CASE REPORT

Carpal tunnel syndrome following an electrical injury in a child

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SUMMARY

Carpal tunnel syndrome (CTS) is very rare in children and has been reported very infrequently in the literature. We present an unusual case of CTS in a 14-year-old girl who developed this following an accidental electrical shock. As far as we are aware, this is the first case report of CTS in a child following electrical injury. This rare complication of electrical injury can easily be disregarded or misdiagnosed as neuropraxia, and this can delay appropriate treatment, as evidenced by this case. We propose that CTS should be considered when instigating initial medical care after an electrical injury, and that a referral to a hand surgeon should not be delayed, as these children need urgent surgical intervention to preserve hand function.

BACKGROUND

Carpal tunnel syndrome (CTS) is a treatable condition that needs timely intervention. Children usually present to paediatricians following electrical injuries and, as CTS is not a well-recognised entity, the symptomatology is very likely to be mistaken for a median nerve neuropraxia. This may delay treatment and result in permanent loss of hand function and sensation.¹

This case is a reminder that children with electrical injuries need evaluation for CTS and an early referral to hand surgeons for appropriate timely intervention must be made.

CASE PRESENTATION

A 14-year-old girl presented to the paediatric accident and emergency department having experienced an accidental electrical shock that had resulted from touching a phone charger and an electrical socket with wet hands. She was immediately thrown backwards onto her bed. She had not sustained any obvious injuries and had retained consciousness throughout the entire incident.

On presentation to the department she was alert, orientated and clinically well. Initial examination of the patient focused on ruling out common complications such as compartment syndrome, burns, fractures and arrhythmias. She reported discomfort, paraesthesia and twitching in her right thumb and index finger. She was considered to have neuropraxia involving the median nerve and was admitted to the paediatric ward for observation and consideration of discharge the following day.

However, her right hand continued to cause her some discomfort, and a detailed neurological review by a senior paediatrician revealed that the patient was unable to make a fist, finger pinch, or flex her

right wrist, and sensation was slightly reduced over the median nerve distribution. Therefore, she was referred to the hand surgeons 24 h after her admission, as there were concerns about median nerve compression. On review by the surgical team, Phalen's test and Tinel's sign were positive. Their impression was that of median nerve compression requiring immediate surgical intervention. The patient underwent surgical decompression on the same day, which resolved her symptoms promptly.

INVESTIGATIONS

The diagnosis was made on clinical grounds by the paediatric team and the hand surgeons.

OUTCOME AND FOLLOW-UP

Motor function recovered in 24 h and sensory function in 48 h. At 6-month follow-up, our patient was noted to have normal hand function. She had felt occasional tingling over her right palm soon after hospital discharge but this was not a consistent feature and her clinical examination remained normal.

DISCUSSION

CTS, a collection of symptoms caused by median nerve entrapment, is a rare condition in children.²⁻⁴ Its aetiology differs from that in adults, with the majority of cases attributed to a variety of genetic conditions, such as congenital lysosomal storage diseases (mucopolysaccharidosis/mucopolipidosis) and primary familial CTS.^{3,5}

Limited case reports exist that explore the diagnosis and treatment of well-established sequelae of electrical injuries to the hand and forearm such as arrhythmias, burns and their subsequent infections, and fractures.^{6,7} However, our literature review has revealed no paediatric case studies that report the diagnosis of CTS post-electrical injury. It is acknowledged that this is a very unusual cause of CTS, and therefore this may account for the limited literature available.⁸

Electrical energy has been shown to damage tissue in many ways, either through the direct transmission of current or through electrical thermal energy (caused by current in conductive objects placed on a patient).⁸⁻¹⁰ However, its association with CTS is hypothesised to be associated with the limited amount of conductive tissue within the carpal tunnel rather than the theory of mechanical compression usually associated with CTS.⁸ This theory, therefore, encompasses the idea that the majority of the electrical energy is directed towards the median nerve. It is also theorised that the risk

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of CTS may not be dependent on the extent of damage to tissue.^{8–10} A study has demonstrated that the amount of energy needed to cause damage to the nerve may not need to be as high as to cause visible damage to the skin's surface.⁸ Furthermore, it has been demonstrated that not all patients who receive an electrical shock will necessarily develop CTS, regardless of the electrical current delivered to them.⁸ These factors all play a significant role in the difficulties of considering and diagnosing CTS post-electrical injury.

This case represents an acute CTS caused by electric trauma, and the corresponding soft tissue swelling and inflammation which is likely to have increased pressure on the median nerve within the carpal tunnel. The initial thermal trauma develops over the site with the highest electrical resistance, which is usually a bony part, followed by the soft tissue and nerves.

Regardless of the aetiology of the CTS, symptoms of CTS can be varied and unpredictable.³ The specificity and sensitivity of standard tests, such as Tinel's sign and Phalen's test, have been discussed in the literature, and no clear conclusion has been made regarding their merit.^{11–12} Additionally, the signs and symptoms of CTS can easily be mistaken for neuropraxia, as demonstrated in this case report. However, the management of these two conditions varies significantly, and so the differentiation between the two is highly important.

A study regarding CTS following burns in adults has reported that CTS does not necessarily develop immediately after an electrical injury, but rather has been shown to develop up to 5 months after the injury.³ This, therefore, highlights the importance of following up a patient who has experienced an electrical injury before excluding CTS as a complication.

A final confounding factor in the diagnosis of CTS post-electrical injury in paediatric patients is that the signs and symptoms of CTS can be mild and may not be apparent, or may not be thought worthy to report, to the child. This, therefore, is an important point to establish, as this further highlights the importance of always considering CTS post-electrical injury regardless of the reporting of symptoms.

Despite CTS being a rare complication of electrical injury in children, this case study illustrates the importance of broadening one's differentials when assessing a patient in order to instigate correct medical and surgical care in a timely fashion.

Multiple factors exist that may delay or hinder the diagnosis of CTS in a child post-electrical injury. First, the lack of known cases of CTS developing post-electrical injury and the lack of literature available may reduce the awareness of this uncommon complication of CTS in paediatric patients. Second, the lack of clear trauma in a patient may also lead to a delay in diagnosis and treatment.

Furthermore, the lack of clear and distinguishing signs and symptoms may disguise the development of CTS, especially in young children who may not be able to convey these symptoms.² These variable and vague signs can also be confused with other conditions, such as neuropraxia. Lastly, studies have shown that the onset of CTS can be delayed, so it is important that patients are followed up after discharge in order to exclude delayed onset CTS.

Through this case report we would like to convey the importance of considering CTS early in all children who receive an electrical injury, as an early referral to hand surgeons and acute surgical intervention can result in a successful recovery of movement and sensation of the hand.

Learning points

- Carpal tunnel syndrome (CTS) can occur as a result of electrical trauma.
- It is important to proactively look for signs and symptoms of CTS in children presenting to the emergency department, as timely surgical intervention will alter outcome.
- CTS can be misdiagnosed as neuropraxia and this can delay appropriate management.

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