Lipomas of the Brachial Plexus: A Case Series and Review of the Literature

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Abstract

Background: Lipomas are common benign tumors. When they develop in proximity to peripheral nerves, they can cause neurologic symptoms secondary to mass effect. Previous reports have shown symptom resolution after removal of lipomas compressing various upper extremity peripheral nerves. However, brachial plexus lipomas are relatively rare. Our multidisciplinary experience with brachial plexus lipoma resection is reviewed in the largest case series to date. **Methods:** A retrospective chart review of all patients undergoing resection of brachial plexus lipomatous tumors between 2006 and 2016 was performed. Patient demographic data, diagnostic imaging, clinical presentation, operative details, surgical pathology, and clinical outcomes were reviewed. **Results:** Twelve brachial plexus lipomatous tumors were resected in 11 patients: 10 lipomas, 1 hibernoma, and 1 atypical lipomatous tumor. The most common tumor location was supraclavicular (50%), followed by axillary (42%), and proximal medial arm (8%). The most common brachial plexus segment involved was the upper trunk (50%), followed by posterior cord (25%), lateral pectoral nerve (8%), lower trunk (8%), and proximal median nerve (8%). Most patients presented with an enlarging painless mass (58%). Of the patients who presented with neurologic symptoms, symptoms resolved in the majority (80%). **Conclusions:** Brachial plexus lipomas are rare causes of compression neuropathy in the upper extremity. Careful resection and knowledge of brachial plexus anatomy, which may be distorted by the tumor, are critical to achieving a successful surgical outcome with predictable symptom resolution. Finally, surveillance magnetic resonance imaging may be warranted for atypical lesions.

Keywords: brachial plexus, lipoma, nerve compression, tumor, soft tissue mass, upper extremity

Introduction

Lipomas are the most common human mesenchymal tumor.⁴ They are comprised of mature adipocytes and commonly present as firm, painless subcutaneous nodules with a predilection for the neck, trunk, buttocks, and proximal extremities.^{4,16} Lipomas are usually solitary but can present at multiple sites in 5% to 10% of patients or as diffuse lipomatosis in the setting of a multisystem syndrome.⁴

Lipomas can be classified by anatomic site, histologic characteristics, and size.^{11,18} Anatomically, lipomas can be found in dermal, subcutaneous, and subfascial (parosteal) planes.¹¹ They have also been described within muscle, bone, nerve, and visceral organs.¹⁸ The histologic classification of the adipocyte distinguishes variant subtypes from that of ordinary lipomas, including lipoblastoma (immature vs mature), hibernoma (brown fat vs white fat), angiolipoma (microvascular thrombosis present), spindle cell lipoma (mature fat cells with spindle cells and strands of dense collagen), and pleomorphic lipoma (“floret-like cells” present).⁴ Giant lipomas are defined as greater than 10 cm in length or weighing more than 1000 g.¹⁸

While most lipomas are asymptomatic, their slow but progressive growth pattern can eventually lead to pain, numbness, or weakness secondary to peripheral nerve compression.⁷ In the upper extremity, compression of the radial, median, and ulnar nerves as well as the suprascapular, axillary, musculocutaneous, and posterior interosseous nerves have been described.^{1,2,6,8,9,12,14,15,19,20,25-27} However, lipomas compressing the brachial plexus are relatively rare, with only a few reports in the literature.¹² The goal of this study was to review our experience with the surgical management of these rare tumors in the largest case series to date.

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Figure 1. Magnetic resonance imaging of a large supraclavicular lipoma from coronal (a), axial (b), and sagittal (c) views compressing the upper trunk.

Figure 2. Incision markings drawn (a) allow for adequate exposure of large supraclavicular (b) and infraclavicular (c) brachial plexus lipomas.

Methods

An institutional review board (IRB)–approved retrospective chart review was performed on all patients who underwent surgical excision of brachial plexus tumors by senior authors (J.S., W.D., D.K., and P.H.) from 2006 to 2016. Patient demographic data, diagnostic imaging, clinical presentation, operative details, surgical pathology, and clinical outcomes were reviewed. Patients included in the study were referred to plastic surgery or orthopedic surgery clinic with an enlarging or symptomatic axillary or neck mass. Symptomatic lesions were defined as those causing numbness, weakness, paresthesias, or pain in the affected extremity. Sensory disturbance was evaluated with Semmes-Weinstein and/or nerve conduction studies and electromyography when deemed appropriate by senior surgeon. All patients were examined by senior authors and underwent preoperative magnetic resonance imaging (MRI) confirming the benign lipomatous nature of the lesion (Figure 1). Nonlipomatous tumors of the brachial plexus as identified on final pathology were excluded from this study.

Our operative technique involved placing the patient on the operating table in the supine position with a shoulder roll. All procedures were performed under general anesthesia without paralysis to facilitate nerve identification. Patients received prophylactic antibiotics and preincision subcutaneous infiltration of local anesthetic with epinephrine for hemostasis.

The surgical approach to supraclavicular masses included an incision on the posterior border of the sternocleidomastoid that curved inferolaterally to parallel the clavicle terminating within the deltopectoral groove (Figure 2). The platysma was then divided. A subplatysmal flap was then elevated inferiorly to superiorly. The omohyoid muscle was identified and retracted inferiorly. The upper and middle trunks were then identified and dissected away from the mass and protected throughout their course during the dissection.

Greater exposure for infraclavicular brachial plexus lipomas can be achieved through an additional deltopectoral incision. The cephalic vein is retracted laterally. The interval between the pectoralis major and deltoid is established. The pectoralis minor is divided, which exposes the

Table 1. Patient Cases and Outcomes.

Patient	Age	Gender	Tumor location	Brachial plexus involved	Laterality	Presentation	Size	Histology	Surgery	Resolution of neurologic symptoms
1	58	Male	Supraclavicular	Upper trunk	Right	Shoulder paresthesias	11.1 × 11.0 × 1.5 cm	Atypical lipomatous tumor	Mass excision with external neurolysis	Yes
2	64	Female	Supraclavicular	Upper trunk	Left	Left shoulder paresthesias and hand intrinsic weakness	5.8 × 2.2 × 0.7 cm	Lipoma	Excision; in situ cubital tunnel release	Yes
3	49	Male	Axilla	Posterior cord	Left	Enlarging axillary mass	10.5 × 7.0 × 4.0 cm	Intramuscular (triceps) lipoma	Excision	—
4	50	Male	Axilla	Posterior cord	Left	Recurrent enlarging axillary mass	12.0 × 12.0 × 2.5 cm	Lipoma	Reexcision	—
5	26	Female	Supraclavicular Infraclavicular	Upper trunk	Left	Shoulder numbness and pain	10.0 × 4.0 × 2.0 cm	Hibernoma	Excision	—
6	52	Female	Axilla	Lateral cord Posterior cord	Left	Shoulder paresthesias Enlarging mass	12.0 × 9.0 × 2.5 cm	Lipoma	Mass excision	Yes
7	45	Male	Supraclavicular	Upper trunk	Left	Enlarging mass	16.0 × 8.0 × 1.0 cm	Lipoma	Excision	—
8	30	Male	Axilla	Posterior cord	Right	Painful enlarging lateral chest mass	15.0 × 11.0 × 2.0 cm	Lipoma	Excision	Yes
9	24	Female	Supraclavicular Medial arm	Upper trunk Median nerve	Right	Recurrent shoulder pain Recurrent enlarging masses of neck and medial arm	11.0 × 6.0 × 1.5 cm (arm) 13.0 × 7.0 × 2.6 cm (neck)	Lipoma (proximal arm) Lipoma (posterior neck)	Reexcision	No
10	61	Male	Supraclavicular	Upper trunk	Left	Enlarging mass	15.0 × 6.0 × 1.5 cm	Lipoma	Excision	—
11	80	Male	Axilla	Lower trunk	Right	Recurrent pain in axilla Enlarging mass	6.8 × 5.2 × 2.0 cm	Lipoma	Reexcision	Yes

terminal branches of the brachial plexus. Circumferential dissection of the mass is done under loupe magnification with addition of the operating microscope if needed. The medial and lateral pectoral nerves are preserved. For axillary lesions, a lazy S incision is made. Masses are removed in 1 piece and sent to pathology for definitive diagnosis. Following hemostasis, a drain is placed. Patients typically go home the night of the procedure or are admitted overnight for outpatient recovery and neurovascular monitoring.

All patients were followed for a minimum of 1 year. Postoperative outcomes were assessed by chart review of mass palpability, pain, sensory, and/or motor disturbances following mass excision. In addition, final pathology of resected specimens as well as recurrence rate was recorded. Tumor size was derived from pathology report for all tumors. Descriptive statistics were used to characterize patient and tumor details.

Results

A total of 12 tumors in 11 patients were identified during the study period (Table 1). The average age of the patient at time of surgery was 49 years (range, 24-80). The majority of patients were male (64%), and tumor laterality was left (58%). The most common tumor location was supraclavicular (50%), followed by axillary (42%), and arm (8%). The most common brachial plexus segment involved was the upper trunk (50%), followed by posterior cord (25%), lateral pectoral nerve (8%), lower trunk (8%), and median nerve (8%). Most common presenting symptom was an enlarging painless mass (58%), followed by shoulder paresthesias (25%), pain (25%), and hand weakness (16%). Three patients were operated on for recurrent lesions treated initially at outside hospitals. One of these patients had Cowden's syndrome, a known multisystem syndrome asso-

ciated with hamartomas and lipomatosis. There was also one known recurrence after surgical excision during the study period in a different patient.

All patients underwent mass excision via standard approach. Masses were excised in their entirety and sent to pathology for permanent section. Average specimen volume was 183 mL (range, 9-330 mL). Histology revealed benign lipoma in the majority of cases (84%); however, 1 hibernoma and 1 atypical lipomatous tumor were also identified. Of the patients who presented with motor and/or sensory disturbance at the time of consultation (45%), all but one achieved complete symptom resolution. This patient had a history of chronic shoulder pain and paresthesias from multiple lipoma excisions throughout her lifetime that did not improve following lipoma excision. One patient who underwent an axillary lipoma excision developed a postoperative seroma that resolved with percutaneous aspiration in clinic. There were no wound or perioperative complications in any of the patients during the study period.

Discussion

Lipomas of the brachial plexus are rare but can potentially be a significant site of pain, sensory, and/or motor disturbance in the upper extremity. They represent the most common tumor of a large group of benign nonneural sheath tumors that can affect peripheral nerves. These include vascular tumors such as venous angiomas, hemangiopericytomas, glomus tumors, lymphangiomas, and hemangioblastomas, as well as myositis ossificans, osteochondromas, ganglioneuromas, meningiomas, cystic hygromas, myoblastomas, and epidermoid cysts.^{7,12}

The pathogenesis of lipomas is believed to be multifactorial, involving a combination of genetics, inflammation, and antecedent trauma.¹⁸ Lipomas can induce neuropathy through extrinsic neural compression such as in a solitary lipoma, as well as through “macro dystrophia lipomatosa” causing overgrowth of the hand or fingers, intrinsic compression from an encapsulated lipoma located in a nerve, and lipofibromatous hamartoma formation.¹²

There are reports of compressive neuropathy secondary to lipomas in both upper and lower extremities.^{1,2,6-8,11,14,15,19,20,25,26} Reports of lipomas involving the brachial plexus in the supra- and infraclavicular regions and axilla, however, are rare.^{12,13} In the largest series of benign peripheral nonneural sheath tumors, only 4 of 111 patients treated over 30 years at a single institution were found to have lipomas involving the brachial plexus.¹² In our series, 12 tumors in 11 patients were treated over a 10-year span.

The diagnosis of brachial plexus lipoma should be confirmed with MRI prior to consideration of surgical resection (Figure 1). The specimen should be sent for pathology following resection to rule out the possibility of an atypical

Figure 3. Large encapsulated infraclavicular lipoma removed from patient 8.

lipomatous tumor. Typically mature adipocytes are uniformly observed without high variation in size.¹⁷ In addition, no lipoblasts are present, distinguishing lipomas from liposarcoma.⁵ Atypical lipomatous tumors have a reported 1% to 4% risk of dedifferentiation to liposarcoma, an aggressive cancer with metastatic potential.¹⁷ Lipomas show characteristic uniform high intensity in both T1- and T2-weighted images on MRI. Additional MRI features that suggest an atypical lipomatous tumor with malignant potential include tumor diameter (>10 cm), depth (deep), thickened septa (usually present), and enhancement (usually present).¹⁷ Clinical features found to be more common in atypical lipomatous tumor than a benign lipoma also include a tumor size >10 cm, thigh location, and age >60 years.³

Excision of brachial plexus lipomas is indicated when they become symptomatic and/or are increasing in size. A complete medical history should be performed and may reveal previous tumors, motor and sensory symptom location, and family history of lipomatous syndrome. A Tinel's sign with percussion over mass is often present at the site of nerve compression. Formal sensory and motor testing via Semmes-Weinstein and electrodiagnostic studies are performed as needed and help to localize and identify alternative sites of nerve compression. Two patients in our series had electrodiagnostic findings of carpal and cubital tunnel syndrome, respectively, in addition to symptomatic upper trunk compression. Brachial plexus lipomas are usually large and tend to involve the supra- and infraclavicular regions as well as axilla.

For surgical exposure, both anterior supra- and infraclavicular and posterior subscapular approaches have been described.²²⁻²⁴ Anterior supra- and infraclavicular approaches are most common.^{10,21} When possible, the tumor is removed in total as 1 specimen (Figure 3). If necessary to protect the nerves, however, the tumor can be removed in segments.

Figure 4. Anterior displacement of suprascapular nerve (a) and median nerve (b), as well as anterior and medial displacement of lateral cord (c) by large brachial plexus lipomas.

Lipomas are encapsulated and rarely directly invade nerve, but exploration of the brachial plexus often reveals compression or displacement of normal anatomy (Figure 4). Careful dissection is critical in preventing nerve injury.

Drains placed at time of surgery are removed at the first postoperative appointment. Early and aggressive physiotherapy is also started at this time to improve shoulder strength and mobility. If permanent pathology confirms a benign lipoma, no further surveillance is warranted. For atypical lipomatous tumors, we routinely obtain a baseline MRI 6 months following resection of the tumor and follow the patient with yearly MRI for 5 years to surveil for recurrence.

Conclusion

Lipomas of the brachial plexus are benign lesions that usually present as slow-growing painless masses. However, due to their critical location, careful resection and knowledge of brachial plexus anatomy are keys to achieving successful and predictable outcomes. For patients who present with an enlarging mass in the neck or axilla and distal motor and/or sensory symptoms, it is important to keep lipomas in mind as a potential etiology.

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Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Statement of Informed Consent

Informed consent was obtained from all patients for being included in the study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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