

Chemical necrotising fasciitis secondary to self-injection of permethrin insecticide

自我注射氯菊酯殺蟲劑導致化學性壞死性筋膜炎

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We report a 65-year-old male with chemical necrotising fasciitis after self-injection of permethrin insecticide. The patient also developed persistent hypoglycemia secondary to massive insulin overdose. There was no evidence of systemic toxicities from the insecticide poisoning. Multiple debridement and skin grafting were performed over his right forearm due to extensive tissue damage. He eventually recovered with impairment of his right hand function. The clinical features and the management of this uncommon route of insecticide poisoning are discussed. (Hong Kong j.emerg.med. 2011;18:441-445)

我們報告一例65歲男性自我注射菊酯殺蟲劑後的化學性壞死性筋膜炎。病人還因為大量的胰島素過量，同時也有持久性低血糖。病人沒有殺蟲劑全身性中毒的毒性特徵。他的右前臂由於有廣泛的組織損傷，需要進行多次清創，植皮手術。他最終痊癒，但右手功能受損。我們對本例罕見的殺蟲劑中毒路徑的臨床特點和處理進行了討論。

Keywords: Insecticides, necrotizing fasciitis, poisoning, pyrethrins, suicide

關鍵詞：殺蟲劑、壞死性筋膜炎、中毒、除蟲菊酯、自殺

Introduction

Permethrin belongs to the group of type I synthetic pyrethroids and is a registered pesticide in Hong Kong. Permethrin is available in different formulations including liquid form, wettable powder and granule.

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There are locally registered pesticide products containing mixture of permethrin with other insecticides, e.g. piperonyl butoxide and tetramethrin. Insecticide products containing permethrin is commonly available in agricultural product shops. The usual concentration of permethrin available is 10% while the maximum concentration of registered products in liquid form is 25%¹ and hydrocarbons are usually used as solvent. Injections of hydrocarbon-based insecticides have been reported to cause severe tissue damages and systemic complications.

Case

A 65-year-old man, who had diabetes mellitus, hypertension, and past history of drug overdose, was admitted after suicidal attempt with self-injection of 800 units of Protaphane HM and small amount of insecticide (containing 10% Permethrin) over his abdominal wall and his right hand in May 2010. The bottle of insecticide was brought to the emergency

department (ED) and the total volume of insecticide being injected was around 10 ml. Moreover, he also claimed to have an overdose of unknown amount of gliclazide and metformin.

He presented to the hospital around 7 hours post-exposure with symptoms of hypoglycaemia. On arrival to the ED, the haemostix level was only 2.6 mmol/L. His blood pressure was 177/70 mmHg with pulse rate 88 beats per minute, respiratory rate 20 breaths per minute, normal body temperature and SpO₂ 99% on 6 liters of oxygen per minute delivered with nasal cannula. The initial Glasgow coma scale was 10/15. The electrocardiogram showed sinus rhythm with normal QRS duration and corrected QT interval. The chest X-ray revealed clear lung fields. His conscious state improved with intravenous administration of 50% dextrose solution.

He was transferred to the intensive care unit (ICU) for close observation and further management. He developed repeated episodes of hypoglycaemia with blood glucose levels around 2 to 3 mmol/L, requiring a total of 8 days of dextrose solution infusion. His haemodynamic status was all along stable. He developed hypokalaemia with the lowest potassium around 3 mmol/L, which was corrected with potassium replacement. In view of persistent hypoglycaemia and history of oral hypoglycaemic agent overdose, octreotide was also given initially but subsequently discontinued as urine and blood toxicology screening test results showed absence of oral hypoglycaemic agents. Blood ethanol and salicylate were negative. Serum paracetamol level was unremarkable. Serial arterial blood gas analysis showed no metabolic acidosis. He developed profound fluctuant swelling over his right hand on the next day of ICU admission (Figure A1). There was no clinical evidence of compartment syndrome and the distal circulation of his right upper limb was intact. Needle aspiration was attempted with nil output. X-ray of his right forearm was normal. Intravenous ampicillin and cloxacillin were started empirically.

His right hand condition deteriorated subsequently (Figure A2). Ultrasonography revealed thick fluid

collection over the dorsum of his right hand with gross soft tissue swelling extending proximally to the forearm. (Figure C). Emergency operation with excisional debridement was performed on day 4. There was extensive necrotising fasciitis involving the dorsum of his right hand to the forearm (Figure A3). The antibiotic regimens were subsequently changed to ceftriaxone and clindamycin in view of the operative findings. Repeated debridement was performed on day 6 and day 10. He had low grade fever and mild leukocytosis (white cell counts of 12 to 15 x 10⁹/L with reference range of 3.9 to 10.7 x 10⁹/L). However, the culture results of the pus swab and necrotic tissue from his right forearm wound were negative. Increasing swelling with signs of inflammation was noticed over the abdominal wall injection area (Figures B1 and B2). Incision and drainage was performed. Large amount of "pus-like" collection was demonstrated but bacterial culture was also negative. We performed microbiological analysis of 2 pyrethroid insecticides available in local agricultural product shops including the same product involved in this case. The results were negative which indicated minimal role for the bacterial infection contributing to the clinical picture (Table 1). His condition was stabilised and was transferred to general ward eventually. Skin grafting over his right forearm was performed on day 17. He had psychiatric assessment during his hospital stay and a diagnosis of situational reaction was made. He was discharged home after a total of 24 days of hospitalisation. Subsequent follow-up revealed limited movement of his right wrist and impaired right hand function.

Discussion

Pyrethrins and pyrethroids are commonly used insecticides and considered to have low toxicity to human. Pyrethroids are synthetic derivatives of pyrethrins which are naturally occurring pesticides from extracts of the flowers of *Chrysanthemum cinerariaefolium*. Pyrethroids are widely used as insecticides owing to their selective action on the insect sodium channels. By delaying the closure of the voltage-sensitive sodium channels, pyrethroids prolong the neuronal excitation causing repetitive firing and

paresthesiae. In contrast to organophosphate insecticide, pyrethroids are less toxic to humans. Despite the low toxicities to human, poisonings from pyrethroids have been reported due to occupational and intentional exposure. Depending on the chemical properties, two distinct clinical features of pyrethroids poisoning have been described including "T" (tremor) syndrome from type I pyrethroids which do not have a cyano substitution and "CS" (choreoathetosis/salivation) syndrome from type II pyrethroids which bears a cyano group. Dermal exposure of pyrethroids causing parasthesiae is probably secondary to the

hyperactivity of cutaneous sensory nerve fibres. However, pyrethroids are poorly absorbed through skin.² Common symptoms from ingestion and inhalation include vomiting and dizziness. Severe systemic toxicities, e.g. coma, convulsion and fatalities had been reported from significant exposures.³

Suicidal poisonings with self-injection of insecticide were rarely reported but could be associated with severe local and systemic complications. Reported toxicities and complications are mostly contributed by the solvents of the insecticide which are usually

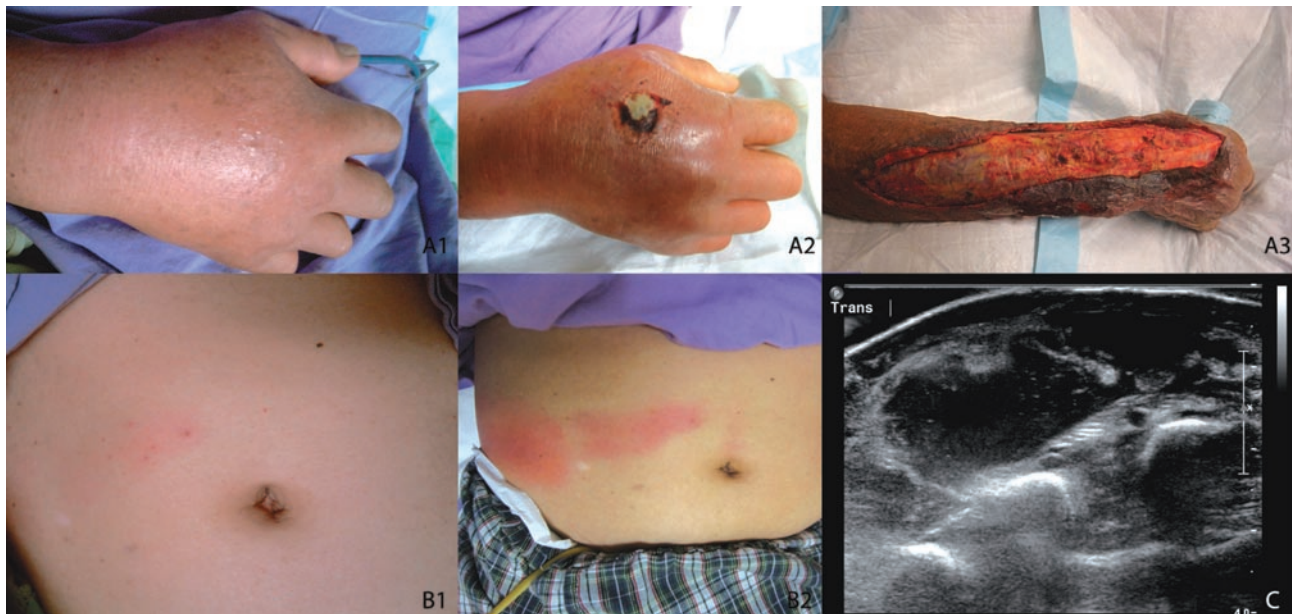


Figure. Clinical photos of the patient's right hand/forearm and abdomen. **A1:** Moderate swelling over the patient's right hand after the self-injection of pesticide noticed on admission. **A2:** Increasing swelling with small area of tissue necrosis over his right hand on day 3. **A3:** Excisional debridement showing extensive subcutaneous tissue involvement but intact extensor muscles. **B1:** multiple needle marks over the patient's abdominal wall with minimal local inflammation found in the initial assessment. **B2:** Increasing swelling with signs of inflammation over the abdominal wall injection area noticed and large amount of "pus-like" collection drained out eventually. **C:** Ultrasonography showing thick fluid collection (hypochoic shadow) over the dorsum of the patient's right forearm.

Table 1. Bacterial culture results of 2 pyrethroid insecticides (including the same product involved in our case) bought in local agricultural product shops

| Insecticide product | Insecticide group | Other ingredient | Concentration | Bacterial culture | pH |
|---------------------|---------------------|---------------------------------|---------------|-------------------|-----|
| Permethrin | Type I pyrethroids | Petroleum distillate as solvent | 10% | No growth | 4.5 |
| Cypermethrin | Type II pyrethroids | Petroleum distillate as solvent | 12% | No growth | 6.0 |

hydrocarbons. Subcutaneous injection of hydrocarbons is associated with chemical cellulitis with sterile abscess.⁴ Compartment syndrome with extensive necrosis involving vessels, tendons and nerves after self-injection of insecticide over the both hands of a patient had been reported.⁵ With injection of significant amount, the hydrocarbons could dissolve the lipid-rich membranes of the microvasculature resulting in liquefaction necrosis and eventually migrate along the tissue plane leading to sterile necrotising fasciitis.⁶

In contrast to bacterial necrotising fasciitis, "chemical necrotising fasciitis" secondary to the local effect of the hydrocarbons has a more benign course and bacterial culture is often negative.^{7,8} We have performed microbiological analysis of 2 pyrethroid insecticides available in local agricultural product shops including the same product involved in this case. Using the membrane filtration method, there was no microbial growth (see Table 1). One major limitation was that the 2 pyrethroid insecticides tested was not the original solution that was injected by the patient, so this analysis could only provide circumferential evidence for the chemical cause of necrotising fasciitis in this case. Nevertheless, the combination of damage to the vasculature and formation of large area of tissue necrosis favours secondary bacterial infection. Thus antibiotics therapy should be considered particularly in patient with systemic features of infection.⁹ For example, secondary infection in the necrotic tissue could be resulted from needle contamination during the injection.¹⁰

Systemic complications could also result from injection of hydrocarbons. Chemical pneumonitis secondary to intravenous injection of hydrocarbon-based insecticide had been reported.¹¹ There is a potential risk of the insecticides being injected directly into the systemic circulation during subcutaneous and intramuscular administrations, which, theoretically, could also result in systemic absorption of the insecticides causing prolonged toxicities. Although systemic organophosphate toxicities with profound muscarinic symptoms and prolonged muscle weakness had been reported following percutaneous injection,¹² there was

no data on systemic toxicity following subcutaneous injections of pyrethroids in the literature.⁹

The management of patient with insecticide injection involves prompt evaluation for the systemic toxic effects and local complications. The timing of surgical intervention is controversial. Early debridement has been suggested to minimise the systemic toxicities by enhancing the clearance of the toxic substances. On the other hand, surgical intervention could be delayed unless there is presence of compartment syndrome or vascular compromise because of the low toxicities of pyrethroids and the fact that assessment of the extent of tissue involvement in the early state is often inaccurate due to the allergic and acute inflammatory reactions.⁷ Radiological examination may be helpful if the insecticide contains solvents like halogenated hydrocarbons which are radio-opaque, giving a better delineation of surgical margins.¹³ However, the radiographic assessment of the right forearm of our patient was negative. Due to the lipid solubility of hydrocarbons which enables it to disperse along tissue planes and the lack of detoxification mechanisms of the body, the extensive tissue damages often result in multiple debridements.¹⁰ Furthermore, expertise management for tendon damage causing hand function impairment and psychiatric assessment are essential.

Suicidal insulin overdose is uncommon and associated with profound hypoglycaemia causing convulsion, permanent neurological deficits and even death. The prolonged absorption of insulin secondary to the depot effect from the formulation could result in persistent hypoglycaemia¹⁴ as illustrated in our case. Octreotide is an effective antidote for sulfonylurea overdose but is not effective to reverse the hypoglycaemic effect from insulin overdose. Successful outcome with surgical debulking of subcutaneous tissue around the injection site in patients with massive injection of long-acting insulin preparations had been reported.¹⁵ The patient in this case had prolonged effect from insulin overdose requiring long period of intravenous dextrose solution infusion. Surgical excision was not performed because of the lack of clear demarcation of the abdominal wall swelling in the initial assessment.

Conclusion

Apart from the dose of exposure, the routes of administration also determine the toxicities in poisoning. Compared with organophosphates and other commonly used pesticides, pyrethrins and pyrethroids are generally considered to be of low toxicities to humans. Our case illustrates that injection of the usual preparation of these commonly used insecticides can lead to severe toxic effects.

References

1. Pesticide Control and Related Information. Agriculture, Fisheries and Conservative Department of HKSAR. [cited 12 August 2010]. Available from: http://www.afcd.gov.hk/english/quarantine/qua_pesticide/qua_pes_pes/qua_pes_pes.html.
2. Bradberry SM, Cage SA, Proudfoot AT, Vale JA. Poisoning due to pyrethroids. *Toxicol Rev* 2005;24(2):93-106.
3. Bateman DN. Management of pyrethroid exposure. *J Toxicol Clin Toxicol* 2000;38(2):107-9.
4. Wedin GP, Jones RR. Parenteral administration of hydrocarbons. *J Toxicol Clin Toxicol* 1984;22(5):485-92.
5. Larsen JM, Bindiger A, Sherman R, Kushner SH. Insecticide injection injuries to both hands: a case report. *J Hand Surg Am* 1992;17(6):1073-5.
6. Shusterman EM, Williams SR, Childers BJ. Soft tissue injection of hydrocarbons: a case report and review of the literature. *J Emerg Med* 1999;17(1):63-5.
7. Terzi C, Bacakoğlu A, Unek T, Ozkan MH. Chemical necrotizing fasciitis due to household insecticide injection: is immediate radical surgical debridement necessary? *Hum Exp Toxicol* 2002;21(12):687-90.
8. Goldberg LH, Shupp D, Weitz HH, Zeccardi JA. Injection of household spray insecticide. *Ann Emerg Med* 1982;11(11):626-9.
9. Aydin A, Aköz F, Erer M. Subcutaneous injection of insecticide for attempted suicide: a report of two cases. *Acta Orthop Traumatol Turc* 2004;38(4):295-7.
10. Buchman MT. Upper extremity injection of household insecticide: a report of five cases. *J Hand Surg Am* 2000;25(4):764-7.
11. Neeld EM, Limacher MC. Chemical pneumonitis after the intravenous injection of hydrocarbon. *Radiology* 1978;129(1):36.
12. Hadimioglu N, Dosemeci L, Arici G, Ramazanoglu A. Systemic organophosphate poisoning following the percutaneous injection of insecticide. Case report. *Skin Pharmacol Appl Skin Physiol* 2002;15(3):195-9.
13. Farahvash MR, Yegane RA, Bashashati M, Ahmadi M, Tabrizi N. Surgical approach to hydrocarbon injection in upper extremities: case series. *Int J Surg* 2009;7(4):382-6.
14. Wong OF, Tsui KL, Kam CW. A case of acute insulin poisoning. *Hong Kong J Emerg Med* 2006;13(4):232-4.
15. McIntyre AS, Woolf VJ, Burnham WR. Local excision of subcutaneous fat in the management of insulin overdose. *Br J Surg* 1986;73(7):538.