

High-pressure injection injury of the finger

Sanjay Saraf

ABSTRACT

The high-pressure injection injuries are unusual injuries and the extent of tissue damage is often under estimated. They represent potentially disabling forms of trauma and have disastrous effects on tissues if not treated promptly. We present a case of high pressure injection injury to the finger from lubricant oil. The patient presented late with necrosis of volar tissue of left index finger. The patient was aggressively managed in stages, with delayed flap cover, with satisfactory functional and aesthetic outcome.

Key words: High-pressure injury, injection injury, finger

INTRODUCTION

High pressure injection (HPI) injuries to the hand are relatively uncommon. They are caused by high-pressure guns emitting jet streams at pressures exceeding thousands of psi (pound force per square inch). This extreme pressure forces the material through poorly distensible digital or palmar tissues and leads to diffusion along fascial planes, tendon sheaths, and neurovascular bundles with resultant significant damage.¹ The most commonly injected materials in HPI injury to the hand include paint, automotive grease, solvents, and diesel oil.²⁻⁴ The injected material has deleterious effects in many ways including direct toxic effect of the involved chemical, ischemia, high-velocity mechanical impact, secondary infection, and raised pressure into the closed digital space.⁵⁻¹⁰ Early recognition and treatment of these injuries is important as delay may result in compromised function of the hand or even the amputation of a digit.^{2,10-12}

CASE REPORT

A 57 year-old man presented with a painful, swollen, and

discolored left index finger. The patient had sustained a high-pressure injection injury by lubricant injector (pressure being around 5000 psi) a week ago. There was a small puncture wound just proximal to the distal interphalangeal (DIP) joint crease with surrounding induration along with loss of sensations and compromised vascularity of the volar skin, distal to the proximal interphalangeal [PIP] joint crease [Figure 1a]. The capillary refill was found to be sluggish and the oxygen saturation [SpO₂] probe showed no signals. The X-ray of the finger was suggestive of soft-tissue swelling with no radio opacities. The patient was aggressively managed in stages. First, the wound was explored with Brunner's zig-zag incision with immediate decompression and debridement of necrotic tissue and foreign material. The wound was left open and dressed. After 2 days, a second look was given and further debridement of the non-viable volar tissue was done [Figure 1b]. The resultant volar defect with exposed tendons on the left index finger was covered by a superior based abdominal flap [Figure 2a]. The flap was delayed after 3 weeks, with final inset after 6 days, with satisfactory result [Figure 2b]. At 3 months follow-up, the flexion at DIP and PIP joints was satisfactory allowing the patient to return to his pre injury occupation [Figure 2c].

DISCUSSION

The exact incidence of HPI injuries is difficult to assess, but the incidence could be significant, given the widespread use of pressure machinery in industry. Over a hundred cases of HPI injuries involving hand have been documented in the literature. The first reported case was described by Hesse (1925) and Rees (1937) published the first case involving diesel fuel.^{13,14}

The HPI injuries typically occur to the nondominant hand, and the index finger is the usually affected site. The palm

Department of Plastic Surgery, NMC Specialty Hospital, Dubai, UAE

Address for correspondence: Dr. Sanjay Saraf,
Department of Plastic Surgery, NMC Specialty Hospital, Dubai, UAE.
E-mail: drsaraf@hotmail.com

Access this article online	
Quick Response Code: 	Website: www.ijoonline.com
	DOI: 10.4103/0019-5413.49384

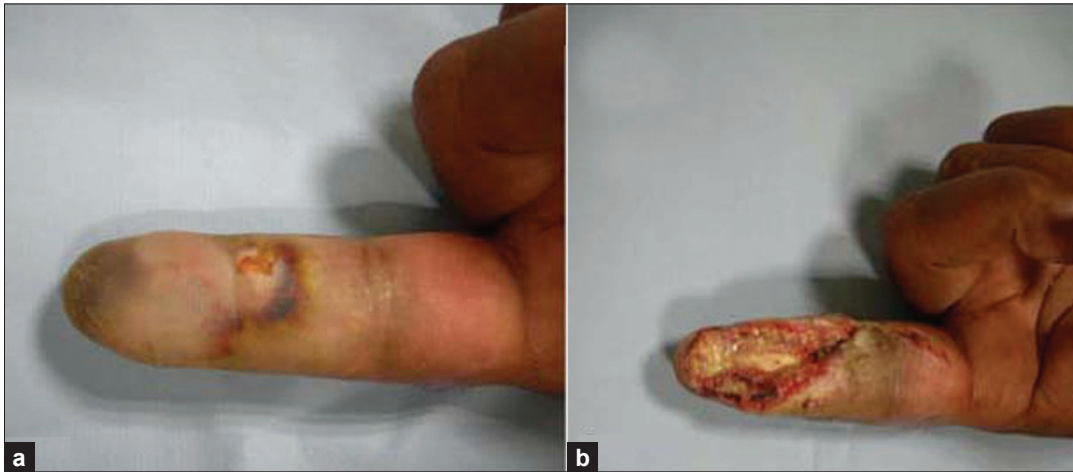


Figure 1: (a) Clinical photograph of the left index finger depicting a small puncture wound just proximal to the distal interphalangeal joint crease with surrounding induration along with loss of sensations and compromised vascularity of the volar skin, distal to the proximal interphalangeal joint crease. (b) The wound was explored with a Brunner's zig-zag incision. The photograph shows the resultant volar defect with exposed tendons after final wound debridement



Figure 2: (a) Clinical photograph depicting coverage of the volar defect over the left index finger by superior based abdominal flap and (b) the resultant final appearance and (c) function at 3 months.

and middle finger are next most frequently injured.^{2,10,15} The point of entrance is often deceptively small [Figure 1a].

In HPI injuries to the hand, the foreign materials are accidentally injected under a high injection pressure of 141-703 kg/cm².¹⁶ The morbidity is dependent to a large extent upon the type of material injected. The most commonly injected materials are automotive grease, diesel oil, paint and other solvents.^{2,4} The severity is related to the nature, pressure, volume, viscosity, anatomical level of injection, toxicity of the injected substance, secondary infection and the time interval between the injury and management.^{6,10,12}

The chemical properties of the injected material have a profound effect. In high-viscosity substances, such as grease and oil-based compounds, dispersion is less marked compared with more fluid materials. Low-viscosity solvents, such as paints and paint thinners produce the most severe inflammatory responses and more damage because of rapid lipid dissolution and destruction of tissues.^{10,17}

They are associated with a high incidence of subsequent amputation. Grease and oil based compounds may lead to oleogranulomas with chronic fistula formation, scarring, and eventual loss of digit function.^{2,6,17}

Various mechanisms have been used to explain the effects of HPI injuries. They include the direct toxic effect of the involved chemical, ischemia, necrosis from high-velocity mechanical impact, and infection.^{5-7,10} Factors contributing to digital ischemia include massive vessel thrombosis from volatilization of the injected material, temporary vascular spasm, venous outflow obstruction, and digital artery compression from compartment effect.⁸ The chemical toxicity has been considered as a significant mechanism of tissue damage, more than the ischemia. In the digits, amputation rates are reported to be as high as 48%.^{2,10}

The early treatment of these injuries is mandatory, with decompression and evacuation of the foreign material from the digits. The associated medical management includes tetanus toxoid, broad-spectrum antibiotics and

analgesics. The role of steroids is not well defined, but they are used as an adjunct, which has been suggested for severe cases.^{10,18} If a digit is initially cool or poorly perfused, early amputation might have to be considered.^{10,19} The Esmarch bandage should be avoided during surgery for homeostasis as the pressure disseminates the foreign material further. The patient should be operated under general anesthesia and digital or local nerve blocks are contraindicated. The use of solvents other than isotonic sodium chloride solution for irrigation of wound is not recommended.^{5,20} Soft tissue reconstruction, capsulotomy, neurolysis, and tenolysis might need to be considered to restore maximal function.¹⁰

In cases of involvement of tip of index finger and the thumb, restoration of the tip sensation by a sensate flap might need to be considered. Lastly, regular follow-up and early intensive rehabilitation is a must to achieve optimal functional outcome. To conclude, HPI injuries are surgical emergencies that demand prompt diagnosis and treatment. The early recognition and management of condition is the key to successful management.

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How to cite this article: Saraf S. High-pressure injection injury of the finger. *Indian J Orthop* 2012;46:725-7.

Source of Support: Nil, **Conflict of Interest:** None.