SOLITARY BENIGN PERIPHERAL-NERVE TUMOURS

REVIEW OF 32 YEARS' EXPERIENCE

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Solitary benign peripheral-nerve tumours are rare and may be difficult to diagnose correctly. Surgical excision may increase the patient's symptoms and may not be necessary.

We have reviewed the presentation, clinical findings and histology of 104 solitary tumours presenting at one centre between 1959 and 1990. Male patients predominated for both schwannoma and neurofibroma. There was considerable but variable delay before presentation; 94% of patients complained primarily of a mass and less than half had pain or paraesthesia. The correct diagnosis had been made in only a few cases before operation, and the incidence of neurological symptoms doubled after exploration. We emphasise the need for vigilance, accurate preoperative diagnosis, and careful surgery.

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Tumours arising from peripheral nerves are a rare cause of lumps in the limbs. Some are easily diagnosed from characteristic symptoms, an isolated mass and distal neurological signs, but in others the diagnosis is more difficult. Benign tumours are classified as traumatic neuroma, solitary neurofibroma and schwannoma (neurilemmoma). There are also malignant peripheral nerve-sheath tumours. Traumatic neuroma, non-neoplastic proliferation of Schwann cells and axons, is excluded from our series.

Solitary neurofibromas and schwannomas cause virtually identical symptoms and signs, and there are no clinically distinct pathognomonic features. Either may present as an isolated soft-tissue mass of uncertain origin and duration. Failure to appreciate the possibility and the nature of these tumours at the time of surgery may lead to a catastrophic loss of function for the patient.

Such tumours can present to many different medical and surgical specialties. We have reviewed only tumours of the limbs and girdles which are likely to be referred to an orthopaedic surgeon.

PATIENTS AND METHODS

At the Western Infirmary, Glasgow, from 1959 to 1990, 104 solitary peripheral-nerve tumours were registered from a primary catchment population of 250 000. We recorded patient details, symptoms, signs and operative findings from the clinical records, excluding patients with a known diagnosis of multiple neurofibromatosis. The original tissue blocks were retrieved and fresh sections cut, stained and examined by one of the authors (RR) with no knowledge of the clinical history or the original pathological report.

Pathology. The schwannoma or neurilemmoma is an encapsulated tumour containing two tissue types, cellular tissue (Antoni A) with areas of nuclear palisading (Verocay bodies) and more myxoid, less cellular tissue (Antoni B). Tumours of large nerves usually appear as eccentric masses over which nerve fibrils are stretched, while those of smaller nerves may expand the entire nerve. The capsule is of epineurium, usually with overlying tortuous vessels. The cut surface is yellow-grey and may be cystic.

Neurofibromas may occur in unidentifiable cutaneous nerves or in larger trunks. Within an identifiable larger nerve, they expand into a fusiform mass and often extend into soft tissue; they are well-defined but non-encapsulated and they may be nodular. Histologically, they show spindle-shaped cells in a myxoid stroma containing collagen fibres resembling the Antoni-B tissue of a schwannoma. Some neurofibromas may be premalignant (Enneking 1983).

Schwannoma and neurofibroma can usually be differentiated histologically by conventional haematoxylin and eosin staining, or from the relationship of the axons to the mass, but in cases of doubt immunocytochemistry with antibodies to neurofilaments is helpful. Immunostaining for S100 protein (Weiss, Langloss and Enzinger 1983) is nearly always positive in the spindle cells of schwannomas, but negative or only weakly positive in most neurofibromas.
RESULTS

The 104 registered tumours had been excised from 101 patients. The clinical and pathology records were adequate for 88 patients, and 101 pathology blocks were available, but one was unsuitable for re-examination.

In 83 of the 88 patients (94%) the presenting symptom was a mass. A positive statement that there was no lump was recorded in five cases (6%). Pain was noted in 38 cases (43%) and paraesthesia in 20 (23%), with both complaints together in 18 patients (20%). A preoperative neurological deficit was recorded in only five instances, but paraesthesia was always exacerbated by direct percussion of the mass. The clinical notes suggested that the operative findings and subsequent laboratory reports had produced some unexpected results.

Male patients showed a slight preponderance for both types of tumour: 37 to 32 for schwannoma and 16 to 9 for neurofibroma. The age at presentation ranged from 8 to 74 years (mean for schwannoma 48.3 years, for neurofibroma 40.6 years; Fig. 1). Two neurofibromas and two schwannomas presented in patients under 18 years of age.

The sites of tumours are shown in Figure 2 and Table I. Three patients had multiple tumours; one had two ankle lumps at the same time, one had two hindfoot masses 15 years apart, and one had two arm tumours four years apart; all of these were schwannomas. The interval between the patient first noticing the lump and the operation ranged from 3 months to 22 years (median 24 months).

A specific preoperative diagnosis had been made in only 37 (42%) cases (Table II), of which only seven were of neurofibroma or schwannoma. Sixteen patients had a diagnosis of ‘tumour, unspecified’, and the remainder had no diagnosis or the notes were inadequate.

Postoperative problems were noted in 13 of 79 adequately recorded cases (17%). These included severe haemorrhage after exploration of the brachial plexus, pain at the operation site in two cases, a motor-nerve deficit in three, sensory deficits in six and a mixed-nerve deficit in one.

Our review of the pathology changed 15 of the diagnoses

| Table I. Sites of all 104 tumours, including nine of unconfirmed or other pathology |
|---------------------------------|--------|
| Supraclavicular fossa           | 7      |
| Shoulder or axilla              | 10     |
| Upper arm                       | 8      |
| Elbow or forearm                | 6      |
| Wrist or palm                   | 17     |
| Digits                          | 13     |
| Thigh                           | 8      |
| Popliteal fossa                 | 1      |
| Leg                             | 19     |
| Ankle or foot                   | 12     |
| Uncertain                       | 3      |
We were unable to differentiate one ‘mixed’ tumour. Ten neurofibromas were reclassified as schwannomas.

**DISCUSSION**

The incidence of isolated peripheral-nerve tumours is low. Jenkins (1952) described only three seen in 12 years at the Hammersmith Hospital. Adams (1985) recorded only 65 cases of schwannoma of peripheral nerves from a series of 1500 primary neurological tumours. Trojanowski, Kleinman and Proppe (1980) described 24 malignant and 607 benign tumours of nerve-sheath origin in an overall register of 25 000 pathological specimens. Whitaker and Droulias (1976) recorded 76 peripheral-nerve schwannomas in 1 500 000 hospital admissions.

Das Gupta et al (1969) found a greater incidence of schwannoma in the upper limb in a series of 303 schwannomas; our results support this, giving a 2:1 ratio in upper and lower limbs. The neurofibromas were more evenly distributed. This imbalance contrasts with the incidence of soft-tissue tumours of the musculoskeletal system in general; for these the lower limb is the more common site. The imbalance may relate to the more prominent function of the nerves in the upper limb, but both Stack (1960) and Strickland and Steichen (1977) found that less than 5% of hand tumours had arisen from nerves.

The age at presentation did not correlate with tumour type: 63% of schwannomas and 65% of solitary neurofibromas were in patients presenting between 30 and 59 years of age. Our data support the impression that nerve tumours are particularly rare in children. Ruda et al (1991) report one schwannoma in a 12-year-old child, but our series includes only four patients under 18 years of age, two with schwannoma and two with neurofibroma.

Anatomical considerations suggest that a nerve-related mass should be in the line of a nerve trunk, mobile in the transverse plane, but tethered in the longitudinal axis of the limb. Such clinical findings, however, do not lead to a diagnosis more specific than ‘peripheral-nerve tumour.’ Intraosseous tumours give symptoms due to nerve irritation and pain rather than the presence of a mass (Enneking 1983; Crone and Watt 1987).

Most of our patients presented after a long delay with a palpable mass as their only symptom, as reported for other series (Holdsworth 1985; Spiegel et al 1986). Only 43% of the palpable masses were associated with another recorded symptom, usually pain or tenderness. Nerve irritation is usually apparent as paraesthesia with a positive Tinel sign, although Holdsworth (1985) found that only two of 18 patients (11%) with upper-limb tumours reported neurological symptoms. In contrast, Spiegel et al (1986) reported that 63 of 76 patients (83%) with a schwannoma in the lower limb complained of pain.

The preoperative diagnosis of a nerve tumour was made in only one quarter of our cases. Poor diagnostic accuracy must increase operative uncertainty, but it should be made clear that most patients in our study presented before sophisticated imaging techniques had become available. New imaging techniques may give an indication of the precise pathology. Ultrasound is well established but little has been published in relation to peripheral nerves and their small tumours (Hughes and Wilson 1986). High-frequency, high-resolution ultrasound shows these tumours to be masses of low echogenicity with distal enhancement (Obayashi, Itoh and Nakano 1987; Fornage 1988). CT has the disadvantage that the slice thickness is similar to the size of the lesion being sought. MRI is now the best imaging method (Fig. 3) since it provides both longitudinal and transverse sections. Nerve-conduction studies are useful to exclude other pathology such as compression syndromes, but the function of nerve fibrils is rarely disrupted by the presence of a discrete, benign schwannoma or neurofibroma.

The excision of a solitary nerve tumour may not be therapeutically necessary but it is the only way to obtain a tissue diagnosis. The characteristic appearance of a schwannoma is of an ovoid mass, often smooth, shiny and greyish in colour, with nerve fibrils spread thinly and diffusely over its surface. The mass may be placed eccen-
MR scans of leg showing a subcutaneous neurofibroma, before (a) and after gadolinium enhancement (b).

FIG. 3A  FIG. 3B

trically in the nerve, and meticulous dissection with magnification can achieve complete enucleation without neurological loss (Cutler and Gross 1936; Strickland and Steichen 1977; Phalen 1986).

A neurofibroma, by contrast, is more intimately involved with the nerve fibrils, and any attempt at removal must be balanced against the danger of structural damage to the nerve. This must be considered before the surgical exploration of a nerve, and particularly for proximally positioned tumours. Bonney (1986) and Birch et al (1991) have stressed the hazard of limited exposures near important axial structures, and especially the brachial plexus. They condemn the practice of biopsying nerves and paraneural structures. Ten patients in our series had an increase in nerve dysfunction after surgery.

Cavallazzi et al (1988) reported the combination of a schwannoma and neurofibroma on the same peripheral nerve trunk (median) and Lewis, Nannini and Cocke (1981) reported a patient with multiple schwannoma in hand and forearm. Multiple tumours, however, are rare except in von Recklinghausen’s disease. Three of our patients had two tumours, but at long intervals in two of them.

Conclusions. In our hospital, peripheral-nerve tumours were diagnosed at a rate of 3.25 per year, usually presenting as an innocuous mass. Careful clinical and imaging examinations are essential; medical defence organisations continue to stress the problem of damage to peripheral nerves from biopsy or other surgery near such tumours. The possibility of iatrogenic nerve injury at the time of exploration should be considered and discussed with the patient before the operation. At surgery there must be clear exposure of the nerve both proximally and distally to the site of the lesion. Magnification and appropriate instruments must be available, and all excised tissue should be examined histologically.

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REFERENCES


