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Iatrogenic spinal accessory nerve injury in children

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Abstract Injury to the spinal accessory nerve in the posterior triangle of the neck results in trapezius paralysis and shoulder dysfunction. The most common etiology is iatrogenic and has been reported extensively in adults. We report 3 cases of spinal accessory nerve injury recognized postoperatively in children and discuss the microsurgical treatment, results, and simple strategies to avoid this complication.

The most common cause of spinal accessory nerve injury is iatrogenic and usually occurs during a lymph node or other biopsy in the posterior triangle of the neck [1-5]. The resultant trapezius paralysis disrupts scapulohumeral synchrony and manifests clinically as a loss of shoulder motion (ie, abduction), scapular winging, pain, and a functional deficit. In the pediatric population, the diagnosis remains challenging and is often delayed. Dedicated examination of scapulothoracic and glenohumeral function in children postoperatively after surgical procedures involving the posterior cervical triangle is difficult. Anatomic variations in trapezius innervation may create differences in the clinical presentation and subsequent confusion regarding diagnosis and treatment [6]. Nevertheless, even later microsurgical neurolysis and reconstruction may result in significant recovery, as demonstrated in the following 3 cases.

1. Case 1

A 15-year-old adolescent boy was evaluated for right upper extremity weakness. Six months prior he underwent a lymph node biopsy on the right neck and subsequently noted weakness. Physical examination revealed significant atrophy of the trapezius. A sharp Tinel's sign overlying a well-healed scar was present across the lower third of the sternocleidomastoid muscle. His shoulder active range of motion was limited to 70° of elevation with no external rotation. Electrodiagnostic studies were consistent with an injury to the spinal accessory nerve. Because of persistent symptoms without improvement, he underwent exploration and microsurgical neurolysis of the right spinal accessory nerve at 11 months postinjury. The nerve was found in continuity but compressed by encasement in dense scar. His postoperative course was uneventful. At 1 year after surgery he had recovered full active range of shoulder motion with some residual weakness (M4+) during athletic activities.

2. Case 2

A 10-month-old male infant was seen 5 months after surgery in the right posterior triangle of the neck for drainage of an apparent infection. Subsequently, the child was noted to have persistent limitations of shoulder motion on the right side. Physical examination revealed a hypertrophic scar in the right neck crossing the lower third of the sternocleidomastoid muscle and marked atrophy of the trapezius. Active shoulder

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elevation was limited to 90° with obvious scapular instability. The child underwent operative exploration of the spinal accessory nerve. A complete transection was found with extensive neuroma formation. After resection of the neuroma, the defect was repaired using a 3.5-cm reversed cervical plexus sensory nerve graft. At 2 years postoperatively, the child had recovered essentially full shoulder elevation (180°) and active external rotation (90°). There was persistent mild scapular instability (winging) but progressively increasing bulk and strength (M4+) to the trapezius.

3. Case 3

A 12-year-old boy was seen for left upper extremity symptomotology with marked left shoulder pain and limitation of active shoulder motion. Six months prior he had undergone surgery for a recurrent cystic hygroma in the left neck. Obvious left trapezius atrophy and a local Tinel's sign were present at the initial examination. He also had marked limitation of active shoulder movement and was unable to abduct actively past 70°. In addition, anesthesia in the distribution of the greater auricular nerve was noted on initial examination. Electrodiagnostic studies confirmed the presence of a spinal accessory nerve injury. Nine months after the injury he underwent surgical exploration. Complete transection of both the spinal accessory nerve and the greater auricular nerve was found. The spinal accessory nerve was reconstructed after neuroma resection using a 4-cm reversed sural nerve graft. At the last follow-up 2 years after surgery, the child demonstrated almost full active shoulder elevation (175°) and full external rotation. He continues to undergo physical therapy for residual mild atrophy and weakness (M4+) of the trapezius muscle.

4. Discussion

Iatrogenic injury to the spinal accessory nerve is well described in the literature. It is generally associated with the biopsy of a mass or lymph node in the posterior triangle of the neck, but has also been reported after radical neck dissection and penetrating trauma [1-4]. In adults, the injury is usually recognized in the early postoperative period by shoulder pain and dysfunction of active shoulder motion. The literature strongly supports the benefits of early surgical intervention with primary repair or reconstruction [7,8].

Management of these injuries has received little attention in children. In this population, and in the cases presented, spinal accessory nerve injury may not be recognized early and the presentation for treatment is often later. In the presented cases, the mean time to surgical exploration was 8 months (range, 5-11 months) after the causative surgical procedure. Nevertheless, an excellent outcome was achieved with either microsurgical neurolysis performed when intraoperative neurophysiologic findings were consistent with a lesion-in-continuity (ie, stimulation causes contraction of the trapezius) or neuroma resection and nerve graft reconstruction, as indicated by operative findings (ie, lesion-in-continuity without evidence of stimulated nerve action potential or complete transection).

Avoidance of this injury in children should always be possible. A thorough understanding of the complex regional anatomy of the posterior cervical triangle is paramount (Fig. 1). The spinal accessory nerve traverses the jugular foramen and emerges from the posterior border of the sternocleidomastoid into the posterior triangle of the neck. Kierner et al [9] demonstrated that the spinal accessory nerve can be identified on the posterior border of the sternocleidomastoid muscle approximately 8 cm cranial to the clavicle. The nerve enters the posterior triangle of the neck dorsal to the sternocleidomastoid in approximately one third of specimens and through the muscle in two thirds of cases. Within the floor of the posterior cervical triangle and along the levator scapula, its course is oblique and superficial just deep to the cervical fascia toward the anterior border of the trapezius. The sensory branches of the greater auricular and transverse cervical nerves are derived from the cervical plexus. The greater auricular nerve and the superficial cervical vein, a branch of the external jugular vein, may both be used as anatomical landmarks for identifying the accessory nerve in this region [10-12]. The spinal accessory nerve may be identified just behind the greater auricular nerve at the posterior edge of the sternocleidomastoid muscle [10]. In addition, a recent cadaveric study performed by Shiozaki et al [12] demonstrated that the nerve lies slightly superior to the superficial cervical vein along the anterior margin of the trapezius. The course of the spinal accessory nerve may also be approximated along a line from the transverse process of C2 palpated deep to the sternocleidomastoid to the tip of the shoulder.

Motor innervation patterns of the trapezius remain variable. Soo et al [10] have previously described contributory motor innervation to the trapezius from the cervical plexus (ie, C2 and C3) via the spinal accessory nerve. Dailiana et al [13] observed direct innervation of the trapezius by cervical plexus branches in 25% (5/20) of cadaveric specimens and connections between the cervical plexus and the spinal accessory nerve deep to the sternocleidomastoid in 19 dissections. Kierner et al [14] reported that the nerve supply to the descending part of the trapezius always consisted of a single fine branch of the spinal accessory nerve, whereas the transverse and ascending parts of the trapezius were innervated by both the spinal accessory nerve and trapezial motor branches of the cervical plexus. Shiozaki et al [12] recently identified 3 patterns of accessory nerve innervation of the sternocleidomastoid muscle and 5 types of trapezius innervation derived from the main trunk and a variable number of branches of the accessory nerve. As the relative contributions to the innervation of the trapezius vary,

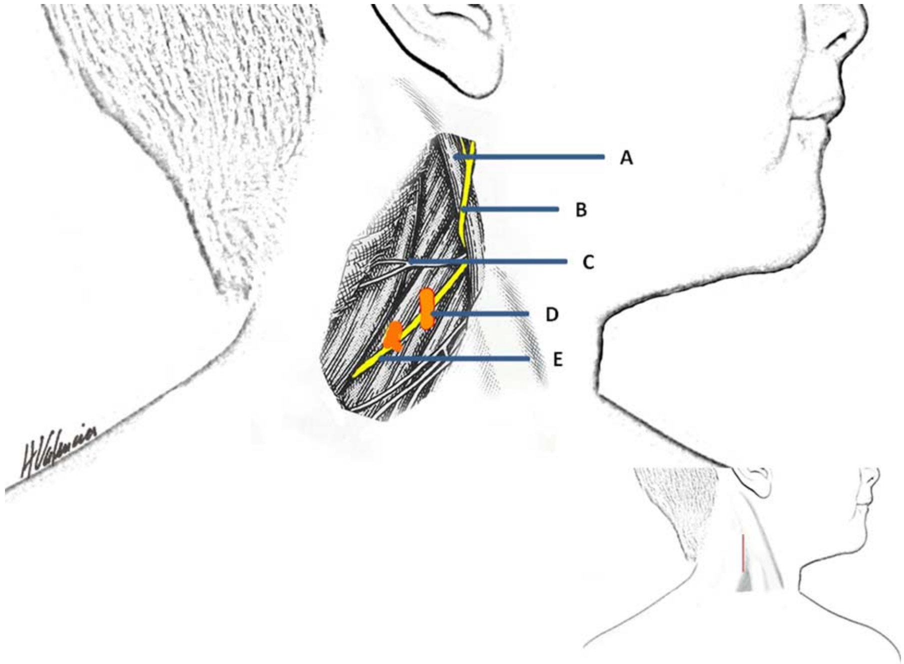

Fig. 1 Suggested incision (lower right) and identification of important local anatomy: (A) sternocleidomastoid muscle, (B) greater auricular nerve, (C) cervical plexus sensory branches, (D) posterior triangle lymph node, and (E) spinal accessory nerve.

symptomatology in the setting of spinal accessory nerve palsy may vary.

Based on a careful analysis of the operative records of the 3 reported cases and review of the literature, several strategies for prevention are suggested. First, because of the small size of the nerve, the use of loupe magnification is warranted. Second, the incision must be adequate to allow direct visualization of the nerve. Usually, a transverse lesion is made over the target mass in the posterior triangle of the neck, within a skin crease for aesthetic reasons. A safer approach is via a short incision paralleling the posterior border of the sternocleidomastoid muscle. This allows identification and direct visualization of both the greater auricular nerve and spinal accessory nerve. The latter can then be followed and protected during mass excision. Third, because the nerve is often adherent to the lymph node being biopsied, confirmation of the nerve using a nerve stimulator and distinguishing the spinal accessory nerve from adjacent cervical plexus sensory nerves is critical. This is greatly facilitated using the above-described incision. It should be noted that in the senior author's (JAIG) experience using an extended version of this incision in more than 300 brachial plexus explorations in infants, no requests have been made for a scar revision. Finally, within 1 week after the procedure the child should be specifically examined to confirm the integrity of the spinal accessory nerve by examining scapulothoracic and glenohumeral motion. Given the differential functional roles of the upper, middle, and lower trapezius, each should be isolated during physical examination by examining shoulder shrug, medial scapular adduction, and scapular rotation with active glenohumeral abduction, respectively. It is important to recognize that satisfactory shoulder elevation may still be present as the upper trapezius remains innervated through cervical plexus branches [10,11]. Obviously, this can be difficult in small children. The strength of shoulder abduction beyond 90° must be specifically assessed as the serratus anterior and levator scapula contribute to scapular rotation and shoulder elevation below the horizontal plane. Subjective complaints of periscapular and arm pain as well as occipital and posterior neck discomfort are common after accessory nerve injuries [3], but difficult to ascertain in the pediatric population.

Parents should be advised of the possibility of this complication preoperatively. Early nerve exploration is warranted in the presence of dense paralysis, when the clinical exam fails to improve and/or there is no electrodiagnostic evidence of recovery (ie, reinnervation) within 4 to 6 months of the injury. With these indications, surgical options include neurolysis for lesions-in-continuity or neuroma resection and microsurgical repair (end-to-end if tension free), or neuroma resection with nerve graft reconstruction (cervical plexus or local or sural nerve). Although operative intervention may be most efficacious within 3 months of injury, even later microsurgical neurolysis and reconstruction may result in significant recovery as demonstrated in these cases.

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