

Late Compartment Syndrome of the Hand Due to Wasp Sting in a Child

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We report a 6-year-old girl, with no history of previous anaphylactic reaction, who sustained a wasp sting to the volar aspect of her left hand. The child did not present any symptoms at the beginning. She was first examined at the emergency department with developed compartment syndrome, after more than 24 hours later and she was urgently taken to the operating theatre. The midpalmar, thenar, and hypothenar spaces were decompressed, and the transverse carpal ligament was released. At the 11-month followup, she presented with normal function of the hand and normal 2-point discrimination in all fingers. Although the accurate mechanism of the development of compartment syndrome after a wasp sting in children is not thoroughly clear, the treatment seems to be the same as in all other cases of compartment syndrome; urgent fasciotomy. It is very important to keep in mind the possibility, even if it is extremely low, of compartment syndrome after a wasp sting in children; even of those with no history of anaphylactic reaction. (Journal of Surgical Orthopaedic Advances 20(3):202–205, 2011)

Key words: Wasp Sting, Child, Compartment Syndrome, Hand

Compartment syndrome occurs when the interstitial tissue pressure increases within an enclosed fascial envelope, preventing adequate tissue oxygenation and can result in tissue damage and difficulties with circulation. It can occur in many locations, including the hand, forearm, upper arm, lower leg, thigh and buttocks (1). The most common cause is trauma (e.g., fractures, soft tissue injuries, arterial injury, prolonged limb compression and burns) (2), but exercise-induced edema (3), bleeding (4), and infection (5) have also been described.

Although adults are more commonly diagnosed with compartment syndrome numerous pediatric cases have been reported. Previous studies have described various reactions to hymenopteras' sting (6) but according to our knowledge this is the first reported case of compartment syndrome associated with a wasp sting in the hand of a child with no history of anaphylactic reaction. In this case the symptoms established after more than 24 hours later. The parents of the child were informed that data concerning the case would be submitted for publication.

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Case Report

A 5-year-old girl presented to the emergency department on the 18th of October 2008 for evaluation of a swollen and painful left hand. According to her parents she was stung by a wasp in the volar aspect of her left hand 24 hours ago. She did not develop immediate symptoms but on presentation the hand was grossly swollen (Fig. 1), erythematous and very painful. The child was unable to move the wrist and the fingers because of pain, but she could easily move her elbow and ipsilateral shoulder. There was no visible puncture bite on the hand. On physical examination the hand was exquisitely tender to palpation and all compartments of the hand were firm. There was excessive pain on passive flexion and extension of the fingers and wrist, as well as loss of sensation at the dorsal and volar aspects of the hand. Her vital signs were blood pressure 125/85 mm Hg, pulse rate 81 beats/min, respiratory rate 15 breaths/min, temperature 36.40°C (97.50°F) and oxygen saturation 98%.

Based on the clinical symptoms, compartment syndrome was diagnosed and right after the informed consent that had been obtained, immediate fasciotomies of the hand were carried out. During narcosis and without tourniquet control, the compartments of the hand were exposed. Dorsal fasciotomies of the intermetacarpal spaces as well as decompression of the midpalmar space were carried out by two small longitudinal incisions at the middle of the dorsal aspect of the second and fourth metacarpals (Fig. 2A). An incision was performed at the radial aspect of the first metacarpal for the thenar muscles (Fig. 2B) and an additional incision at the ulnar aspect of

the fifth metacarpal for decompression of the hypothenar space (Fig. 2C). Finally the transverse carpal ligament and the palmar aponeurosis at the level of the third intermetacarpal space were dissected up to the distal palmar crease in order to perform carpal tunnel decompression (Fig. 2B). The wounds were left open and dressed with moist sterile gauze. Three doses of intravenous antibiotics were given to the patient postoperatively for prophylaxis.

During the next days, the patient's symptoms improved but due to the persistent edema, definitive wound closure was decided on the eighth postoperative day. The patient was discharged in stable condition on hospital day 10 with minimal swelling and good range of motion of the wrist and fingers.

At 11-month followup, there was complete functional recovery without any deficit regarding the sensation of the hand. The girl had returned to all normal activities without any restriction. The surgical incisions were hardly visible (Fig. 3).

Discussion

Insect stings are a common event and are responsible for severe systematic hypersensitivity reactions in 2% to 3.5% of the general population (7). Insect stings are mainly associated with local reactions of various sizes, being characterized by pain, swelling and redness at the site, usually last 1 to 2 days and resolve with simple treatment measures. Large local reactions, which affect 10% to 15% of adults are considered to be late-phase manifestations of IgE-mediated hypersensitivity, may involve the whole extremity and may last up to a week (8). More serious systematic reactions occur in 0.4% to 0.8% of children and 3% of adults (8).

Unusual or unexpected reactions have occurred in a temporal relationship following insect stings (6) but according to our knowledge, compartment syndrome of

the hand caused by a wasp sting to a person with no previous allergic reactions has not been reported. Lately, Sawyer et al, reported the case of a 5-year old boy with a history of allergic rhinitis who presented with acute compartment syndrome of his hand after a wasp sting (9).

These rare reactions include neurologic (acute disseminated encephalomyelitis, demyelinating disease, cerebral infarction, Guillain-Barre syndrome, myasthenia gravis, peripheral neuritis) (10), renal (acute renal failure, nephrotic syndrome) (11), cardiac (silent myocardial infarction, cardiac arrhythmia, atrial fibrillation) (12), pulmonary (alveolar hemorrhage) (13), ocular dysfunctions (corneal decompensation, cataracts, conjunctivitis, lens abscess, optic neuropathy) (14), as well as rhabdomyolysis (15), thrombocytopenic purpura (16), and Fisher's syndrome in children (17).

In our patient, compartment syndrome developed after a wasp sting which belongs to the Hymenoptera order. The families of stinging insects in the order Hymenoptera are Vespidae, Apidae and Formicidae. Wasps, yellow jackets and hornets belong to the same family, the Vespidae family; honeybees belong to the Apidae family; and stinging ants to the Formicidae family (18).

The accurate mechanism of the development of compartment syndrome following a wasp sting is poorly clear. Its venom is composed of melittin, iminime, phospholipase A and B, apamin and acid phosphatase. Melittin, phospholipase A and phospholipase B cause cell lysis while acid phosphatase and iminime may cause allergic reactions (19). Hymenoptera venoms contain peptides, proteins, and vasoactive amines including acetylcholine, norepinephrine, histamine, dopamine and 5-hydroxytryptamine that are responsible for venom toxicity (18, 20).

Apamin is an extremely potent neurotoxin which acts by blocking Ca^{+2} dependent K^{+} channels in the brain and spinal cord. It is a potent convulsant and also induces motor hyperactivity. Allergic reactions occur by way of a type-I hypersensitivity reaction mediated by IgE with

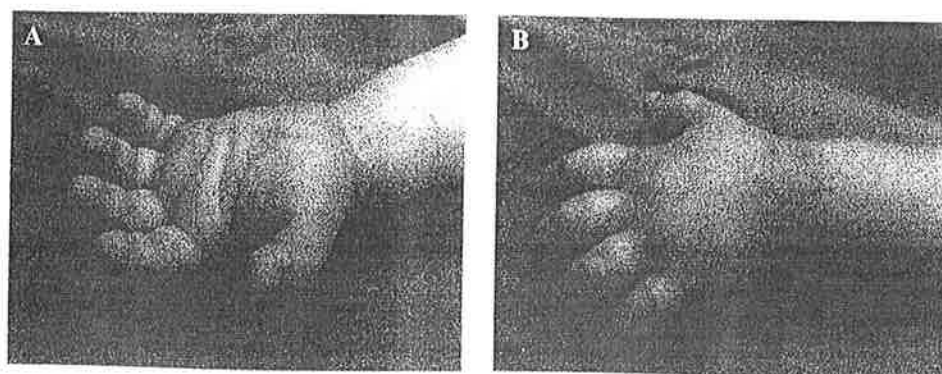


FIGURE 1 The hand 24 hours after the wasp sting in the operating theatre, extremely swollen with edematous tissues, just before surgery (A, volar aspect; B, dorsal aspect).

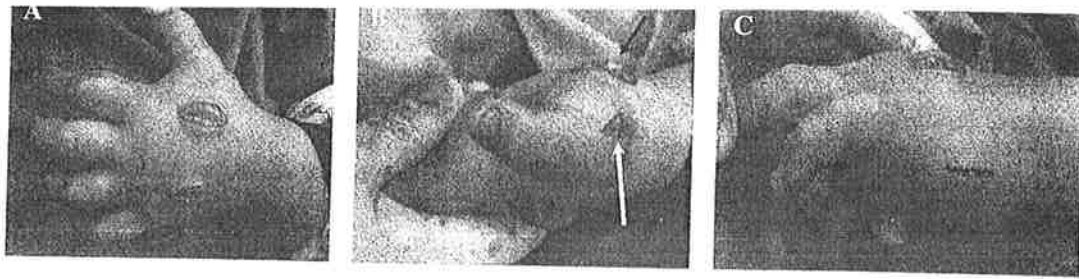


FIGURE 2 A, Dorsal fasciotomy of the first, second, third, and fourth intermetacarpal spaces with concomitant decompression of the midpalmar space was performed with two incisions on the dorsum of the second and fourth metacarpals. B, A small incision on the radial aspect of the thenar and carpal tunnel respectively. C, The hypothenar space was decompressed through an incision at the ulnar aspect of the fifth metacarpal.

release of chemical mediators of inflammation. Individuals with mastocytosis and a high level of tryptase are susceptible to severe allergic reactions from Hymenoptera venom. Consequently, Hymenoptera venom can induce mast cell release by Ig-E independent mechanisms. Moreover, Hymenoptera venom compounds act as strong sensitizers in the general population (21). Saravanan et al (22), described two patients with claw hand as a result of a bee sting. Both patients were treated conservatively with full resolution within 48 hours, without any lasting effects. The authors hypothesized that this was caused by the apamin which has an effect on the upper limb, spinal cord and peripheral nerves and they concluded that is important to recognize that the claw hand is not due to the compartment syndrome.

Taking into consideration the large number of people who are stung by wasps annually, it is rather interesting to describe such a reaction; a compartment syndrome to a child with no history of previous allergic reaction. Although it is of high interest, our patient had no clear explanation for developing compartment syndrome. The

most probable mechanism is that the release of inflammatory factors and immune mediators by the wasp venom might increase the capillary permeability that caused the edema within the compartments of the hand.

It is widely accepted that the key to successful treatment of acute compartment syndrome is early diagnosis and decompression of the affected compartment (1, 2). The classical signs and symptoms can be unreliable in an often scared, uncooperative, irritable and uncomfortable child. It is well known that the measurement of the intracompartmental pressure (23) is the most reliable method for the diagnosis of acute compartment syndrome. In our case, measurement of the intracompartmental pressure was not performed due to the fact that the appropriate device was not available at the A+E department.

The outcome for compartment syndrome in adults is poor. Late diagnosis increases the risk for severe complications, including infections, neurologic injury, need for amputation and death (24).

Despite the likely delayed presentation, our patient recovered fully. Such a recovery has been reported

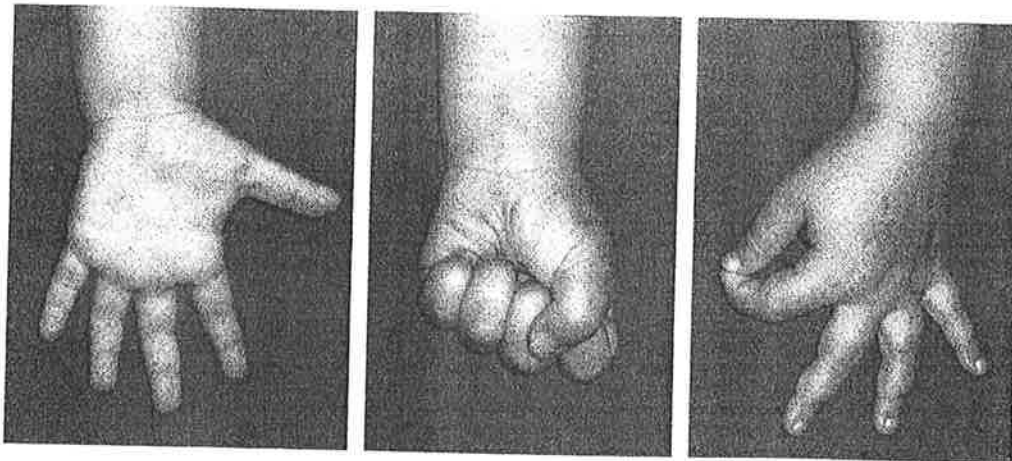


FIGURE 3 At the latest followup, the child presented with normal function of the hand. No limitation was recorded regarding the range of motion of the MTP and IP joints.

following compartment syndrome of the hand in children even after delayed presentation (25). The potential for recovery of muscle function may be greater in children than in adults. This is consistent with the increased ability for recovery observed in other types of injuries in children, such as fractures, traumatic head injuries and articular cartilage injuries (26).

Conclusion

Acute compartment syndrome is one of the most challenging diagnostic problems in orthopaedic surgery and can be caused by a myriad of circumstances with potentially devastating consequences. The presented case is extremely rare for three reasons: the compartment syndrome constitutes a relatively rare situation in childhood, it was caused by a wasp sting, and the symptoms appeared 24 hours later, but the rarity is not an excuse for the pediatric orthopaedic surgeon who is obliged to diagnose and operate urgently on a compartment syndrome. Otherwise the consequences may be disastrous and may influence the function of the hand and the future of the child. Surgeons always have to be aware of the eventuality of a compartment syndrome due to the broad variety of possible rare etiologies like a wasp sting. The potential for recovery after compartment syndrome may be greater for children than adults.

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