all seventeen patients at two to seven months (average, six months) after the operation. For these studies, a velocity of fifty meters per second or more was considered to be normal. In the three patients who had bilateral symptoms, the conduction velocities were reduced in both nerves (Table IV). In the eight patients in whom only the left ulnar nerve was symptomatic, the velocity of conduction was decreased in all of the left and in seven of the right nerves. In the six patients in whom only the right ulnar nerve was symptomatic, the velocity of conduction was abnormal in five and normal in one of the right nerves and was abnormal in five of the six left nerves.

When we attempted to re-evaluate these seventeen patients at an average of 3.5 years (range, 3.2 to 3.6 years) postoperatively, three had died and three could not be located. Of the eleven who were still available for study, four had had a bypass of a coronary artery and seven had had a different procedure. Of the four patients who had undergone heart surgery, one still had symptoms and three were symptom-free. Of the seven patients who had had a different procedure, three still had symptoms and four were asymptomatic. Considering the eleven patients who were followed for an average of 3.5 years, nine had been symptomatic at three to seven months postoperatively. However, when they were last seen, only four of those nine still had symptoms.

Of the eleven available patients, nerve-conduction studies were performed in five (three with and two without symptoms) at 3.2 to 3.6 years (average, 3.5 years) after the operation. Of the other six patients who did not have a conduction study after three years, one had a cardiac pacemaker, which precluded a nerve-conduction study, and five could be contacted only by telephone. Of the five patients who did have conduction studies, the velocities of the five nerves that had been symptomatic originally were still reduced whether the symptoms had subsided or not, while the

<table>
<thead>
<tr>
<th>Case</th>
<th>Side Involved</th>
<th>Across Left Elbow</th>
<th>Across Right Elbow</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left</td>
<td>40.5</td>
<td>40.0</td>
</tr>
<tr>
<td>2</td>
<td>Left</td>
<td>37.0</td>
<td>39.0</td>
</tr>
<tr>
<td>3</td>
<td>Left</td>
<td>26.0</td>
<td>38.0</td>
</tr>
<tr>
<td>4</td>
<td>Left</td>
<td>34.5</td>
<td>38.5</td>
</tr>
<tr>
<td>5</td>
<td>Left</td>
<td>48.0</td>
<td>46.0</td>
</tr>
<tr>
<td>6</td>
<td>Left</td>
<td>36.5</td>
<td>52.0†</td>
</tr>
<tr>
<td>7</td>
<td>Left</td>
<td>39.0</td>
<td>44.0</td>
</tr>
<tr>
<td>8</td>
<td>Left</td>
<td>39.5</td>
<td>40.0</td>
</tr>
<tr>
<td>9</td>
<td>Right</td>
<td>50.0</td>
<td>45.0</td>
</tr>
<tr>
<td>10</td>
<td>Right</td>
<td>45.0</td>
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<td>11</td>
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<tr>
<td>13</td>
<td>Right†</td>
<td>44.5</td>
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</tr>
<tr>
<td>14</td>
<td>Right†</td>
<td>41.5</td>
<td>39.0</td>
</tr>
<tr>
<td>15</td>
<td>Both</td>
<td>46.0</td>
<td>44.5</td>
</tr>
<tr>
<td>16</td>
<td>Both†</td>
<td>46.0</td>
<td>42.0</td>
</tr>
<tr>
<td>17</td>
<td>Both</td>
<td>44.5</td>
<td>44.5</td>
</tr>
</tbody>
</table>

* Values are in meters per second. The normal value is fifty meters per second.  
† Asymptomatic at the time of the study.
conduction velocities of the five opposite ulnar nerves were normal in two patients and reduced in three.

Analysis of the results for the patients who were still symptomatic and comparison with those of the patients whose symptoms had resolved revealed no aspects of their general health that distinguished the symptomatic patients from the others.

Discussion

Many causes of postoperative ulnar-nerve palsy have been proposed. Two of these are direct pressure on the nerve in the ulnar groove \(^1,2,10\) and prolonged flexion of the elbow while the patient is on the operating table, resulting in compression of the nerve secondary to the reduced volume of the cubital tunnel in this position \(^5,6,8,15\). In addition, systemic diseases such as diabetes or other neuropathies have been implicated in some patients who have ulnar-nerve palsy. It also appears from this study that there is a subclinical state, characterized by marginally adequate function of the nerve, that may be worsened by the effects of a surgical procedure. Any of these factors may depress function of the nerve sufficiently to bring on the clinical syndrome.

The durations of the palsy have varied in different studies. In 1979, Miller and Camp found that all eight of their patients were still symptomatic after an average length of follow-up of 23.5 months. They compared their findings with those of Dhuné, who found that the symptoms had subsided and were completely gone in seven of his eight patients after two to five months. In our series, four of the eleven patients who could be followed were still symptomatic at an average of 3.5 years after surgery. These findings suggest that, in many of the patients who have a milder form of ulnar-nerve palsy, the symptoms resolve spontaneously even though subclinical neuropathy persists.

In any discussion of this entity, the anatomy of the ulnar groove and ulnar nerve must be considered. As the elbow is flexed from zero to 45 degrees, the arcuate ligament tightens because the distance between its points of attachment increases by five millimeters \(^6\). This tightening diminishes the volume of the cubital tunnel and may cause compression of the ulnar nerve within the tunnel. In studies of the topography of the ulnar nerve, Sunderland found that the sensory fibers are superficial where the nerve passes under the arcuate ligament (Fig. 1). Therefore, these fibers would be vulnerable to pressure that is associated with prolonged flexion of the elbow during a surgical procedure.

Instability or subluxation of the ulnar nerve was not found in any of our patients, but in one study it was present in 16.2 per cent of 2,000 normal elbows \(^6\).

The role of excessive spreading of the sternum during surgery on the coronary arteries was discussed by Seyfer et al. in their report of fifty-three patients who had had cardiac surgery. Of these fifty-three patients, twenty (38 per cent) had postoperative motor and sensory neuropathy of the ulnar nerve: fifteen had symptoms that were limited to the ulnar nerve and five, neuropathy of one ulnar nerve and an as-
pressure cuff on the arm; the effect of an intravenous line that is used for replacement of fluid; and tension or pressure on the nerve that is produced by prolonged flexion at the elbow or pronation of the forearm, or both.

After the completion of our study, various preventive measures were instituted. The staffs on the hospital floor and in the operating room were made aware of this problem. All patients were questioned preoperatively as to whether they had had symptoms of neuropathy. All patients wore elbow pads during the procedure and the arms were held at the side or were abducted gently, with the forearm in a supinated position. Prolonged flexion of the elbow was also avoided. Finally, blood-pressure cuffs were applied loosely. Despite these measures, however, during the four-year period after our study, eleven additional patients with postoperative ulnar-nerve palsy were identified and were referred to one of us (F. G. A.) because of persistent symptoms. Of these eleven patients, eight were male and three were female. Four had had a bypass of a coronary artery; one, a general surgical procedure; and six, an orthopaedic procedure. The blood-pressure cuff had been placed on the affected and unaffected extremity in equal numbers. The length of time in the operating room ranged from thirty to 120 minutes, with a mean of ninety minutes. Eight patients recalled that symptoms had developed during the first to third postoperative day, two had noted the onset four and six weeks after operation, and one could not recall the precise time of onset.

At the time of writing, these eleven additional patients had been followed for a range of two months to four years. When they were last seen, in September 1984, the one patient who had been followed for only two months was still symptomatic. Of five other patients who had been followed for a range of six to eighteen months, three still had symptoms and two were asymptomatic. The five remaining patients, who had been followed for a range of eighteen months to four years, were also still symptomatic. Nerve-conduction studies were performed on ten of these eleven patients at the time of the last office visit. The other patient, who was asymptomatic, had a cardiac pacemaker in place and could not be tested. One asymptomatic patient had a normal velocity of conduction of both ulnar nerves. In all but one of the remaining nine patients who still had symptoms, the conduction velocity was decreased for both nerves. One patient had decreased velocity on the symptomatic side and normal velocity on the opposite, asymptomatic side.

As already noted, the four patients whose cases originally stimulated our interest in this problem also had slow conduction velocity in all of the four symptomatic limbs and in three of the four asymptomatic extremities.

Based on these findings, we believe that preventive measures may be helpful in avoiding postoperative ulnar-nerve palsy. However, some patients who have a subclinical syndrome of entrapment of the nerve may become symptomatic after a surgical procedure despite preventive measures. Certainly any patient who has had nocturnal paresthesias or dysesthesias, or any evidence of ulnar neuropathy, should be told of the risk that a surgical procedure may aggravate this condition.

Conclusions

Postoperative ulnar-nerve palsy appears to be precipitated by a surgical procedure in otherwise normal patients. However, the findings in this study suggest that some patients may have subclinical entrapment of the ulnar nerve that may be aggravated by various maneuvers in the operating room, such as application of a blood-pressure cuff, placement of intravenous lines, positioning on the operating table, and so on. These patients tend not to mention the symptoms during the immediate postoperative period, but when specifically questioned they usually can recall the time of onset of the symptoms. It appears that in many patients postoperative ulnar-nerve palsy slowly improves with time. However, the longer the postoperative symptoms persist, the more likely they are not to subside.

References