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## Finger compartment syndrome due to a high-pressure washer injury: A case report

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### Abstract

#### BACKGROUND

Although the finger compartment syndrome is not common, it compresses the neurovascular bundles in a limited space and blocks blood flow to the fingers, causing necrosis of the fingertips. Finger fasciotomy through unilateral or bilateral midline release of the finger can achieve decompression of the finger compartment. Herein, we report a case of the compartment syndrome in a finger injury caused by a high-pressure water flow which is commonly used in car washing stations.

#### CASE SUMMARY

A 60-year-old man injured his right middle finger while using a high-pressure washer at a car washing station. The patient complained of severe pain in his middle finger and a 0.2 cm punctured open wound on the volar side of the distal phalangeal joint of the middle finger. The fingertip was pale, numb, and characterized by severe swelling and a limited range of motion. Finger radiography showed that there was no fracture in the finger. Digital decompression was performed through finger fasciotomy by bilateral midline incision. On the second day after surgery, the color of the fingertip returned to pink, swelling was resolved, and the range of motion returned to normal. The sensation of the fingertip was completely restored, and the capillary refill test and pinprick test were positive.

#### CONCLUSION

The fingertip compartment syndrome can be caused by a high-pressure water flow damage to the fingers when using high-pressure washers at a car washing station. To avoid finger necrosis, rapid diagnosis of the finger compartment syndrome and appropriate digital decompression are essential to better outcome.

**Key Words:** Compartment syndrome; Crush injuries; Fasciotomy; Finger injuries; Case

report

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**Core Tip:** Though the fingertip compartment syndrome is not common, the digital decompression through finger fasciotomy with midlateral release is essential. In this case, compartment syndrome occurred in the middle finger without fracture due to a crushing injury caused by a common high-pressure washer. Fasciotomy was performed immediately. The patient was concerned about necrosis of the finger and demanded early amputation on the first day after operation. But the complete recovery was confirmed on the next day without significant complications. Therefore, we should avoid determining the recovery of finger circulation hastily and performing premature amputation of the fingertip.

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## INTRODUCTION

Compartment syndrome is a pathologic condition in which blood circulation to tissues is impaired due to increased pressure in the closed osteofascial compartment[1]. High pressure in the compartment leads to increased interstitial fluid pressure, capillary bed stenosis, decreased perfusion into tissues, and cell death[1]. This causes not only severe pain and swelling, but also tissue necrosis and functional morbidity. The most common cause of compartment syndrome is trauma, and other causes include burn, muscle overuse, infection and snake bites[1,2].

In the finger, two neurovascular bundles on the radial and ulnar sides of fingers are confined by the digital cutaneous ligament, Cleland's ligament, and Grayson's ligament[3]. Severe swelling of the finger compresses the neurovascular bundles in a limited space and blocks the blood flow of the fingers, causing necrosis of the fingertips. Although finger compartment syndrome is not common, finger fasciotomy through midlateral release of the finger can achieve decompression of the finger compartment[2]. Here, we report a case of compartment syndrome in a finger injury caused by a high-pressure water flow system commonly used at car washing stations.

## CASE PRESENTATION

### Chief complaints

A 60-year-old man injured his right middle finger while using a high-pressure washer at a car washing station.

### History of present illness

The middle finger was penetrated by high-pressure stream from a 2 mm nozzle of a high-pressure washer. The patient complained of severe pain in his middle finger and was admitted to the emergency room four hours after the injury. There was a 0.2 cm puncture wound on the volar side of the distal phalangeal joint of the middle finger, and the fingertip was pale and numb (Figure 1A). The water flow pressure of the high-pressure washer was 140 bar.

### History of past illness

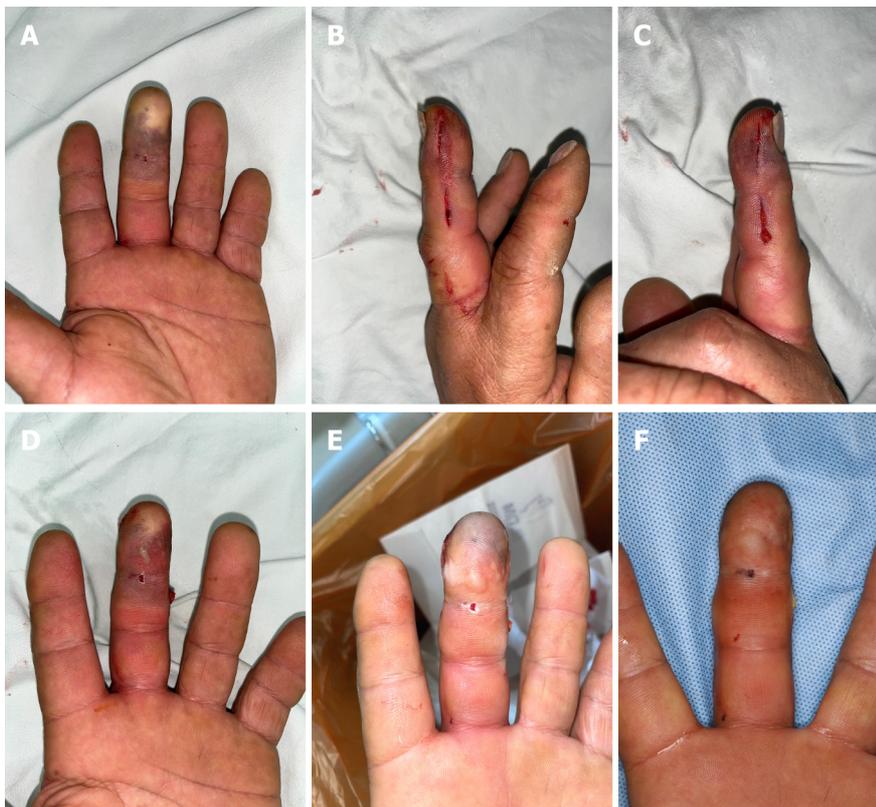
The patient had a 90-pack-year smoking history without other underlying diseases.

### Personal and family history

The patient had no other relevant personal and family history.

### Physical examination

Severe swelling and a limited range of motion were observed. Since the middle finger showed negative results in the capillary refill test and the pinprick test, finger fasciotomy was immediately performed (Figure 1B and C).



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**Figure 1 Clinical course of finger compartment syndrome.** A 60-year-old man was diagnosed with compartment syndrome in the right middle finger with an 0.2 cm penetrating wound on the distal phalangeal joint. A: Preoperative photograph showing the pale and tense distal phalanx in the middle finger; B and C: Finger fasciotomy on the radial and ulnar sides of the middle finger; D: Immediate postoperative photograph showing incomplete recovery of the fingertip; E: First-day postoperative photograph showing no further recovery at the middle fingertip; F: Third-day postoperative photograph showing complete recovery at the middle fingertip.

#### **Laboratory examinations**

No laboratory examinations were performed.

#### **Imaging examinations**

Finger radiography showed that there was no fracture in the finger.

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### **FINAL DIAGNOSIS**

The final diagnosis was the compartment syndrome in finger injury.

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### **TREATMENT**

Incisions were performed on both lateral midlines in the distal and middle phalanx, and digital compartment decompression was achieved. After fasciotomy, an improvement in capillary perfusion was observed in the fingertip, but without complete recovery (Figure 1D).

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### **OUTCOME AND FOLLOW-UP**

On the first day after surgery, the fingertip was still pale, swollen, and numb (Figure 1E). The capillary refill test and pinprick test were also negative and the patient requested amputation of the fingertip because he did not want the treatment period to be prolonged. However, we proposed delaying amputation for a few days because there was a possibility that the blood flow would improve after fasciotomy and the boundary of necrosis was not yet demarcated. On the second day after surgery, the color of the fingertip returned to pink, swelling was resolved, and the range of motion returned to

normal. The sensation of the fingertip was completely restored. The pinprick test was positive, and the capillary refill test time was normal (*i.e.*, within 2 s). The patient was discharged on the third day after surgery (Figure 1F). After two weeks, the patient recovered without complications, and the fasciotomy incision sites underwent wound healing by secondary intention.

## DISCUSSION

Compartment syndrome is caused by increased interstitial tissue pressure due to intrinsic or extrinsic factors. This increased pressure causes progressive arteriole collapse and local tissue hypoxia. If this condition continues without appropriate treatment, it can lead to loss of function, limb, or life[2,4]. The most common cause of compartment syndrome is traumatic injury associated with crushing-type mechanisms[2]. However, few studies have investigated acute compartment syndrome of the fingers and presented data on its prevalence[5]. In this case, compartment syndrome occurred in the middle finger without fracture due to a crushing injury caused by a high-pressure washer.

Although the compartment pressure may be helpful for diagnosis, consensus on the threshold is still lacking. However, McQueen *et al*[6] reported that the difference between tissue pressure and perfusion pressure can be a useful clinical marker. Codding *et al*[7] recommended that the hand compartment be released when the tissue pressure is within 30 mmHg of the patient's diastolic blood pressure. The "5 P's" are often associated with compartment syndrome: Pain, paleness, paresthesia, lack of pulse, and paralysis. These 5 P's are used as a routine evaluation method as a clinical feature of compartment syndrome for diagnosis[2]. In our case, the patient's compartment syndrome symptoms were clear, but it would have been better to check the tissue pressure to obtain objective results.

Since digital neurovascular bundles are limited by the finger skin ligaments, Cleland's ligaments, and Grayson's ligaments, excessive finger swelling can constrict the neurovascular bundles in this space[3]. Cleland's ligaments are located dorsal to the digital blood vessels and nerves, and Grayson's ligaments are located volar to these structures[8]. These ligaments provide stability to the digits, and protect the digital blood vessels and nerves. However, these ligaments need to be released when finger compartment syndrome is diagnosed.

Digital decompression is an operation to release Cleland's ligament through a midaxial incision of the phalanx[4]. During operation, care must be taken with the skin incision to avoid iatrogenic injury to the neurovascular bundles. Ischemic damage in the muscle area can recover within 4 h, but irreversible damage remains if the interval until treatment exceeds 8 h. Therefore, for a better prognosis in treatment of compartment syndrome treatment, not delaying treatment is important[9]. In this case, fasciotomy was performed 4 h after the injury, but recovery was not clear until the first day after surgery. The patient was convinced of necrosis of the fingertip on the first day after surgery. Because the patient did not want to prolong the treatment period, he urged the medical staff to amputate the distal phalanx prematurely. However, complete recovery was observed on the second day.

The relationship between the degree of injury and recovery time has not been reported in fingertip compartment syndrome. However, in this case, proper digital decompression was performed, and complete recovery was confirmed on the second day after surgery. It would not be an appropriate judgement to hastily evaluate the recovery of finger circulation and perform premature amputation of the fingertip.

## CONCLUSION

Fingertip compartment syndrome can be caused by high-pressure water flow damage to the fingers when using a high-pressure washer at a car washing station. To avoid finger necrosis, a rapid diagnosis of finger compartment syndrome and digital decompression are essential.

## FOOTNOTES

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