The Injection Of Noxious Materials Into The Hand

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In our present highly industrialized society, workers are exposed to many obvious hazards. They are protected by systematic study of these dangers by safety engineers, who develop methods and devices to decrease the hazards. No employer would allow a tyro to step up to a punch press and begin work without thorough orientation as to the dangers inherent therein.

The problem however, is to anticipate the hazards of innocuous appearing mechanical devices and protect against injury from them. Many novices handle high pressure grease guns without preliminary instruction, or trepidation. This device is capable of destroying a hand as thoroughly as any punch press.

The injury potential of the grease gun is shared by a number of devices which extrude a variety of liquids and semisolids through fine apertures in their nozzles. The propelling force may reach several thousand pounds per square inch due to the extremely small opening. At close range such a jet can penetrate skin and soft tissue. Pressure lubricating devices, fuel injection nozzles in gasoline and diesel engines, pressure guns for sealants, and plastic injection presses are some of the more familiar devices that can cause injection injury.

Figure 1 (a) and (b)
Grease gun injury of index finger showing diffuse damage and multiple draining sinuses.

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Stoppage of normal function may result in the operator exploring the nozzle with his finger or inserting a small wire into the aperture in an attempt to clear the malfunction. This places the hand in a position where injury is inevitable if the nozzle clears.

A number of cases of injection injuries of the hand have been encountered by the Plastic and Reconstructive Surgery Division. Three representative cases follow:

CASE 1. A 33 year old mechanic ran his finger over the nozzle of high pressure lubrication gun. He felt immediate discomfort. He was seen in the medical section of his plant where he was placed on warm soaks and antibiotics. He was seen in this hospital 9 days post injury with a marked swelling of the index finger and distal palm over the 2nd metacarpal area. The tissue was evenly indurated. He had no evidence of circulatory embarrassment of the digit or of involvement of the spaces of the hand or wrist. He was continued on antibiotics and returned on the 21st post injury day with several localized fluctuant areas over the proximal phalanx. These areas were drained as was a collection in distal palm. Saponified grease and necrotic tissue was removed from each of these areas. There was minimal improvement. Multiple small sinuses developed extruding white cheesy material. Amputation of the digit was advised but refused by the patient. The patient was able to work but the constant low grade discomfort and drainage made the patient consent to amputation, four months after injury. An index ray amputation was carried out which made it feasible to also clear the palm of all damaged tissue.

Figure 2
Sealing Compound Injury

(a) Swelling of thenar space
(b) Swelling of adductor space
CASE 2. A 42 year old male automobile assembly worker was using a pressure gun to seal crevices in an automobile body. He accidentally scraped the gun across his palm. He went to the medical section where it was assumed that the injury was...
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A superficial laceration contaminated with the sealing compound, the wound was cleaned and he was placed on antibiotics. In the next 12 hours pain and swelling increased. He was seen in this hospital 18 hours after injury where it was presumed he had cellulitis of the thenar area. No fluctuation was noted. The hand improved on warm soaks and antibiotics. After 72 hours no further improvement was noted. Operative exploration was carried out. The thenar space was opened through the original wound. The space was filled with about 15 cubic centimeters of sealing compound. The adductor space was opened dorsally and approximately 5 cubic centimeters of sealant welled out. Drains were placed and in the ensuing few days the hand improved dramatically. After a few weeks the hand was asymptomatic except for dense scarring of the thenar musculature. A secondary procedure was carried out. The scar and small locule of sealing compound was removed. Virtually normal function was obtained post operatively.

**CASE 3.** A 40 year old female seen because of a stenosing tenosynovitis of her third finger. She had a scar in her palm as a result of a minor injury incurred 7 years previously on a plastic moulding machine. No treatment had been given at the time of injury and no symptoms had been noted other than the mass. At the time operation for the presenting complaint the palm was opened and a small mass of clear plastic was extracted. Eight months later the patient returned complaining of swelling of the wrist. This was felt to be a ganglion or adventitious bursa. At operation this was found to be a bursa overlying a plastic mass between the flexor carpi radialis and flexor sublimis tendons. The mass was moulded about the radialis tendon. Tissue reaction about the mass was negligible except for the aforementioned bursa. The post operative course was unevenful, after removal.

**DISCUSSION:**

The salient features of several types of injection injury have been illustrated. The minimal initial symptoms belie the gravity of the injury. An apparently minor injury with a pressure actuated injection device should be considered severe until proven otherwise. The tissue injury ensuing may be due to several factors. The quantity injected may be sufficient to cause interference with circulation. This is especially true in anatomically well compartmented structures such as the hand. The temperature of the injected material may cause thermal injury. The material may be a tissue irritant causing immediate acute inflammation or a more chronic response, such as granuloma formation. All of these factors may be present in a single injury.

Examination should include roentgenograms which may aid in localizing collections of injected material. A careful physical examination of the hand should be conducted bearing in mind the injected material may be evenly dispersed in the soft tissue (Case 1), penetrate the digital theca and follow into the ulnar or radial bursa (Case 3), or fill the anatomical spaces (Case 2).

Management of the injury should be the immediate removal of the injected material if feasible. In the thermolabile plastic injury the material is solidified in a few moments. Removal must be through adequately and properly placed incisions. The
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concomitant thermal injury makes it unwise to close the wound primarily. The wound should be left open until all nonviable tissue has separated. Closure is then obtained secondarily by skin grafts or suture.

The injection of hydrocarbon fuels or lubricants presents a problem of immediate physical damage and continuing reaction due to granuloma formation. The reaction varies considerably because of varied composition of such products. Asphaltic or plastic sealants will also vary in the amount of tissue reaction elicited. The exact composition of the material should be sought and its toxicity determined. In early cases all indentifiable collections should be drained. This can result in dramatic improvement in the circulatory status and motion. After early measures have been exhausted, conservatism is indicated. The conservative course should be followed in all cases seen late. Infection should be prevented. Drainage of necrotic areas as they appear and maintenance of proper joint posture should allow maximum salvage of function. The morbidity may extend over many months. When the damage is isolated to a single digit or segment of the hand judicious amputation can result in rapid restoration of usefulness to the hand. Amputation should be a last resort but should not be deferred until the patient is exhausted physically, emotionally and economically.

REFERENCES