injury produced by an adult fingernail. An open safety pin, which was impacted at the thoracic inlet, was retrieved. A similar incident occurred one month later, but the safety pin had already passed into the stomach and was subsequently voided. The mother was convicted of assault. The child subsequently had a dead ear, with loss of stapes superstructure and a fistula below the facial nerve into the vestibule.

Comment

Early detection of non-accidental injury to children depends on a high index of suspicion and the recognition of specific injuries indicating abuse. Failure to recognise and intervene in such cases may result in the escalation of injury with increasing morbidity and possibly death.³

Spontaneous haemorrhage from the ear may occur after acute otitis media, but this is normally associated with pus. Recurrent bleeding from the ear should be considered as a manifestation of abuse when no satisfactory parental explanation is forthcoming and results of coagulation studies are normal. Laceration of the anterior meatal wall and tears of the pharyngeal wall should especially arouse suspicion as these are sites that are rarely injured accidentally. It is important that these covert injuries are recognised so that the child may be protected from further serious injury.

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Diurnal variation in nerve conduction, hand volume, and grip strength in the carpal tunnel syndrome

Despite the high incidence of the carpal tunnel syndrome its pathophysiology is poorly understood. The symptoms commonly occur in the early hours of the morning, and the theories for this include redistribution of oedema at night, oedema due to compression of the axillary vein while lying on the affected side, kinking of the median nerve due to abnormal wrist positioning at night, and venous stasis leading to engorgement of synovial vessels.^{1,2} Reversible changes in conduction velocity of the median nerve have been shown with wrist flexion,³ ischaemia,⁴ and after operation to release the nerve.⁵ We carried out a study to see whether diurnal changes occur in the conduction velocity of the median nerve, hand volume, and grip strength in patients with the carpal tunnel syndrome.

Patients, methods, and results

We studied 32 hands (23 symptomatic, nine asymptomatic) in 16 patients with the carpal tunnel syndrome and five control hands. The patients were admitted to hospital overnight before undergoing routine decompression of the carpal tunnel. Conduction velocity of the median nerve, hand volume, and grip strength were measured on four occasions over 24 hours (at noon, midnight, 4 am, and 8 am). Sensory conduction velocity of the median nerve was measured at 32°C using an electromyograph and expressed as a percentage of the conduction velocity of the ulnar nerve. Hand volume was measured five times on each occasion and was averaged. Grip strength was measured three times on each occasion and the maximal value recorded. The results were analysed by analysis of variance.

All the patients with the carpal tunnel syndrome had symptoms at night. Phalen's test was positive in 16 hands and Tinel's sign occurred in 11 hands. Six patients complained of swelling of the hand at night, but no swelling was visible.

Ten of the symptomatic hands gave a positive result to Phalen's test and showed Tinel's sign: they showed a slowing in conduction in the median nerve at night of 5.62% ($p < 0.05$). Overall, the 23 symptomatic hands showed a slowing of conduction of 2.93% (not significant). The nine asymptomatic

hands and the five control hands showed no significant change in conduction velocity (figure). None of the groups of hands showed any significant change in volume over the 24 hours (the symptomatic hands showed a decrease of 1.8% at midnight and the control hands an increase of 2.55% at 4 am). Grip strength was significantly reduced in all three groups at night ($p < 0.05$)—by 14.3% in the symptomatic hands, 28.6% in the asymptomatic hands, and 17% in the control hands—but there was no significant difference between the groups.

Percentage change in median nerve conduction velocity with time in hands of patients with the carpal tunnel syndrome (○ = symptomatic hands, ● = symptomatic hands giving positive result to Phalen's test and showing Tinel's sign, △ = asymptomatic hands) and in controls (□).

Comment

Evidence suggests that the median nerve may be ischaemic in patients with the carpal tunnel syndrome.⁴ Reversible changes in nerve conduction have been shown to occur.³⁻⁵ The evidence presented here shows that a significant slowing of conduction in the median nerve occurs at night in patients whose symptoms are easily reproducible by local pressure over the median nerve. The nerve in these patients is probably more sensitive to small changes occurring in the carpal tunnel, and this leads to a transient ischaemia of the nerve.

The widely held concept that redistribution of oedema at night produces swelling of the hands and nocturnal symptoms¹ is not supported by our findings. The feeling of swelling often accompanies the other symptoms of pain, paraesthesiae, and numbness and probably reflects altered conduction in the median nerve producing the sensation that the hand is swollen. The absence of demonstrable swelling at night makes the use of diuretics questionable in "idiopathic" carpal tunnel syndrome. Some patients complain of weakness of grip on waking at night. Weakness does occur, but no more so than in normal subjects, and it is probably due to the patient waking at an unaccustomed hour at night.

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