Acutely reconstructed isolated supraclavicular brachial plexus injury caused by a chainsaw

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Lacerations to the brachial plexus are rare. The author describes a case involving a man who sustained a chainsaw wound to the neck with isolated injury to the proximal part of the upper trunk of the brachial plexus. The patient underwent acute surgical exploration. After resection of the lacerated ends of the nerve stumps, four nerve grafts from the sural nerve were used for the reconstruction. Reinnervation was successful and the patient was able to abduct his arm (Medical Research Council 5 of 5) and flex his elbow (Medical Research Council 4 of 5) to its full range, within 24 months.

Key Words: *Brachial plexus injury; Chainsaw injury; Nerve graft*

The typical brachial plexus injury is a closed high-velocity stretch trauma. Open injuries are less common and usually it is the infraclavicular segments that are damaged by sharp objects such as knives or glass pieces. Open injuries of the supraclavicular parts of the brachial plexus are very rare in civilian surgery and are usually caused by stab or gunshot wounds (1). Furthermore, open nonfatal chainsaw injury to the neck is exceedingly rare, with only sporadic cases reported previously in the English literature (2,3).

CASE PRESENTATION

A 60-year-old right-hand-dominant man was sawing wood with a chainsaw in his outhouse. He did not appreciate the height of the ceiling and when he straightened from his working position, the chainsaw struck the ceiling and kicked back against his left collar bone. He sustained a laceration to the left supraclavicular area with immediate onset of left upper limb palsy.

He was transferred to the nearest hospital for exploration of the wound due to suspicion of a vascular injury; however, due to the upper limb weakness, he was instead transferred to the care of a specialist peripheral nerve surgeon for exploration and repair. The surgery was performed at the Department of Neurosurgery, Hospital Kralovske Vinohrady (Prague, Czech Republic).

Preoperative examination

On examination, there was a 10 cm wound from the superior aspect of the sternum medially, extending through the medial aspect of the left clavicle and ending in the trapezius muscle laterally. A neurological assessment of his upper limb revealed a palsy involving the upper trunk of the brachial plexus. Clinically, he was unable to abduct his shoulder due to paralysis of the supraspinatus and deltoid muscles. The elbow flexors (biceps and brachialis muscles) and external rotators of the shoulder (infraspinatus and teres minor muscles) were also all paralyzed (all muscles Medical Research Council [MRC] grade 0). All other movements were normal. Light touch sensation was reduced in C5 and completely absent in the C6 dermatome. Peripheral pulses were normal in the limb and there was no significant hematoma in the neck. The wound was clean. The patient consented to surgical exploration and possible sural nerve harvesting for nerve grafting.

Operative technique

The patient was given antibiotics and, under general anesthesia and while supine, the wound was extended posteriorly to the total length of 15 cm. The wound was irrigated with a solution of povidone-iodine and hydrogen peroxide. The large neck vessels and phrenic nerve were intact. A laceration of the cranial part of the upper trunk of the brachial plexus (corresponding to the C5 root) was found just laterally from the scalene muscles. The suprascapular nerve was found to be intact. Under the microscope, the lacerated ends of both proximal and distal stumps were cut until the intact fascicular structure was reached. The resulting gap was 15 mm in length. Nerve stimulation of the distal stump confirmed contraction of the deltoid and biceps muscles. The sural nerve was harvested from right calf and the upper trunk was reconstructed by four cable nerve grafts using perineurial 10/0 nylon suture and fibrin glue.

Postoperative examination

The patient was hospitalized for one week with the arm fixed in shoulder adduction and elbow flexion while taking antibiotics. The arm remained immobilized for three weeks; thereafter, daily rehabilitation of the denervated muscles using electrostimulation was recommended. He received periodic electrophysiological examinations using electromyography and was clinically examined using the MRC muscle grade score.

The first electrophysiological signs of reinnervation was observed in the supraspinatus and deltoid muscles at three months postoperatively and improvement in shoulder abduction began nine months postoperatively (MRC scores: supraspinatus 3 of 5; deltoid muscle 2 of 5). The muscle strength of elbow flexors was MRC 1 of 5 at this time. The follow-up period was 24 months.

During the last examination, the patient was able to abduct his arm and flex his elbow to their full range of movement, and muscle strength of the deltoid and the supraspinatus muscles was MRC 5 of 5 and the elbow flexors (brachialis and biceps muscle) MRC 4 of 5. Electromyography results indicated good reinnervation.

DISCUSSION

Open wounds of the brachial plexus are significantly less common than closed traction injuries. Narakas (4) found only five cases (0.5%) from a total of 1068 patients treated over an 18-year period in Switzerland and Songcharoen (5) only 4.3% from total of 1173 cases operated on in Thailand. Research undertaken for the present case report found 29 of

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441(6.6%) patients operated on in the Czech Republic during 18-year period had open wounds of the brachial plexus. Open injuries included 23 cut or stab wounds, five iatrogenically caused lesions and one gunshot wound. In all cases, only infraclavicular elements were damaged (6). However, these injuries appear to be more frequent in the United States according to results of the study published by Kim et al (1), who operated on 118 gunshot wounds (12%) and 71 lacerations (7%) of total 1019 brachial plexus surgeries. Although they described chainsaw injury as a cause of some brachial plexus lacerations, they did not specify either the number of such cases or the injury level (supra- or infraclavicular).

Chainsaw kickback is the reactive force that can occur when the tip of the guide bar comes into contact with a relatively massive or immovable object with chain under power. The chain may jam hard into the wood and hurl the bar upward toward the operator. These injuries occur most typically in upper (36%) and lower limbs (43%) and head (9%). The neck is affected less frequently, but in such cases have a worse prognosis or end fatally due to common vascular or airways injuries (7). We found only three cases of nonfatal neck injury caused by a chainsaw in the English literature (2,3,8).

Every open wound in the neck area should be explored as soon as possible due to high risk of hidden large vessel trauma, such as a small rupture or pseudoaneurysm formation (9), in contrast to closed brachial plexus injuries (10). Immediate nerve repair is controversial. Generally, contaminated open injuries such as gunshot or bite wounds should be explored, disinfected and loosely closed with a drain, and delayed revision after antibiotic therapy should be performed two to three weeks after initial trauma (9). Chainsaw wounds are characterized by one main cut with multiple smaller adjacent cuts. These parallel cuts vary in depth, resulting in tissue loss, surface abrasions and incisions in the affected tissue. The depth of the main wound varies significantly depending on the duration and force of the saw, and the width of the cuts varies with the lateral motion of the saw. The wound can be contaminated with wood chips, bark, oil, grease, bacteria and fungi (7). In our patient, however, the only wound was clean and the cut was straight without extensive skin laceration. There are some advantages to early intervention: the anatomy is easier to identify; the length of the nerve is not lost due to retraction; concomitant scarring of surrounding tissues is not present; and the acute primary repair results is one of the best in brachial plexus injury even for elements generally viewed as unfavourable for repair. In contrast, the delayed graft repair in patients with blunt trauma has only 45% success rate (9). Therefore, in the present case, after cutting the lacerated ends of the nerve stumps until visible fascicular structure, it was decided to directly perform reconstruction by nerve grafts.

The only similar case report published by Demuynck and Zuker in 1995 (8) described a young man presented with C4 and superior trunk transection and scapular nerve avulsion after chainsaw injury. In their case, the C4 root and superior trunk were repaired by direct suture and the suprascapular nerve was reinserted to the supraspinatus muscle two weeks after trauma. The deltoid muscle and elbow flexors regained good muscle power (MRC grade 4 to 5).

CONCLUSION

Every open wound in the neck area should be explored acutely due to high risk for large vessel trauma. When the injury presents with a straight cut and clean wound, the nerve injury can be reconstructed after thoroughly disinfecting and cutting the contused ends of the nerve stumps in one stage.

DISCLOSURES: None to report.

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