Anterior interosseous nerve syndrome
A case report with neurophysiological investigation

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Summary Details of a 23 year old patient who suffered the spontaneous onset of an anterior interosseous nerve palsy are recorded together with the results of a full neurophysiological investigation.

Isolated lesions of the anterior interosseous nerve are rare and there are no recorded cases with comprehensive neurophysiological investigation. The anterior interosseous nerve is a purely motor nerve and supplies the flexor pollicis longus, flexor digitorum profundus to the index and middle fingers and pronator quadratus muscles. The detailed anatomy and its normal variation has been discussed by Sunderland (1945), Mangini (1960), and Spinner (1970).

Case Report A 23 year old male labourer found difficulty in picking up a cup of tea on a Sunday morning in July 1971; this was apparently due to weakness of the right thumb and index finger. He had no pain or paraesthesiae at any time. It may be relevant that he had drunk about 10 pints of beer the night before and slept well. He was first seen two months later and there had been no real change in his symptoms. Examination showed no voluntary flexion of the terminal phalanx of the right thumb, and flexion of the terminal phalanx of the right index finger was very weak (MRC Grade 1) when the proximal interphalangeal and the metacarpophalangeal joints were fully extended. There was also weakness of flexion of the terminal phalanx of the middle finger (MRC Grade 3). Pronator quadratus is a difficult muscle to test in isolation, but there was undoubted weakness of pronation of the right forearm when the elbow was fully flexed to minimize the effect of the pronator teres muscle. There was no weakness of abductor pollicis brevis, flexor digitorum sublimis, or any of the small hand muscles and there was no sensory deficit.

Neurophysiological Investigation The patient lay supine and relaxed on a couch. An infra-red lamp was used to maintain the surface temperature of both arms at 37° C.

Stimulation and recording Motor conduction studies and antidromic sensory action potentials were recorded from both median nerves after stimulation by cloth-covered silver electrodes, soaked in saline, placed 2-5 cm apart and applied over the nerve at the wrist or the elbow. The cathode was placed at the point of lowest threshold for M waves and 50 µsec rectangular electrical pulses were delivered by a Devices stimulator type 3072 at a voltage which was supramaximal for M waves by 50 V. The same electrodes and placements were used for recording orthodromic sensory action potentials when the digital nerves were stimulated by ring electrodes made of silver strip covered with electrode jelly. The cathodal electrode was placed round the terminal phalanx 2 cm from the tip.

Throughout the experiments a flat metal earth electrode covered in electrode jelly was attached to the dorsum of the hand.

A unipolar concentric needle electrode (Medelec Ltd.) was used to record the electromyographic interference pattern of the muscles and for the motor conduction studies. The potentials were fed into an amplifier of which the frequency response was 3 db down at 2 Hz and 5 KHz. The signals were then displayed on a Hewlett Packard storage oscilloscope type 141A and photographed on Polaroid film. A gain of 5 µV/cm or 10 µV/cm was used for the recording of sensory nerve action potentials, but gains of up to 5 mV/cm were used during the recording of muscle action potentials.

During the sensory recordings the patient was encouraged to relax completely and the amplitude of

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the stimulus was raised until the maximum evoked response was obtained. Latencies were measured to the onset of the initial negative deflection; an accuracy of 0.1 msec was attempted after the central portion of the time base had been expanded. A series of 10 responses was measured. Each muscle was sampled at three sites with a concentric needle electrode and a search was made for spontaneous activity; the gain of the amplifier was 20 μV/cm on the oscilloscope. The needle was usually inserted perpendicular to the skin surface but an oblique approach was used to record from the pronator quadratus muscle. The interference patterns of the muscles were assessed on a 100 msec sweep of the oscilloscope time base during minimal, moderate, and maximal voluntary contraction and the peak to peak amplitude of the patterns was measured on the screen. Each muscle was identified by surface anatomy and by the electromyographic activity during appropriate voluntary movements. Size and duration of motor unit action potentials were roughly assessed by a series of stored sweeps of the oscilloscope during minimal and moderate voluntary contraction of the sampled muscle. Some of these single sweeps were photographed to indicate the fullness of the interference patterns during maximal voluntary contraction.

RESULTS

Motor and sensory nerve conduction studies are summarized in Table 1 and Fig. 1. The results are within the normal limits for this department. Spontaneous activity was not detected in any

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**TABLE 1**

**MOTOR AND SENSORY NERVE CONDUCTION STUDIES**

<table>
<thead>
<tr>
<th>Recording</th>
<th>Site of recording</th>
<th>Stimulation (200 V, 50 μsec)</th>
<th>Point of stimulation</th>
<th>Size of response (mV)</th>
<th>Latency of response (msec)</th>
<th>Distance (cm)</th>
<th>Conduction velocity (m/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentric needle</td>
<td>Right abductor pollicis brevis</td>
<td>Surface electrodes median nerve</td>
<td>Wrist</td>
<td>14</td>
<td>3.5</td>
<td>26</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td>Left abductor pollicis brevis</td>
<td>Surface electrodes ulnar nerve</td>
<td>Wrist</td>
<td>11</td>
<td>8.0</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Right first dorsal interosseous</td>
<td>Wrist</td>
<td>Elbow</td>
<td>13</td>
<td>3.4</td>
<td>25</td>
<td>58</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Elbow</td>
<td>11</td>
<td>7.7</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wrist</td>
<td>25</td>
<td>3.8</td>
<td>58</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Elbow</td>
<td>20</td>
<td>7.8</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Above elbow</td>
<td>19</td>
<td>9.6</td>
<td>61</td>
<td></td>
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</table>

<p>| Sensory nerve conduction (orthodromic), surface electrodes, 37°C |</p>
<table>
<thead>
<tr>
<th>Recording</th>
<th>Site of recording</th>
<th>Stimulation (90 V, 50 μsec)</th>
<th>Point of stimulation</th>
<th>Size of response (μV)</th>
<th>Latency of response (msec)</th>
<th>Distance (cm)</th>
<th>Conduction velocity (m/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R median nerve</td>
<td>Wrist</td>
<td>Ring electrodes, digital nerve</td>
<td>Base of index finger</td>
<td>18</td>
<td>2.0</td>
<td>11</td>
<td>55</td>
</tr>
<tr>
<td>L median nerve</td>
<td>Wrist</td>
<td>Ring electrodes, digital nerve</td>
<td>Base of index finger</td>
<td>18</td>
<td>2.0</td>
<td>11</td>
<td>55</td>
</tr>
<tr>
<td>R ulnar nerve</td>
<td>Wrist</td>
<td>Ring electrodes, digital nerve</td>
<td>Base of little finger</td>
<td>10</td>
<td>1.9</td>
<td>10.5</td>
<td>55</td>
</tr>
</tbody>
</table>

<p>| Sensory nerve conduction (antidromic), surface electrodes, 37°C |</p>
<table>
<thead>
<tr>
<th>Recording</th>
<th>Site of recording</th>
<th>Stimulation (70 V, 50 μsec)</th>
<th>Point of stimulation</th>
<th>Size of response (μV)</th>
<th>Latency of response (msec)</th>
<th>Distance (cm)</th>
<th>Conduction velocity (m/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R thumb</td>
<td>Base of thumb, ring electrodes</td>
<td>Surface electrodes, median nerve</td>
<td>Wrist</td>
<td>30</td>
<td>2.0</td>
<td>9.5</td>
<td>47</td>
</tr>
<tr>
<td>index finger</td>
<td>Base of index finger</td>
<td>Surface electrodes, median nerve</td>
<td>Wrist</td>
<td>30</td>
<td>2.3</td>
<td>11</td>
<td>48</td>
</tr>
<tr>
<td>index finger</td>
<td>Base of index finger</td>
<td>Surface electrodes, median nerve</td>
<td>Elbow</td>
<td>24</td>
<td>6.5</td>
<td>26</td>
<td>62</td>
</tr>
<tr>
<td>middle finger</td>
<td>Base of middle finger</td>
<td>Surface electrodes, median nerve</td>
<td>Wrist</td>
<td>30</td>
<td>2.3</td>
<td>11.0</td>
<td>48</td>
</tr>
<tr>
<td>ring finger</td>
<td>Base of ring finger</td>
<td>Surface electrodes, median nerve</td>
<td>Wrist</td>
<td>28</td>
<td>2.2</td>
<td>10.5</td>
<td>48</td>
</tr>
</tbody>
</table>
Anterior interosseous nerve syndrome

FIG. 1. 1–5 Antidromic digital sensory action potentials (SAP) in all five digits. Gain 10 μV/cm. 6 Orthodromic ulnar sensory action potential. Gain 5 μV/cm. 7 Antidromic median sensory action potential. 8 + 9 Maximal motor M waves. Right abductor pollicis brevis after stimulation of median nerve at wrist and elbow. Gain 500 μV/cm and 5 mV/cm.
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A muscle but the interference patterns during maximal volitional activity were greatly reduced in the right pronator quadratus, flexor pollicis longus, and part of flexor digitorum profundus muscles. The reduction in the interference patterns in the muscles supplied by the right anterior interosseous nerve is clearly shown in Fig. 2, while the normal findings in the other muscles, particularly those innervated by the median nerve, are shown in Table 2.

DISCUSSION

Table 3 summarizes the clinical features of 23 previously reported patients with the anterior interosseous nerve syndrome; these accounts are the principal contributions to this subject which have appeared in the English language since the war. Parsonage and Turner (1948) described five cases in which a palsy of the anterior interosseous nerve complicated neuralgic amyotrophy. They also briefly described one patient with an isolated palsy. Thomas (1962) mentioned in discussion that he had seen two patients with a syndrome similar to that recorded by Kiloh and Nevin (1952). It is of interest to analyse the clinical features of the 23 cases which have been reported fully. Nine of these were due to injury

FIG. 2. Interference patterns of median innervated muscles of right arm during maximal volitional activity. Concentric needle electrode. Amplifier frequency response 3 db down at 2 Hz, 5 KHz.

A = abductor pollicis brevis, 100 msec, 1 mV/cm. B = opponens pollicis, 100 msec, 1 mV/cm. C = pronator quadratus, 100 msec, 1 mV/cm. D = flexor digitorum profundus, 100 msec, 1 mV/cm. E = flexor pollicis longus, 100 msec, 500 µV/cm. F = flexor digitorum sublimis, 100 msec, 1 mV/cm. Those muscles innervated by the anterior interosseous nerve (C, D, E) show reduced interference patterns.
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TABLE 2
CONCENTRIC NEEDLE ELECTRODE STUDIES

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Anterior interosseous nerve</th>
<th>Interference pattern</th>
<th>Peak to peak amplitude of interference pattern (mV)</th>
<th>Largest size of units (mV)</th>
<th>Average duration of units (msec)</th>
<th>Spontaneous activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>R Abductor pollicis brevis</td>
<td>Full</td>
<td></td>
<td>8-0</td>
<td>6</td>
<td>10</td>
<td>Nil</td>
</tr>
<tr>
<td>Opponens pollicis</td>
<td>Full</td>
<td></td>
<td>8-0</td>
<td>6</td>
<td>10</td>
<td>Nil</td>
</tr>
<tr>
<td>Flexor digitorum profundus</td>
<td>+ Reduced</td>
<td></td>
<td>2-5</td>
<td>2</td>
<td>10</td>
<td>Nil</td>
</tr>
<tr>
<td>Flexor pollicis longus</td>
<td>+ Reduced</td>
<td></td>
<td>0-75</td>
<td>0-5</td>
<td>11</td>
<td>Nil</td>
</tr>
<tr>
<td>Flexor digitorum sublimis</td>
<td>Full</td>
<td></td>
<td>3-0</td>
<td>2</td>
<td>10</td>
<td>Nil</td>
</tr>
<tr>
<td>1st dorsal interosseous</td>
<td>Full</td>
<td></td>
<td>6-0</td>
<td>6</td>
<td>10</td>
<td>Nil</td>
</tr>
<tr>
<td>Triceps</td>
<td>Full</td>
<td></td>
<td>6-0</td>
<td>4</td>
<td>10</td>
<td>Nil</td>
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<tr>
<td>Biceps</td>
<td>Full</td>
<td></td>
<td>7-5</td>
<td>6</td>
<td>10</td>
<td>Nil</td>
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<tr>
<td>Deltoid</td>
<td>Full</td>
<td></td>
<td>7-5</td>
<td>4</td>
<td>10</td>
<td>Nil</td>
</tr>
<tr>
<td>L Abductor pollicis brevis</td>
<td>Full</td>
<td></td>
<td>7-5</td>
<td>6</td>
<td>10</td>
<td>Nil</td>
</tr>
</tbody>
</table>

TABLE 3
CLINICAL FEATURES

<table>
<thead>
<tr>
<th>Authors</th>
<th>Sex</th>
<th>Age (yr)</th>
<th>Pain at onset</th>
<th>Evidence of median nerve involvement</th>
<th>Comment</th>
<th>Cause</th>
<th>Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiloh and Nevin (1952)</td>
<td>M</td>
<td>52</td>
<td></td>
<td></td>
<td>FPL only, occurred at night</td>
<td>Forearm fracture</td>
<td></td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>28</td>
<td>+</td>
<td></td>
<td></td>
<td>Forearm fracture</td>
<td></td>
</tr>
<tr>
<td>Warren (1963)</td>
<td>M</td>
<td>20</td>
<td>+</td>
<td></td>
<td>Forearm fracture</td>
<td>Forearm fracture</td>
<td></td>
</tr>
<tr>
<td>F 69</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fearn and Goodfellow (1965)</td>
<td>M</td>
<td>9</td>
<td>+ +</td>
<td></td>
<td></td>
<td>Lacerations</td>
<td>Fibrous band</td>
</tr>
<tr>
<td>Stern and Rosner (1967)</td>
<td>M</td>
<td>30</td>
<td>+ +</td>
<td></td>
<td></td>
<td>Injury</td>
<td>Fibrous band</td>
</tr>
<tr>
<td>Sharrard (1968)</td>
<td>M</td>
<td>42</td>
<td>+ +</td>
<td></td>
<td></td>
<td>Fibrous band</td>
<td></td>
</tr>
<tr>
<td>Farber and Bryan (1968)</td>
<td>M</td>
<td>21</td>
<td>+ +</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vichare (1968)</td>
<td>M</td>
<td>50</td>
<td></td>
<td></td>
<td>Occurred at night</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F 48</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F 43</td>
<td>M</td>
<td>43</td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F 60</td>
<td></td>
<td></td>
<td>+</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spinner (1970)</td>
<td>M</td>
<td>24</td>
<td></td>
<td></td>
<td>FPL only</td>
<td>Exercise</td>
<td>Adhesions</td>
</tr>
<tr>
<td>F 24</td>
<td>M</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F 27</td>
<td>M</td>
<td>27</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>M 33</td>
<td>M</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M 28</td>
<td>M</td>
<td>58</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M 22</td>
<td>F</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>M 46</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

FPL = Flexor pollicis longus muscle.

To the forearm, including four patients with forearm fractures, two with lacerations, and three with other contusion injuries. Direct pressure to the forearm was the cause in a further three patients; one of these was due to a plaster, in one to carrying a handbag over the forearm, and in a third to leaning over a beam. Four of these 12 patients with a known cause for their lesion had evidence of involvement of the main trunk of the median nerve and a further two patients, with an apparently spontaneous palsy, also had evidence of involvement of the median nerve. Four patients had involvement of the flexor pollicis longus muscle only, presumably indicating involvement of the branch of the anterior interosseous nerve to this muscle, though
in these patients there may have been a separate
nerve to this muscle from the main trunk of the
median nerve. In three patients the palsy de-
veloped during the night, as in the present case.
Lifting heavy weights and strenuous exercise
involving the forearm muscles was a precipitating
factor in three patients, presumably causing a
compression of the nerve against a fibrous band,
a mechanism which has been shown to apply to
some patients with radial nerve palsy (Lotem,
There remain eight patients in whom no certain
cause could be identified; these include the
three patients who developed the palsy during
the night and pressure could not be excluded as a
cause for these lesions. Pressure could have been a
factor in the patient recorded in this paper,
since he had had 10 pints of beer the night before
and slept heavily so that his anterior interosseous
nerve palsy could have been a form of 'Saturday
night palsy'.

The prognosis seems to be very variable; some
patients recover in a few weeks, while others
show no satisfactory recovery and may require
tendon transfer. Thirteen of the 23 patients
reported were subjected to operation; in these a
median nerve neuroma was found in one and
constricting fibrous bands were found in seven
patients. Patients appeared to recover function
more rapidly after operation than did those who
were not operated upon. The indications for
operation have been discussed by Spinner (1970).
Surgery was not considered in the present patient
because the electrophysiological findings indi-
cate partial denervation probably due to seg-
mental demyelination, with axonal preservation.

We are grateful to Dr. D. D. Barwick for permission
to record details of the patient who was under his
care, Professor A. J. McComas for his helpful com-
ments regarding the neurophysiological investiga-
tions, and Professor J. N. Walton for his advice and
encouragement.

ADDITIONUM

Since the preparation of this paper two further
cases have been reported from Scandinavia. One
was a lady of 60 years who suddenly developed
pain and the typical pattern of weakness at
night; she was explored 10 weeks later and a
fibrous band was found and divided. She had
recovered completely at 16 weeks. The other
patient was a woman of 40 years who suffered
the sudden onset of typical pattern of weakness
with no obvious cause and no pain. She was
explored at two weeks and again a fibrous band
was found and this was divided. She had fully
recovered in a further three months. (Schmidt,
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