HSE GUIDANCE NOTE 3

High Pressure Paint Gun Injuries

Version – 3

This guidance note has been constructed to aid the effective treatment of high pressure spray gun injuries to the human body by competent Medical Practitioners / Surgeons.
CONTENTS

HSE GUIDANCE NOTE 3 ................................................................................................................................. 1
CHANGE LOG ................................................................................................................................................... 2
INTRODUCTION ............................................................................................................................................... 2
INJURIES CAUSED BY SPRAY PAINT GUNS NEED IMMEDIATE MEDICAL ATTENTION ............. 2
APPENDIX 1 – BRITISH MEDICAL JOURNAL ARTICLE – NOVEMBER 1977 .................................. 4

CHANGE LOG

<table>
<thead>
<tr>
<th>version</th>
<th>date</th>
<th>paragraph</th>
<th>details of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>03/1998</td>
<td></td>
<td>BMJ article only</td>
</tr>
<tr>
<td>2</td>
<td>02/2007</td>
<td></td>
<td>BU guidance added</td>
</tr>
<tr>
<td>3</td>
<td>03/2007</td>
<td></td>
<td>Restriction on circulation changed to allow Guidance Note to be used by competent Medical Practitioners / Surgeons</td>
</tr>
</tbody>
</table>

INTRODUCTION

1 This BU Guidance Note provides simple, general advice. Its purpose is to help you reduce the probability of an accident and it is designed to ensure that all employees engaged in spray painting activities will exercise due care and attention. This guide also serves to bring to your attention the appropriate actions required in the event of an accident involving a high pressure spray gun.

2 In order to achieve a minimum acceptable standard all employees of M&PC must understand the requirements of this guide. This note is intended to provide guidance to assist medical personnel in the treatment of high pressure injection injuries.

3 It is recognised that some facilities already have their own guidance notes, procedures or standards that address this issue. This note does not replace these; instead, it is intended to supplement them.

INJURIES CAUSED BY SPRAY PAINT GUNS NEED IMMEDIATE MEDICAL ATTENTION

4 Injuries which are caused by paint being injected into part of the human body should seek immediate attention.

5 A high pressure spray gun injury may appear as a tiny puncture wound. **DO NOT** be misled by the size of the wound.
6 The injured person should be sent to a medical centre/hospital accompanied with the MSDS of the paint which may have been injected into his body part and this guidance note.

7 Provide the medical staff with the copy of the MSDS and this guidance note and describe the event leading to the injury.

8 Appended is a British Medical Journal article which describes the consequences of two accidents involving high pressure paint guns. The cases were initially incorrectly treated by the hospital.
High pressure paint gun injuries

C M BOOTH

British Medical Journal, 1977, 2, 1333-1335

Summary

Despite their use for the past 20 years the dangers of injuries from high pressure paint guns are not widely known. Two cases treated incorrectly through ignorance in our casualty department resulted in amputation of digits. Paint solvents are far more damaging than paint or grease injection. All cases should be treated urgently by an experienced surgeon as fairly extensive surgery may be needed.

Introduction

This report illustrates the dangers of incorrect management of high pressure paint gun injuries. Two cases initially treated incorrectly in a London teaching hospital accident department showed ignorance of the condition. This may be partly due to lack of publicity, since no paper has appeared in the British journal since Morley's original description of the injury in 1961.1 One case concerned an injection of paint solvent into the hand. The effects of this are far more damaging than paint or grease injection, and more extensive surgery may be needed in its initial treatment.

Case 1

A 56-year-old painter was cleaning his gun and accidentally injected paint solvent (toluene 67%, isobutanol 7%, ketones 26%) into the ulnar aspect of the middle segment of his left middle finger at a pressure of 240 kg/cm² (3500 lb/in²). The site was marked by a tiny puncture wound.

The finger became painful, then partially anaesthetic and cyanosed; the nail, palm, and dorsum of the hand rapidly became swollen. Two hours after the injury a casualty officer made a small incision under local anaesthesia at the puncture wound and drained a small amount of paint-contaminated fluid. He then told an orthopaedic registrar, who under general anaesthesia performed an emergency decompression of the whole middle finger, its flexor sheath, and the distal palm. Tetanus toxoid, broad-spectrum antibiotics, and steroids were given and the arm was kept raised postoperatively. The hand continued swelling, and 36 hours later the incision was extended proximally to the distal border of the flexor retinaculum. Five days later he was referred to a hand surgeon at the whole forearm, dorsum of the hand (fig 1), ring and little fingers were grossly swollen and the index and middle fingers gangrenous (fig 2). He also had symptoms of median nerve compression in the carpal tunnel.

A decompression of the index, ring, and little fingers, the carpal tunnel, and the dorsum of the hand to mid-forearm level was performed, which disclosed widespread fat necrosis, large collections of

---

FIG 1—Grossly swollen forearm and dorsum of hand five days after accident.
pression of the index finger, palm, and dorsum of the hand was performed, which released large amounts of sterile pus. He was given broad-spectrum antibiotics, silicone baths, and extensive physiotherapy. The finger survived and, though scarred, has recovered full function.

Discussion

Since high pressure paint guns were introduced in the 1950s, 47 injuries due to injection of paint, lacquer, and materials such as vehicle anti-rust undercoating have been recorded in Britain. Including our case there have been 10 injuries when various types of hydrocarbon solvents have been injected (see table). Injection normally occurs from close range into a finger of the non-dominant hand at a pressure of 211-492 kg/cm² (3000-7000 lb/in²).

<table>
<thead>
<tr>
<th>Injected material</th>
<th>No of cases</th>
<th>Amputations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paint and lacquer</td>
<td>35</td>
<td>16 (45.7%)</td>
</tr>
<tr>
<td>Ziebart sealant</td>
<td>4</td>
<td>3 (75%)</td>
</tr>
<tr>
<td>Hydrocarbon solvents</td>
<td>10</td>
<td>2 (20%)</td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>21 (42.9%)</td>
</tr>
</tbody>
</table>

The two cases treated incorrectly in our own casualty department illustrate the need for wider publicity of this grave injury. Moreover, reports and the results described in case 1 show that paint solvent causes far more severe tissue damage than paint (see table). Researchers using cadaver hands and animals have described accurately the anatomical spread of injected substances and the response they elicit in the tissues. The most potent inflammatory agents are the paint vehicle soya alkyd, mineral spirits, and other hydrocarbon solvents. They cause rapid tissue necrosis, acute inflammatory oedema, and accumulation of sterile pus. They dissolve fat, thrombose veins, and dissolve the myelin sheaths of nerves, causing anaesthesia. In an enclosed space like the finger the injected material causes mechanical compression, which, coupled with arterial spasm and venous thrombosis, rapidly results in ischaemia and gangrene. Injecting local anaesthetic potentiates these effects and is absolutely contraindicated.

The spread of injected material depends on the injection pressure, the tissues it strikes, and its viscosity. Paint solvents have a lower viscosity than paint and therefore spread much further. Experimental work and clinical reports do not note any cases of paint spreading proximal to the flexor retinaculum and in only a few cases does sufficient paint reach the dorsum of the hand to necessitate decompression. In the 10 cases of solvent injury swelling of the dorsum of the hand was a pronounced feature in seven, and anaesthesia in the hand of median and digital nerve distribution occurred often.

The laboratory findings, especially the effects of solvents on fat, blood vessels, and nerves have been confirmed clinically in our own case and in others that have been accurately reported. In case 1 it was noted at each decompression that arterial bleeding was free and unobstructed, but the hand and fingers remained cyanosed suggesting that extensive venous thrombosis was the cause of the cyanosis and ischaemia. Gangrenous digits were amputated in eight of the 10 patients with solvent injuries, and in three patients the injured plus an adjacent digit required amputation (see table).

In the 39 recorded cases of injury with paint and anti-rust
materials only 20 needed amputations, and no patient lost more than one finger. The clinical cases confirm the experimental findings that paint and anti-rust sealant are not as tissue destructive as hydrocarbon solvents.

This report illustrates the dangers of delaying correct treatment. Local incisions in casualty departments are futile and merely waste precious time. Injection of local anaesthetics into digits increases tissue tension and worsens ischaemia. Although case 1 was decompressed early, the extent of decompression was inadequate. Low viscosity fluids spread into adjacent fingers, the palm, and thence to the dorsum of the hand and up the forearm. If the fluid is highly inflammatory the initial decompression should include adjacent fingers to the one injured (except the thumb, which is usually spared), the palm, the carpal tunnel, and the dorsum of the hand.

The principles of treatment for this type of injury are: (1) urgent referral to an experienced surgeon; (2) decompression of the digit and palm for paint injuries and wider decompression for solvent injuries under general anaesthesia or brachial block with local anaesthetic. A tourniquet should be applied after raising the arm for five minutes and kept on for as short a period as possible. An Esmarch’s bandage should not be used as the pressure it exerts disseminates the foreign material further; (3) broad-spectrum antibiotics to prevent secondary infection of devitalised tissue—fortunately most solvents are bactericidal; (4) tetanus toxoid cover; (5) high doses of steroids, which may help in reducing the inflammatory response; (6) analgesics; (7) very frequent postoperative observation of the hand, so that further decompression may be performed if necessary; and (8) early intensive rehabilitation to prevent stiffness in the digits.

I should like to thank Mr Basil Helal for advice and permission to report on his cases and Mr A W Hooper of Ziebart Great Britain Ltd for technical help.

References

2 Workman, C E, Missouri Medicine, 1965, 66, 896.
3 Blue, A I, and Diristine, M J, Northwest Medicine, 1965, 44, 342.
15 Remark, F L, and Weeks, P M, Missouri Medicine, 1972, 69, 196.

(Accepted 27 September 1977)