Contribution of nerve biopsy findings to the
diagnosis of disabling neuropathy in the elderly
A retrospective review of 100 consecutive patients

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Summary
Peripheral neuropathy is an important factor of disability in the elderly. In order to learn more on the usefulness of intensive evaluation of patients over 65 years of age with subacute or chronic disabling peripheral neuropathy, we reviewed the clinical and nerve biopsy findings of the last 100 patients of this age group who suffered from a peripheral neuropathy severe enough to justify performance of a nerve biopsy for a diagnostic or prognostic purpose. Normal nerve biopsy findings led to the diagnosis of lower motor neuron disease in three patients and pointed to lesions of the spinal roots in six other patients. Necrotizing arteritis was demonstrated in the biopsy specimens of 23 patients, and non-necrotizing vasculitis in five. In five additional patients the diagnosis of vasculitic neuropathy was kept in spite of non-contributive biopsy findings. In two diabetic patients who had a multifocal neuropathy the biopsy also revealed the presence of vasculitis. Thus 35% of the patients included in this series had one form or another of vasculitic neuropathy. Fourteen patients had a chronic inflammatory demyelinating polyneuropathy. In 11 patients the neuropathy was associated with monoclonal gammopathy, which was benign in nine and associated with malignant plasma cell dyscrasia in two. Among the six patients with diabetes mellitus, two patients who presented with a multifocal neuropathy were found to have vasculitis in the nerve specimen; in the others the biopsy was performed because of uncommonly severe pains or motor involvement due to an extremely severe diabetic neuropathy. Six patients suffered from a long-lasting disability secondary to a drug-induced neuropathy. The remaining 15% had neuropathies of different origin, including amyloidosis, lepromatous leprosy, carcinomatous neuropathy and alcoholic neuropathy. Six patients had a mild, non-progressive or slowly progressive axonopathy of unknown origin, ageing of the peripheral nervous system may have played a role in its development. Our findings show that vasculitis is an important and treatable cause of disabling neuropathy in the elderly and that the proportion of patients with severe neuropathy of unknown origin is small.

Keywords: peripheral neuropathy; elderly; vasculitis; nerve biopsy

Introduction
It is well known that the peripheral nervous system presents some alteration due to ageing (Ochoa and Mair, 1969; Schaumburg et al., 1983; Taylor, 1984; Jacobs and Love, 1985; Ochoa, 1988; Thomas, 1988; Vital et al., 1990; Kanda et al., 1991) but acquired peripheral neuropathies due to treatable causes also represent an important factor of disability in elderly people whose musculoskeletal system is often already compromised by degenerative changes. In order to learn more on potentially treatable factors of disability that can further damage peripheral nerves in this age group, we reviewed the data of the last 100 patients of more than 65 years of age who had been referred to us for a disabling peripheral neuropathy that we found severe enough to justify a nerve and often a simultaneous muscle biopsy, in addition to the routine, non-invasive investigations. In this paper we report on our findings which illustrate the high incidence of vasculitis in this age group and the contribution of nerve biopsy in the management of elderly patients with disabling peripheral neuropathy.

Patients and methods
One hundred patients over 65 years of age suffering from a disabling, usually progressive, peripheral neuropathy were
Electrophysiological tests of the compound muscle action potential and sensory nerve latency, motor and sensory conduction velocity, the amplitude of the compound muscle action potential and sensory nerve action potential. The variables were considered abnormal when they exceeded the limits of normality by 2 SDs. When required in the clinical context, muscles were examined using concentric needles.

Nerve and muscle biopsy
The nerve biopsy was performed in an affected territory in all cases. The superficial branch of the peroneal nerve and the adjacent peroneus brevis muscle were sampled in 88 patients; the sural nerve at the ankle level in seven patients and the superficial radial nerve in five. The nerve specimens were fixed in buffered 3.6% isotonic glutaraldehyde at pH 7.4 and then divided into three parts. One part was embedded in paraffin, cut at 6 μm thickness and examined after staining with haematoxylin and eosin. The second part was embedded in epon. Transverse, thionin-stained, 1 μm sections were examined. Electron microscopic examination of 0.3 μm thick sections was performed only when needed to study abnormal deposits or unmyelinated fibres. The third part was post-fixed in osmium tetroxide and then macerated in 66% glycerol for 48 h before dissection in pure glycerol.

Fifty to 100 fibres were isolated and classified according to their morphology into the following categories: normal fibres; fibres showing segmental abnormalities of myelination; fibres undergoing wallerian degeneration with the presence of a continuous row of ovoids and balls of myelin debris that decreased in size with time to become tiny droplets after a few weeks; degenerating fibres, in which normal proximal internodal myelin was associated with changes of the myelin distally that were similar to wallerian changes; and regenerating fibres, in which the site of transition between the original fibre and the regenerating region could be identified, with a part of the regenerating fibre associated with myelin debris.

In patients, who had the superficial peroneal nerve sampled, a biopsy specimen of the peroneus brevis muscle was obtained during the same procedure. It was fixed in 10% formalin, embedded in paraffin, cut in cross- and longitudinal sections, stained with haematoxylin and eosin and trichrome methods and then examined under the light microscope. Serial sections of the nerve and muscle specimens were performed when vasculitis was suspected.

Laboratory data
All patients had routine blood tests, biochemical assays and protein electrophoresis. Other tests were performed only when required in the clinical context.

Electrophysiological tests
Routine electrophysiological tests were carried out in all patients. The following variables were measured: distal motor latency, motor and sensory conduction velocity, the amplitude of the compound muscle action potential and sensory nerve
Table 1 Disabling peripheral neuropathy in the elderly: summary of clinical manifestations in the largest groups of patients

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Population</th>
<th>Vasculitis</th>
<th>Chronic inflammatory demyelinating polyneuropathy</th>
<th>Neuropathy associated with monoclonal gammopathy</th>
<th>Neuropathy in diabetic patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>72.9</td>
<td>73.2</td>
<td>72.5</td>
<td>75.5</td>
<td>75.7</td>
</tr>
<tr>
<td>Sex ratio (M/F)</td>
<td>54/46</td>
<td>13/20</td>
<td>7/5</td>
<td>7/4</td>
<td>4/2</td>
</tr>
<tr>
<td>Time from onset to performance of nerve biopsy (years)</td>
<td>3.4</td>
<td>1.5</td>
<td>1.7</td>
<td>3.4</td>
<td>2.5</td>
</tr>
</tbody>
</table>

- **Weakness**
  - Absent: 29% (15% mild, 14% severe)
  - Mild: 39% (45% mild, 50% severe)
  - Severe: 32% (39% mild, 36% severe)

- **Pains**
  - Absent: 47% (24% mild, 65% severe)
  - Mild: 41% (58% mild, 35% severe)
  - Severe: 12% (18% mild, 0% severe)

- **Paraesthesiae**
  - Absent: 24% (18% mild, 27% severe)
  - Mild: 59% (58% mild, 55% severe)
  - Severe: 17% (24% mild, 18% severe)

- **Impairment of superficial sensations**
  - Absent: 17% (6% mild, 14% severe)
  - Mild: 71% (88% mild, 72% severe)
  - Severe: 12% (6% mild, 14% severe)

- **Impairment of position sense and vibratory sensations**
  - Absent: 17% (39% mild, 36% severe)
  - Asymptomatic: 71% (52% mild, 36% severe)
  - Severe, with sensory ataxia: 12% (9% mild, 28% severe)

- **Distribution of signs and symptoms of neuropathy**
  - Distal symmetrical sensory-motor polyneuropathy: 56% (3% mild, 91% severe)
  - Distal with some asymmetry: 15% (27% mild, 9% severe)
  - Multifocal sensory-motor neuropathy: 29% (70% mild, 0% severe)

Severe in 17. Mild superficial sensory loss was present in 71 patients; severe sensory loss in 12%. Impairment of proprioception was present but asymptomatic in 46 patients, associated with sensory ataxia in 15 patients but absent in the others. Symptoms of dysautonomia were present in five patients. The distribution of signs and symptoms was distal and asymmetrical in 56% of the patients, distal symmetrical in 15% of the patients, focal or multifocal in 29% of the patients.

No specific complication of nerve biopsy was noted in these elderly patients. Wound healing, subcutaneous haematomas or infection were not more common in this group than in younger patients. In our centre, all patients who have a nerve biopsy performed in the lower limbs have the corresponding limb immobilized for 7–5 days in a plastic cast which is moulded immediately before the surgical procedure. Patients on treatment with corticosteroids carry a higher risk of delayed wound healing and of infection thus we try to maintain them in the hospital until complete wound healing.

**Vasculitic neuropathy**

The most prominent finding was the high incidence of vasculitic neuropathy, which affected 33% of our patients. In this subgroup, necrotizing arteritis was demonstrated in the nerve and/or in the muscle biopsy specimen in 23 patients (70% of this subgroup). Characteristic lesions were found in 65% of muscle specimens and in 78% of the nerve specimens. In 43% of the patients the lesions were present both in the nerve and in the muscle samples. Histological signs of necrotizing arteritis included segmental necrosis of the wall of epineural and perineurial arteries, transmural inflammatory cell infiltration, mixed inflammatory infiltrate, occlusion of the lumen, signs of haemorrhage and sparing of adjacent veinules. Epineurial and perineurial inflammatory infiltrates were common in the vicinity of arterial lesions. On semi-thin sections and teased-fibre preparations, wallerian degeneration often affected the majority of nerve fibres simultaneously, and the larger myelinated fibres were more prone to axon loss. However, axon loss was often complete. In five patients...
jerks were more often preserved. Of motor deficit. Involvement of sensory nerves was present of demyelination in two patients studied soon after the onset degeneration in all these patients, with some signs suggestive circulating immune complexes in one, anti-HB antibodies. Electrophysiological investigation showed signs of axonal in three and lupus anticoagulant in one patient. Antibodies were found in four patients, cryoglobulins in two, present in the patients with rheumatoid arthritis; antinuclear antibodies were more frequent and more severe in this subgroup than in the other groups of patients. The neuropathy was signs of progression of the neuropathy more common (79%), the mean interval between the onset of symptoms and referral (1.4 years) was shorter, and clinical and histological pericarditis (one case).

Among these 33 patients (39% men and 61% women), seven (21%) suffered from rheumatoid arthritis, two (6%) had a cranial arteritis, two (6%) had an interstitial pneumopathy and one (3%) Raynaud’s phenomenon. The neuropathy occurred in the context of a multisystem disorder in 20 of the 33 patients, excluding the two diabetic patients and as the only manifestation of vasculitis in the other 13 patients.

Among the 13 patients with isolated neuropathy, the erythrocyte sedimentation rate was >20 mm in seven (54%), versus 19 out of 20 (95%) in those with symptomatic multisystemic involvement. Multisystem involvement consisted in loss of weight (10 cases), fever (four cases), general malaise (seven cases), arthritis (four cases), skin involvement (six cases), renal involvement (two cases) and pericarditis (one case).

In the subgroup of 33 patients with vasculitic neuropathy, the mean interval between the onset of symptoms and referral for biopsy (1.4 years) was shorter, and clinical and histological signs of progression of the neuropathy more common (79%), than in the other groups of patients. The neuropathy was focal or multifocal in 70% of the patients, distal asymmetrical in 27% of the patients, and distal symmetrical in 3% of the patients with documented necrotizing arteritis. Mononeuritis multiplex was thus the most common pattern of neuropathy in this subgroup. Motor deficit, pains and paraesthesiae were more frequent and more severe in this subgroup than in the rest of our series, while tendon reflexes, especially the knee jerks were more often preserved.

Laboratory findings for this subgroup showed that the erythrocyte sedimentation rate was >20 mm in only 80% of the patients and normal in the others. Rheumatoid factors were present in the patients with rheumatoid arthritis; antinuclear antibodies were found in four patients, cryoglobulins in two, circulating immune complexes in one, anti-HB antibodies in three and lupus anticoagulant in one patient. Electrophysiological investigation showed signs of axonal degeneration in all these patients, with some signs suggestive of demyelination in two patients studied soon after the onset of motor deficit. Involvement of sensory nerves was present in all patients and motor involvement in 74% of them. The electrophysiological abnormalities were asymmetrical in 96% of the patients.

**Chronic inflammatory polyneuropathy**

Fourteen patients (nine men and five women) suffered from a chronic inflammatory demyelinating polyradiculoneuropathy. In this subgroup of patients the mean interval between the first symptoms and the biopsy was 1.65 years (Table 1). Motor involvement was more marked in this subgroup than in the other groups with 86% of the patients presenting a moderate to severe deficit. Tendon reflexes were more often reduced or abolished than in the other groups, with ankle jerks abolished in all of them, knee jerks abolished in 86% and decreased in 14% of them. Pain was not a major symptom in this group; only 35% of them complained of mild pain. Decreased position sense was more common and more pronounced in these patients than in the other groups of this series. This was mild in 36% of the patients and associated with ataxia in 28% of them. The distribution of symptoms were more symmetrical (66%) and the autonomic symptoms more common than in the other groups.

Electrophysiological examination demonstrated signs of demyelination in 12 patients (86%), predominantly axonal abnormalities in nine patients (64%). The CSF was normal in three patients. Motor involvement was found in 11 patients (79%) and sensory involvement in all of them. In 11 patients (79%) morphological studies showed a variable incidence of demyelinated nerve fibres and of fibres undergoing axonal degeneration, and a reduction in the density of axons per mm² of endoneurial area. Marked endoneurial inflammatory infiltration was present in only one nerve specimen, and onion bulb formations in two. In three patients, only axonal loss was present distally; this was in association with a small endoneurial inflammatory infiltrate in one of them.

**Dysglobulinaemic neuropathy**

Eleven patients fit in this group; nine with a benign monoclonal gammopathy, one with Waldenström’s macroglobulinaemia and one with a multiple myeloma. In this subgroup of patients the mean interval between the first symptoms and the biopsy was 3.4 years. Motor deficit was less important and less common in this subgroup (absent in 36%, mild in 55% and severe in 9%). Mild pains were noted in 18% of the patients of this subgroup. The impairment of superficial sensation was less frequent but more marked than in the rest of our population. A mild decrease in position sense and vibratory sensation affected 82% of the patients of this group. The distribution of symptoms were distal and symmetrical in all patients. Five patients (45%) had an IgM monoclonal gammopathy including two with an anti-myelin associated glycoprotein activity; five had an IgG and the last one an IgA monoclonal gammopathy.

Electrophysiological investigations showed a demyelin-
Drug-induced neuropathy

Drug-induced neuropathy was common in this group, with many patients (55%), associated with signs of axonal loss in three; electrophysiological signs of an axonal neuropathy predominated in five patients. Electrophysiological alteration of motor nerves was found in eight patients (73%) and that of sensory nerves in all of them. The neuropathy was symmetrical and predominantly distal in all of them. In seven patients of this group, histological examination showed reduced density of myelinated fibres and signs of demyelination and remyelination. In three of them, onion bulb formations were present on cross-sections. In the other four patients only a few fibres were undergoing wallerian degeneration. Endoneurial amyloid deposits, which can complicate monoclonal gammopathy, were not found in this series.

Neuropathy in diabetic patients

Six patients were on treatment for diabetes mellitus at the onset the neuropathy, including one who had been receiving insulin for 12 years. A nerve biopsy was performed because many of the features exhibited by these patients were not common in diabetic polyneuropathy. In addition, one of these patients also suffered from a multiple myeloma with mild renal insufficiency, another had an haemochromatosis and a third one had had cranial arteritis. Two patients presented with a multifocal neuropathy. Four patients had a severe distal motor deficit. Spontaneous pains were severe in two patients and the autonomic manifestations were disabling in three of them.

In this subgroup of six patients, the histological examination showed a severe, axonal neuropathy with marked loss of myelinated fibres in the four patients with distal symmetrical sensory and motor polyneuropathy. In the two patients who suffered from a multifocal neuropathy, vasculitis was present with lesions of epineurial and perineurial blood vessels and with segmental necrosis of the wall of some of these vessels. No signs of vasculitis was found in the muscle sample in these patients.

Drug-induced neuropathy

This group comprises six patients who had been treated with potentially neurotoxic drugs. In three of them the causal drug was almitrin (Chedru et al., 1985); isoniazid (Blakemore, 1980). Amiodarone and nitrofurantoin (Sterman and Schaumburg, 1980) were retained as responsible in one each. One of these patients also presented a massive loss of weight of unknown origin, another was also being treated for depression. For these patients the mean interval between the first symptoms and the biopsy was longer (3.9 years) than the average of our population. Pain and paraesthesias were more common in this subgroup than in the other patients. Motor involvement was present in two patients only. The distribution of symptoms was symmetrical in 83% of them. For these six patients, nerve lesions were characterized by a reduced density of nerve fibres, the presence of numerous clusters of small, regenerating, nerve fibres and absence of active lesions of nerve fibres on teased fibre preparation; all these findings could be consequences of a mild, toxic, distal axonopathy.

Other causes

Four patients had an alcoholic neuropathy, two a vitamin B<sub>12</sub> deficiency secondary to intestinal malabsorption (subsequent to surgery for pancreatitis in one and to an ulcer in the other). In these patients the biopsy showed signs of a mild, chronic distal axonopathy. One patient who suffered from a recto sigmoidal carcinoma developed a progressive neuropathy of the lower limbs. In this patient, nerve biopsy showed inflammatory infiltrates in the nerve and muscle sample associated with reduced density of nerve fibres which were often undergoing wallerian degeneration. It also showed metastatic cells in the endoneurium, an uncommon finding in this setting. One patient had a mild peripheral neuropathy associated with Sezary's syndrome. In one patient the neuropathy was ascribed to chronic uraemia; one patient had a multifocal motor neuropathy of the upper limbs associated with nerve conduction block; one patient had demyelinating Charcot–Marie–Tooth disease without detectable PMP22 gene duplication or family history, and one patient was classified as having late onset hereditary chronic sensory polyneuropathy with trophic changes. One had a late onset, severe sensory and autonomic neuropathy ascribed to a primary amyloid polyneuropathy due to accumulation of mutated transthyretin without family history of neuropathy. The diagnosis was based in this case on the presence of transthyretin positive endoneurial amyloid deposits in the nerve biopsy specimen. One patient had a lepromatous lepromatous polyneuritis with characteristic histological features. One had a multifocal pressure palsy secondary to massive loss of weight; the nerve biopsy showed late stages of wallerian degeneration associated with numerous clusters of regenerating fibres, without myelin tomacula.

Patients with normal nerve biopsy findings

In three patients who developed progressive weakness of the lower extremities and borderline sensory symptoms and signs, normal histological appearance of the nerve sample and massive neurogenic atrophy led to the diagnosis of lower motor neuron disease. Six additional patients (four men and two women) had severe paraesthesias and pains which suggested the presence of a peripheral neuropathy but the sensory deficit and electrophysiological data were borderline. Nerve biopsy showed no, or minor, abnormalities thus excluding a peripheral neuropathy. In these six patients the mean interval between the first symptoms and the nerve biopsy was longer than in the other subjects (4.3 years). There was no motor deficit in five of them and only a mild one in one. Pains were severe in two patients and mild in three of them. The neuropathic manifestations were distal
Peripheral neuropathy of unknown origin

In six patients (two men and four women) the cause of the neuropathy remained undetermined. In patients of this group, occasional fibres were undergoing axonal degeneration on teased fibre preparations and a slight reduction in the density of nerve fibres was present on cross-sections. We concluded that these patients suffered from a mild axonal neuropathy of undetermined origin. The mean interval between the first symptoms and the time of referral for nerve biopsy was longer than in the rest of our population. Based on morphological findings, the neuropathy was considered progressive in one patient and stable in the other five. Motor deficit was absent in two patients, mild in three and severe in one. The neuropathy was distal and symmetrical in five patients and distal and asymmetrical in one. Although the cause of the neuropathy was unclear, it is of interest to note that two of these patients had massively lost weight and that may have induced some additional, nutritional problems; one had a macrocytosis without detectable vitamin B₁₂ deficiency and one had a histologically demonstrated temporal arteritis, a condition in which peripheral neuropathy has been reported (Caselli et al., 1988).

Comments

This retrospective study of 100 consecutive patients over 65 years of age who underwent a nerve and muscle biopsy for a disabling neuropathy is not representative of the causes of disabling neuropathies in the elderly in general since we included patients with neuropathy of known origin only if they manifested uncommon signs or symptoms, such as a severe motor deficit or a multifocal neuropathy in a diabetic patient. Thus patients with painful diabetic neuropathy or with cisplatin neuropathy, both of which are common and disabling in this age group, were not biopsied when there were no atypical features requiring a biopsy to exclude other causes. We did not include patients with acute demyelinating polyradiculoneuropathy of the Guillain–Barré type either; this is another cause of disabling neuropathy in this age group. Beside these obvious biases our findings illustrate the usefulness of nerve and muscle biopsy in selected patients with long-lasting neuropathy in this age group.

Vasculitic neuropathy was demonstrated in 23 patients, where it was associated with necrotizing arteritis. It was found very likely in 10 additional patients making vasculitis the first cause of neuropathy in our series, accounting for 33% of the cases. In addition, two diabetic patients who were found to have vasculitis in the nerve specimen, just like those found in some patients with proximal diabetic neuropathy (Said et al., 1994). Thus more than one-third of our patients over 65 years of age and with disabling neuropathy were found to suffer from vasculitic neuropathy. This is a higher proportion than that found in other studies, in which selection of patients was different (Huang, 1981; Hessel et al., 1986; George and Twomey 1986; Barach, 1989; Wertman et al., 1988). This high yield of nerve and muscle biopsy is related both to careful selection of the patients undergoing tissue sampling and of the nerve which is sampled, to simultaneous sampling of muscle and to the high incidence of vasculitis in the elderly (Said, 1988). In a previous study of 100 patients with histologically proven necrotizing arteritis the mean age was >60 years (Said et al., 1988). All the patients included in the present series had a severe and disabling neuropathy which required a biopsy for diagnostic purpose (Hawke et al., 1991). It is of interest to note that 13 patients with vasculitic neuropathy presented with isolated neuropathy. However, vasculitis was also present in the muscle biopsy specimen in many of them, demonstrating that vasculitis was not restricted to the peripheral nervous system in these patients. This is in contrast with the presumed non-systemic, organ specific, vasculitis suggested by Dyck et al. (1987).

The other causes of neuropathy found in our series are more or less those expected in this age group. It must be noted, however, that the onset of symptoms in patients with familial amyloid polyneuropathy occurs in French families much later than in the Portuguese families with the same Met30 mutation (Andrade, 1952). In addition these patients often present as sporadic cases (Adams et al., 1992; Reilly et al., 1995). Another problem is encountered in patients who have had lower motor neuron disease restricted to the lower extremities for several years and with a slow course (Patrikios, 1918); they often present with manifestations mimicking a predominantly motor neuropathy. Such patients often complain of poorly characterized distal dysesthesiae. Thus, in spite of borderline sensory loss and electrophysiological findings, a nerve biopsy was found useful in several of our patients, to exclude an involvement of sensory nerves, i.e. in considering motor neuron disease.

The 14 patients with chronic inflammatory demyelinating polyradiculoneuropathy had a disabling neuropathy, and did not differ from those reported in large series of the literature (McCombe et al., 1987). It is important to note that nine patients, including three with lower motor neuron disease and six in whom signs and symptoms of peripheral neuropathy were finally ascribed to spinal root involvement, had normal nerve biopsy findings in spite of symptoms which suggested the possibility of peripheral nerve lesions. The cause could not be determined in six patients in whom the neuropathy was axonal, minor and non-progressive. In this subgroup, ageing of the peripheral nervous system may have played a role. Only a very small proportion of patients with disabling neuropathy may be considered as having an idiopathic polyneuropathy (Notermans et al., 1993).
The diabetic patients who underwent a nerve biopsy either had a very severe diabetic neuropathy with motor deficit, which is uncommon in distal symmetrical diabetic polyneuropathy (De Freitas et al., 1992; Thomas and Tomlinson, 1993), or a multifocal neuropathy, which is also uncommon and requires the same type of investigation as for non-diabetic patients. In this setting the finding of vasculitis in the two diabetic patients with multifocal neuropathy is in agreement with identification of vasculitis in some patients with proximal diabetic neuropathy, a pattern of neuropathy which can be considered as a focal diabetic neuropathy (Said et al., 1994). It is also of interest to note that, in drug induced neuropathy, symptoms can persist or apparently worsen long after withdrawal of the drug. In such patients the nerve biopsy showed that the nerve lesions are not progressive; they only reflect previous axonal degeneration.

The high incidence of vasculitis in nerve and muscle biopsy specimens in this series is related to the high proportion of patients with multifocal neuropathy that were investigated. We conclude that elderly patients with progressive multifocal neuropathy of recent onset should be investigated by nerve biopsy in order to detect the most common treatable causes of neuropathy in this age group. Also in other carefully selected patients with disabling peripheral neuropathy, nerve biopsy findings can bring useful information concerning the cause or the prognosis of the neuropathy.

References
Andrade C. A peculiar form of peripheral neuropathy: familial atypical generalized amyloidosis with special involvement of the peripheral nerves. Brain 1952; 75: 408–27.
Thomas PK. Late life neuropathy. In: Thomas PK, editor. Peripheral


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