Short report

Carpal tunnel syndrome related to antebrachial Cimino-Brescia fistula

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SUMMARY Two patients are described in whom symptoms of the carpal tunnel syndrome were provoked by haemodialysis for which an antebrachial arteriovenous fistula had been established. The symptoms in one case were partially relieved by ligation of the radial artery distal to the fistula, and in both they were abolished by decompression of the median nerve by section of the flexor retinaculum at the wrist. There is evidence that the median nerve is abnormally susceptible to ischaemia in the carpal tunnel syndrome, and it is suggested that in these patients the symptoms were provoked by a vascular steal mechanism related to the fistula.

The carpal tunnel syndrome arises from a wide variety of causes, and the most prominent symptom usually consists of painful nocturnal acropaesthesiae in the affected limb. Warren and Otieno (1975) have recently reported the occurrence of symptoms considered to be due to the carpal tunnel syndrome during haemodialysis in patients with forearm arteriovenous fistulas. The present communication documents two such cases, in one of which the symptoms were partially relieved by ligation of the radial artery distal to the fistula. The symptoms were completely relieved by surgical decompression of the median nerve. The mechanism of origin of symptoms during dialysis is discussed.

Case reports

Case 1
A 54 year old woman with the nephrotic syndrome was started on treatment by chronic haemodialysis in 1966 employing an arteriovenous shunt in the left arm. This was replaced in 1972 by a surgically produced arteriovenous fistula in the right forearm.

One year later she developed intermittent pain and paraesthesiae in the lateral three digits of the right hand, and noticed some difficulty with fine finger movements. Examination revealed wasting of the thenar eminence and cutaneous sensory impairment of median nerve distribution in the hand. Nerve conduction studies showed a borderline reduction in motor nerve conduction velocity in the forearm on recording from the abductor pollicis brevis (45 m s⁻¹), with a slightly prolonged terminal latency (5.5 ms). No median nerve sensory action potential was detectable.

Temporary relief of symptoms was obtained by the local injection of prednisolone tertiary butyl acetate into the carpal tunnel. Surgical decompression was performed, but her symptoms recurred after six months, being particularly severe during dialysis. The pain decreased following ligation of the radial artery distal to the anastomosis, but weakness and sensory impairment persisted. Repeat nerve conduction studies at this stage showed that motor nerve conduction velocity over the forearm was 40 m s⁻¹, with a now substantially prolonged terminal latency of 9 ms.

Surgical exploration was again undertaken, and a thick fibrous band, producing narrowing of the nerve, was divided. This procedure led to relief of the patient’s symptoms, which had not recurred at the time of her death one year later.

Case 2
A 42 year old man presented with hypertension and chronic renal failure in 1972. Conservative management of his renal failure was unsuccessful and, therefore, haemodialysis with a Cimino-Brescia fistula in the left arm was instituted.

Eleven months later he complained of severe paraesthesiae, pain, and numbness within the distribution of the median nerve in the left hand.

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These symptoms occurred predominantly during
dialysis. No abnormal neurological signs were
detected.

The carpal tunnel was explored surgically, and the
median nerve was noted to be hyperaemic. De-
compression was performed by division of the
flexor retinaculum with immediate relief of the
patient's symptoms. These had not recurred by
the time of his death nearly two years later.

Discussion

Warren and Otieno (1975) reported that 23 out of
36 patients using a forearm arteriovenous fistula
for haemodialysis admitted to pain, numbness, and
paraesthesiae in one or more of the lateral four
digits of the hand on the side of the fistula during
dialysis. No abnormal motor signs and no persist-
sing sensory loss were detected, although in four
patients, diminished tactile sensation of median
nerve distribution was present immediately after
dialysis, but disappeared within 24 hours. These
symptoms were attributed to the carpal tunnel
syndrome but this was not confirmed by nerve
conduction studies. Lindstedt and Westling (1975)
have also reported the occurrence of pain in the
radial three fingers of the hand during haemo-
dialysis employing an antebrachial Cimino-
Brescia arteriovenous fistula.

Warren and Otieno (1975) related the occur-
rence of symptoms attributed to median nerve
dysfunction in their cases to oedema secondary to
the increased venous pressure in the hand pro-
duced by the fistula. They found that predialysis
venous pressure in the hand and hand volume
were greater on the side of the fistula, and that
hand volume increased during dialysis. This is an
attractive suggestion which has been proposed as
an important factor in the causation of nerve
damage in the carpal tunnel syndrome by Sunder-
land (1976). Yet symptoms of the carpal tunnel
syndrome are not a feature of other disorders
that give rise to oedema of the arm and hand,
such as axillary vein thrombosis or lymphoedema
of the arm. Moreover, Fullerton (1963) found that
in acute experiments in patients with the carpal
tunnel syndrome, venous occlusion produced by
a pressure cuff around the arm has no influence
on nerve conduction, whereas inflation of the cuff
above arterial pressure leads to a rapid failure of
conduction.

An alternative suggestion is that the symptoms
are provoked by ischaemia and related to a
vascular 'steal' phenomenon caused by the fistula.
Bussell et al. (1971) demonstrated by plethysmo-
graphy that a radial-cephalic arteriovenous fistula
constant gives rise to increased forearm blood
flow and reduced thumb blood flow. This was con-
ferred by Lindstedt and Westling (1975). They
found that the disappearance of \(^{133}\text{Xenon}\) from
the adductor pollicis was substantially reduced in
patients with antebraclial arteriovenous fistulas.
When flow through the fistula was prevented by
digital compression, or when the radial artery
distal to the fistula was occluded, the clearance of
\(^{133}\text{Xenon}\) from the adductor pollicis showed an
approximately fourfold increase.

Early discussions of the genesis of symptoms
in the carpal tunnel syndrome considered the pos-
sibilities of ischaemia (Simpson, 1956), and direct
mechanical effects on nerve fibres (Thomas, 1960;
Thomas and Fullerton, 1964). It seems likely that
there is a dual mechanism for nerve damage
(Fullerton, 1963). There is now good evidence for
a direct mechanical effect on myelin (Neary et al.,
1975), which presumably leads to a demyelinating
conduction block and conduction delay. This pro-
cess appears to be relatively independent of
ischaemia, since fibres damaged in this way are
not abnormally susceptible to ischaemia (Fullerton,
1963). They recover slowly when the nerve is
decompressed (Goodman and Gilliatt, 1961). In
contrast, it is known that ischaemia produced by
the inflation of a pneumatic tourniquet around
the arm may reproduce the attacks of pain and
paraesthesiae (Gilliatt and Wilson, 1953), and give
rise to a reversible conduction block. Gilliatt and
Wilson (1954) found that median nerve sensory
loss appeared with abnormal rapidity, and Full-
erton (1963) demonstrated that conduction in motor
fibres failed abnormally rapidly because of the
development of a conduction block at the wrist.
Pain and paraesthesiae are often relieved within
24 hours of carpal tunnel decompression, and
this is paralleled by improvement in nerve con-
duction velocity (Hongell and Mattsson, 1971). In
some instances improvement in sensory conduction
is evident within 30 minutes. The rapidity of this
recovery strongly suggests that relief of ischaemia
is likely to be responsible.

These various observations, therefore, support
the view that the attacks of pain and paraesthesiae
in the carpal tunnel syndrome are the conse-
uence of episodes of ischaemia. Thomas (1975) pro-
posed that at times they may be due to partial ob-
struction of the brachial artery related to limb
posture during sleep. If the mechanism for the
appearance of symptoms of median nerve dys-
function during haemodialysis in patients with
antebrachial arteriovenous fistulas is a vascular
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steal, pre-existing median nerve compression in the carpal tunnel may render the patient more vulnerable to this complication. It is, therefore, of interest that both in the report by Lindstedt and Westling (1975) and in our first case, partial relief of symptoms was obtained by ligation of the radial artery distal to the arteriovenous fistula in the forearm, whereas complete relief of symptoms in both of our cases was obtained by surgical decompression of the median nerve at the wrist.

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References


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