Segmental thoracic lipomatosis of nerve with nerve territory overgrowth

Case report

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Lipomatosis of nerve (LN), or fibrolipomatous hamartoma, is a rare condition of fibrofatty enlargement of the peripheral nerves. It is associated with bony and soft tissue overgrowth in approximately one-third to two-thirds of cases. It most commonly affects the median nerve at the carpal tunnel or digital nerves in the hands and feet. The authors describe a patient with previously diagnosed hemihypertrophy of the trunk who had a history of large thoracic lipomas resected during infancy, a thoracic hump due to adipose proliferation within the thoracic paraspinal musculature, and scoliotic deformity. She had fatty infiltration in the thoracic spinal nerves on MRI, identical to findings pathognomonic of LN at better-known sites. Enlargement of the transverse processes at those levels and thickened ribs were also found. This case appears to be directly analogous to other instances of LN with overgrowth, except that this case involved axial nerves rather than the typical appendicular nerves.

Methods

We searched electronic and paper records at our institution for “lipofibromatous hamartoma,” “fibrolipomatous hamartoma,” “intraneural fibrolipoma,” and “fibrofatty tumor,” among other names, but we prefer the WHO terminology of “lipomatosis of nerve.” It is most commonly found in the median nerve as well as the digital nerves of the hands or feet. The neural appearance of LN is pathognomonic on MRI, obviating the need for biopsy.3,17

It is a histologically benign condition that can be variably associated with overgrowth phenomena within the nerve territory, such as skeletal elongation leading to macrodactyly, subcutaneous proliferation, and lipoma formation.6 The appearance of massive enlargement of mesenchymal elements from bony and soft tissue (fibroadipose) overgrowth is routinely referred to as “macrodystrophia lipomatosa” (MDL).9

We were intrigued by the possibility of LN occurring in an axially located nerve, rather than the classic appendicular hypertrophy. In reviewing records at our institution, we found a patient who, although she was previously considered to have hemihypertrophy, appeared to have all the features of LN with overgrowth in multiple thoracic roots and intercostal nerves. To our knowledge, it is the first case of LN associated with hypertrophy of the spine and fibroadipose overgrowth in the innervated tissues.

Key Words • lipomatosis of nerve • fibrolipomatous hamartoma • hemihypertrophy • macrodystrophia lipomatosa • scoliosis • peripheral nerve

Abbreviations used in this paper: LN = lipomatosis of nerve; MDL = macrodystrophia lipomatosa.

This article contains some figures that are displayed in color online but in black-and-white in the print edition.
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Fig. 1. Clinical photograph depicts prominence of the left lower thoracic paraspinal muscles (asterisk), hypertrophic surgical scarring (ocothorpe), and thoracic rigidity.

Fig. 2. Standing 36-inch cassette spine radiograph depicts mild levoscoliosis with hypertrophy of the pedicles, facet complexes, transverse processes, and adjacent ribs.

nerves, even though it was not prospectively identified as LN. We present this case as a proof of concept.

Case Report

History. A 35-year-old woman was initially referred to the Mayo Clinic for chronic back pain and a history of paraspinal tumor. At birth, she had had a large thoracolumbar mass, for which she underwent resection at 6 months of age. The mass recurred within 4 months and grew to its previous size within 1 year. Repeat resection was performed at 18 months of life, and pathology was interpreted as mature fibroadipose tissue arising from muscle. A second mass formed 2 years later, superior to the prior tumor and transversely oriented across the midline. It was initially resected when the patient was 5 years old. The mass recurred, grew to its previous size, and was again resected 1 year later. Pathology both times was consistent with mature fibroadipose. She had prominent keloid formation at both skin incisions, which required operative revision at the ages of 6 and 7 years, with both procedures occurring approximately 6 months after each of the resections. When she was 16 years old, she was referred to our institution for the levoscoliosis noted 2 years earlier. She had pain in the affected paraspinal muscles but without neurological compromise. Her thoracic curve was 18°, and she was deemed unlikely to progress as she was skeletally mature. At age 34 years, she returned to clinic for worsening pain associated with her pregnancy. Her husband indicated that she had had mild enlargement of the left paraspinal mass during the past decade and a half; the mass did not change...
size during her pregnancy. She was genetically tested and found to be negative for Beckwith-Wiedemann syndrome.

**Examination.** She had a prominent soft tissue mass in the left paraspinal region, which was nontender, nonpulsatile, and nonfluctuant (Fig. 1). There was no evidence of axillary freckling, café-au-lait spots, nevi, vascular malformations cerebriform patterning, or varicosities. She had a well-healed midline incision at the thoracolumbar junction and a transverse incision at the inferior pole of the scapula with significant keloid-like scar formation. Detailed neurological examination, including motor and sensory testing as well as reflexes, was normal.

**Imaging.** Spine radiographs revealed a 22° levoscoliotic curve centered at the T-10 vertebral body (Fig. 2). Computed tomography scans with 3D reconstruction (TeraRecon; Fig. 3) demonstrated posterior complex (facet, pedicle, and transverse process) and rib hypertrophy bilaterally at T-6, right at T-7, and left at T-8 through T-12 (A). Oblique axial images demonstrate posterior complex (facet, pedicle, and transverse process) and rib hypertrophy bilaterally at T-6 (B), right at T-7 (C), and left at T-11 (D). There is fatty infiltration of the paraspinal muscles (*asterisk*) ipsilateral to the involved posterior complex.

**Discussion**

This patient has classic features of LN with nerve including the multifidi, spinalis dorsi, longissimus dorsi, and iliocostalis dorsi muscles from T-5 to L-3, excluding the iliocostalis lumborum muscle (not depicted). There was prominent fibrous tissue in the area of prior surgical incisions.
Thoracic lipomatosis of nerve territory overgrowth specifically involving hypertrophied intercostal nerves. The pathognomonic appearance of LN occurs in several contiguous thoracic spinal and intercostal nerves on MRI (Fig. 7).

This case of spinal LN differs from a recent case described as a thoracic neural fibrolipoma, which, in our opinion, was consistent with an angiolipofibrolipoma of the spinal canal. Angiolipomas are considered a distinct pathological entity by the WHO and have a lengthy list of case reports and studies. In our opinion, that case was mistakenly described as a neural lipoma, despite the distinct pathology. In that case, there were none of the hallmarks of LN, and the radiological appearance was identical to other angiolipomas.

The hemihypertrophy previously diagnosed in our patient developed from bony and soft tissue fibroproliferative overgrowth in the distribution of isolated thoracic nerves enlarged by lipomatosis. Such overgrowth was restricted to the innervation pattern of specific thoracic roots, as the immediately adjacent thoracic levels displayed normal tissues with normal-caliber nerves (Fig. 5). Isolated rib and vertebral body overgrowth seen on CT (Fig. 3) was recapitulated in the pattern of isolated nerve hypertrophy (Fig. 6). The apex of her scoliotic deformity was located at the site where multiple contiguous segments were affected unilaterally, suggesting that the bony overgrowth led to a unique form of neurogenic scoliosis.

The fatty infiltration of paraspinal musculature was strikingly isolated to the myotomes of the affected nerves (Fig. 5) with a well-demarcated transition to normal tissue. Likewise, the lipomas were isolated to the same afflicted dermatomes. Hypertrophic scarring occurred after lipoma resection, which we have noted to occur after surgery for LN. While the patient was considered to have hemihypertrophy, her findings were analogous to “macrodactyly,” or in fact MDL, from nerve territory overgrowth in the spine and posterior thoracic wall (Figs. 6 and 8).

Macrodactyly is currently conceptualized as either primary (“true”) or secondary. Cases of secondary macrodactyly are those attributable to another specific lesion, such as a tumor, vascular malformation, or lymphedema. True macrodactyly conceived in this context is divided into categories of association: macrodactyly associated with lipomatosis, with neurofibromatosis, or with syndromes of hemihypertrophy. The present case, by example, suggests that the first category is perhaps more closely related to the last or that many cases of hemihypertrophy should be considered in relationship to LN. For instance, it is intriguing that the LN in our patient was bilateral—a relatively rare finding, with only 6 cases of appendicular LN or MDL reported as bilateral. Perhaps, more subtle, subclinical cases of contralateral LN exist, albeit overshadowed by the predominant side.

Recent genetic work on overgrowth syndromes has...
found somatic mutations isolated to hypertrophied tissue but absent from germline samples. The found mutations have implicated the PTEN/AKT/PIK3CA signaling pathway as an etiology for overgrowth, with clusters of mutations responsible for various overgrowth syndromes like Proteus, CLOVE syndrome (congenital lipomatous overgrowth, vascular malformations, and epidermal nevi), and others. Somatic mutations of PIK3CA, a gene known to be mutated in a range of human cancers, have been demonstrated in the nerve tissue of patients with MDL. However, what separates LN and MDL from other forms of overgrowth is the anatomical restriction to a nerve territory, as well as a milder phenotype. The clear depiction of thoracic nerve territories in the present case suggests that the pathology of LN may result from the somatic mutation of precursors to the peripheral nerve rather than the hypertrophied tissues.

Our case unifies current concepts related to LN and extends the spectrum of its involvement with nerve territory overgrowth from the appendicular skeleton to the axial spine. We believe that this pathoanatomical explanation for LN with nerve territory could encompass other unusual overgrowth or lipomatous disorders.

**Conclusions**

This case of LN in the thoracic region has all the features of the same entity in the periphery. The analogous features of LN with nerve territory overgrowth in this atypical truncal location and the typical appendicular location unify the disease process.

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**Disclosure**

Dr. Spinner is a consultant for Mayo Medical Ventures. The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper. Author contributions to the study and manuscript preparation include the following. Conception and design: Spinner, Mahan. Acquisition of data: Spinner, Mahan, Howe. Analysis and interpreta-
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Fig. 7. Radiological comparison between classic MDL and the present case of LN.  
A: Axial T1-weighted MR image of the digital nerves in an unrelated patient with lipomatosis of the median nerve. The radial digital nerve to the second digit (left) is unaffected by lipomatosis (hollow arrow). The ulnar digital nerve of the second digit and the radial digital nerve of the third digit are mildly affected by lipomatosis (solid arrowheads). The ulnar digital nerve of the third digit is massively enlarged (right). Note that epineural fat produces a higher signal intensity than normal subcutaneous fibroadipose at the joint, creating a halo effect around a massively hypertrophied fascicle. Exostosis at the proximal interphalangeal joint (hollow arrowhead).  
B: Axial T1-weighted MR image of the median nerve proximal to the transverse carpal ligament in an unrelated patient with lipomatosis of the median nerve without a history of surgery. Note the cable appearance on cross-section.  
C: Sagittal nonconstrast 3D T1-weighted CUBE acquisition (3-T MRI) in the patient in the present case showing left intercostal nerves. The T-7 and T-8 intercostal nerves are mildly affected (arrows), with mild nerve hypertrophy, fat deposition, and osseous hypertrophy. The T9–11 intercostal nerves are more significantly hypertrophied (solid arrowheads), with prominent epineural fat hyperintensity and an owl’s eye appearance. Intercostal arteries and veins are immediately rostral to the nerve and larger than normal.  
D: Sagittal T-1 weighted MRI montage from the patient in the present case showing the thoracic root at T-10 and T-11 prior to branching of the dorsal ramus, with a similar cable-like appearance surrounded by epineural sheath and abundant adipose tissue.

Fig. 8. Artistic rendering shows typical LN of the median nerve at the carpal tunnel (left) and the analogous involvement of LN in the thoracic spine (right), depicting hypertrophy of the nerve, fatty infiltration of muscle, lipomas, and osseous overgrowth. Published with kind permission from the Mayo Foundation for Medical Educational Research, 2013.
tion of data: Spinner, Mahan, Amrami. Drafting the article: Spinner, Mahan. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: Spinner. Administrative/technical/material support: Spinner. Study supervision: Spinner.

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