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Case Report

Direct electrical injury to brachial plexus

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ABSTRACT

Electrical current can cause neurological damage directly or by conversion to thermal energy. However, electrical injury causing isolated brachial plexus injury without cutaneous burns is extremely rare. We present a case of a 17-year-old boy who sustained accidental electrical injury to left upper extremity with no associated entry or exit wounds. Complete motor and sensory loss in upper limb were noted immediately after injury. Subsequently, the patient showed partial recovery in muscles around the shoulder and in ulnar nerve distribution at 6 months. However, there was no improvement in muscles supplied by musculocutaneous, median and radial nerves. On exploration at 6 months after trauma, injury to the infraclavicular plexus was identified. Reconstruction of musculocutaneous, median and radial nerves by means of sural nerve cable grafts was performed. The patient has shown excellent recovery in musculocutaneous nerve function with acceptable recovery of radial nerve function at 1-year post-injury.

KEY WORDS

Brachial plexopathy; brachial plexus injury; electrical injury

INTRODUCTION

Electrical injuries account for approximately 3% of burn injuries.[1] Various neurological syndromes have been described after electrical injuries.[2] The brain, spinal cord and nerves may be involved.[3] Involvement of peripheral nerves is well recognised in the form of multiple mononeuropathies which are transient and reversible in most cases.[4] However, brachial plexopathy due to electrical injury is rare.[5]

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CASE REPORT

A 17-year-old male sustained high-voltage electrical injury to his left forearm due to contact with a live wire hanging from a generator van. He also sustained a laceration over the site of contact of the wire while untangling the wire. He gave no history of head injury or fall. No entry or exit wound was found. On exploration of the forearm laceration, soft tissue structures were normal. A distal third minimally displaced radius fracture was noted and

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fixed by percutaneous nailing. No other proximal fractures were found. The patient complained of loss of shoulder abduction, elbow flexion and extension and inability to extend his wrist and use his fingers, suggestive of a brachial plexopathy. Conservative management with rest to the affected shoulder and arm was instituted and patient followed up at 1 month. No corticosteroids were given. Physiotherapy was initiated and an electromyography was done which was suggestive of axonal degeneration involving median, axillary, musculocutaneous and radial nerves. Serial electromyography was performed at 8 weeks which reported no axonal regeneration. However, the patient had started regaining partial shoulder abduction, ulnar deviation of wrist and finger flexion at approximately 4 months after injury. He was posted for brachial plexus exploration at 6 months as his elbow flexion did not recover. On exploration, there was extensive damage with multiple thickened lobulations to long sections of median, musculocutaneous and radial nerves extending from their origins at the cords up to mid arm [Figure 1]. Rest of the plexus exploration was unremarkable [Figure 2]. No perineural fibrosis was noted. The surrounding tissue was surprisingly well preserved. Histopathology of the affected nerve segments showed fibrous tissue.

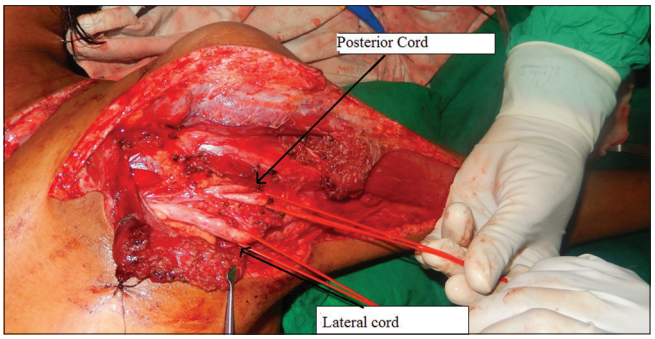

Figure 1: Intra-operative findings on exploration. Thickened lateral and posterior cords

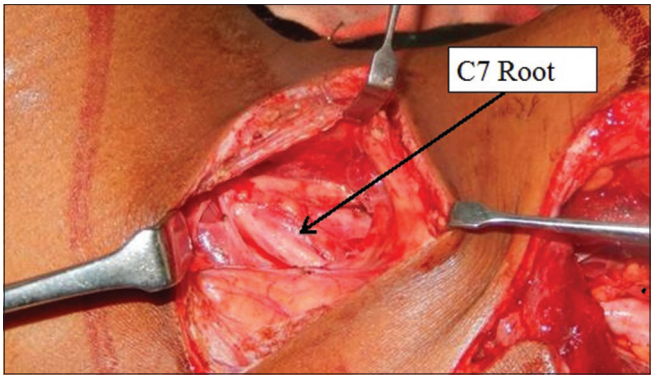

Figure 2: Intact normal C7 seen intraoperatively

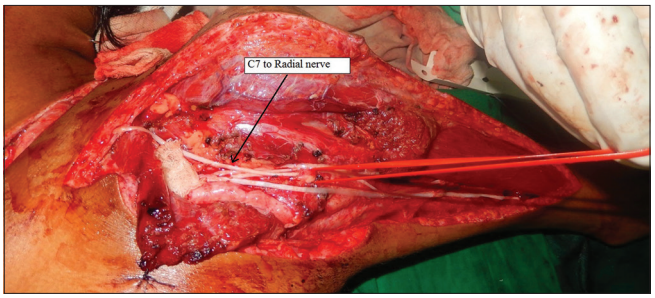

Figure 3: C7 to Radial nerve reconstructed with 13 cm long cable graft

Long Sural nerve cable grafts were harvested. A single 13 cm long nerve graft was placed between anterior division of C7 root and radial nerve at the cranial end of sternal head of pectoralis major [Figure 3]. Lateral cord to musculocutaneous and median nerve reconstruction was performed using 12 and 26 cm single long nerve grafts, respectively [Figure 4].

After post-operative immobilisation for 4 weeks, gradual physiotherapy was initiated. The patient was followed up with clinical examination regularly. At 8 months after surgery, the patient has MRC grade 3+ elbow flexion and 2+ elbow extension and 3+ ulnar finger flexion with almost no recovery of median supplied muscles. At 1-year follow-up, there is MRC grade 3+ power in pronator of the wrist and MRC grade 3 power of the finger flexors except the index finger. Extension at wrist and fingers is absent for which wrist fusion and tendon transfer are planned.

DISCUSSION

Electric current can damage nerve tissue by direct effect or Joule heating. Joule heating causes protein denaturation leading to burns.[6,7] However, no cutaneous burns were noted in this case. Direct effect of current is more complex and leads to disruption of the lipid bilayer of cell membrane which is electric field driven, leading to loss of integrity of cell membrane and hence cellular lysis.[8] Nervous tissue has lower resistance to electricity compared to other tissues. This explains the high incidence of neurological findings in electric injuries.[9] Direct current in addition to causing myelin degeneration also causes microvascular damage and thrombosis to vasa nervosa, resulting in intraneural fibrosis as seen in our case.[10] The most common neurological feature following high-voltage electric trauma is unconsciousness which is seen in 21%–67% of patients. Peripheral neuropathies are also common, seen in approximately 17% of patients.

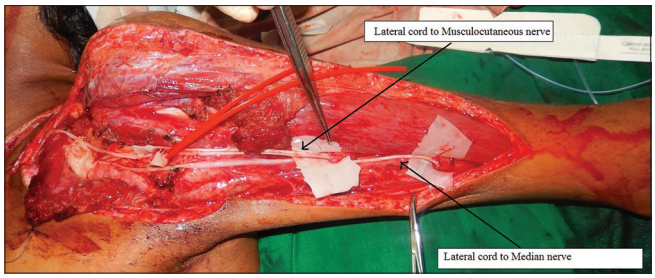

Figure 4: Long nerve grafts from lateral cord to musculocutaneous and median nerves

However, brachial plexopathy is extremely rare, reported in less than a handful of cases.[5] Recovery of neurological deficits is reversible in most cases, rarely progressive and permanent. Recovery is hypothesised to occur by a process of lateral collateralisation. However, in our case, although complete recovery occurred in the ulnar nerve and axillary nerve; no recovery was noted in the musculocutaneous, median and radial nerves;, Hence surgical intervention was warranted. Another interesting point is that despite usage of long nerve grafts in excess of 10 cm for intraplexal reconstruction, we achieved reasonably good function of musculocutaneous and radial nerves. Contrary to all, evidence including patient's deposition regarding his modality of injury the possibility of a strong mechanical force causing infraclavicular brachial plexus injury and fracture of the radius cannot be ruled out.

CONCLUSION

High-voltage electrical injury can have a wide variety of early and late neurological presentations including brachial plexus palsy rarely. In our case which presented with a global palsy initially, partial recovery was seen within 3 months as described in literature; however, part of the deficit remained and required surgical intervention. Long nerve grafts used for reconstruction of damaged brachial plexus can give reasonable results.

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Conflicts of interest

There are no conflicts of interest.

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