A 26-year-old nurse presented to the emergency department (ED) after an accidental injection of 0.3ml of 1:1,000 adrenaline into her thumb. She had been attempting to dispose of an auto-injector that had expired.

She arrived in the ED 45 minutes after the accident and told ED staff that her thumb had almost immediately become pale and cold to touch.

The patient was anxious and tachycardic, with a heart rate of 97 beats per minute.

Her left thumb was white and cool to touch, and a tiny puncture mark was present in the middle of the pulp of the distal phalanx.

The thumb's capillary refill time was delayed. There was no swelling or associated bony tenderness; unusually, there was no sensory loss or pain. The area of ischaemia extended from the tip of the thumb to the base of the metacarpal joint.

A pulse oximeter probe was placed on her thumb to find out if there was oxygenated blood flow to the digit, and this showed a good trace and an oxygen saturation of 99 per cent in air.

Staff at the local plastic surgery service was contacted for advice. They said that, apart from immersion in warm water, no treatment was required because the ischaemia would resolve eventually.

The patient was discharged two hours later and advised to return if symptoms persisted or if her thumb became painful. Immersion in warm water had no effect on her thumb, but the patient did not return for further investigations or management.

**Auto-injectors**

The use of adrenaline auto-injectors such as EpiPens or Anapens, which contain 0.15mg or 0.3mg of adrenaline for the treatment of severe allergic reactions, has become increasingly common since their introduction in the 1980s (Velissariou et al 2004).

The incidence of accidental injection with such devices (Figure 1) is estimated to be one in every 50,000 auto-injectors used (McGovern 1997). Several cases are described in Table 1.

Adrenaline causes intense vasoconstriction, which is mediated by the stimulation of alpha 1 and alpha 2 receptors in the perivascular smooth muscle (Lockey 1980).

Injection of adrenaline has been thought to result in ischaemic necrosis, especially in digits, although this claim is disputed by Fitzcharles-Bowe et al (2007) and Thomson et al (2007).

**Management and treatment**

Various methods of management of accidental injection of adrenaline into digits have been detailed in the literature, including:

- Application of systemic or topical nitroglycerin to cause vasodilatation (Claudy 1995).
- Warm water immersion (Kaspersen and Vedsted 1998).
- Topical infiltration with terbutaline, which is a beta adrenergic receptor agonist that relaxes smooth muscle (Stier et al 1999).
- Local injection of phentolamine (Hardy and Agostini 1995).
Table 1. Literature review of cases of accidental 1:1,000 adrenaline injections into fingers

<table>
<thead>
<tr>
<th>Case description</th>
<th>Treatment</th>
<th>Outcome</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 A three-year-old girl has been injected with adrenaline from an auto-injector.</td>
<td>Local injection of phentolamine</td>
<td>Normal sensation return after three minutes</td>
<td>Ahearn (1998)</td>
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<tr>
<td>Her hand is cold</td>
<td></td>
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<tr>
<td>2 A 35-year-old male has been injected in the index finger with adrenaline.</td>
<td>Application of topical nitroglycerin paste</td>
<td>Normal colour and sensation returns to finger after 12 hours. As is normal, some epithelial peeling for one month</td>
<td>Claudy (1995)</td>
</tr>
<tr>
<td>His finger is cool and white, and sensation has decreased</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 A 39-year-old nurse has numbness, palor and coldness in a finger</td>
<td>Local injection of 1mg phentolamine</td>
<td>Normal colour and sensation return after 30 minutes</td>
<td>Deshmukh and Tolland (1989)</td>
</tr>
<tr>
<td>4 A police officer has been injected in the thumb with 0.3ml of 1:1000 adrenaline. The thumb is white and the patient complains of decreased sensation</td>
<td>Local injection of 2mg phentolamine and warm soak</td>
<td>Normal colour and sensation return after 30 minutes</td>
<td>Hardy and Agostini (1995)</td>
</tr>
<tr>
<td>5 A 17-year-old female has been injected in the thumb with 0.3ml adrenaline and is experiencing a loss of sensation</td>
<td>Local injection of 0.5mg phentolamine</td>
<td>Normal sensation returns after one hour</td>
<td>Hinterberger and Kintzi (1994)</td>
</tr>
<tr>
<td>6 A radiologist injected adrenaline into his thumb</td>
<td>Local injection of phentolamine and a calcium-channel blocker</td>
<td>Digit returned to normal</td>
<td>Khairalla (2001)</td>
</tr>
<tr>
<td>7 A patient is injected in the digit with adrenaline from an auto-injector</td>
<td>Treated with nitroglycerin paste and hot water</td>
<td>Normal sensation returns and there is no digital necrosis</td>
<td>Kaspersen and Vedsted (1998)</td>
</tr>
<tr>
<td>8 A 17-year-old male has been injected in a digit with 0.15mg adrenaline from an auto-injector. His finger is pale, and feels cold and painful</td>
<td>Local injection of 0.5mg phentolamine</td>
<td>Normal colour and sensation return after 15 minutes</td>
<td>Maguire et al (1995)</td>
</tr>
<tr>
<td>9 A 28-year-old woman has been injected in the index finger with adrenaline. Her finger is pale and feels cool</td>
<td>First treatment: digital block of lidocaine, topical nitroglycerin paste and warm compresses</td>
<td>First treatment is unsuccessful and finger remains pale and cold</td>
<td>McCauley et al (1991)</td>
</tr>
<tr>
<td></td>
<td>Second treatment: local injection of 1.5mg phentolamine</td>
<td>After second treatment, normal colour returns after 30 minutes</td>
<td></td>
</tr>
<tr>
<td>10 A 37-year-old woman has been injected with adrenaline in the index finger, penetrating the bone</td>
<td>Local injection of penicillin</td>
<td>No problems identified</td>
<td>Schintler et al (2005)</td>
</tr>
<tr>
<td>11 A nine-year-old girl has been injected in the thumb with 0.3ml adrenaline. Her thumb is pale, and feels cold and painful</td>
<td>First treatment: topical nitroglycerin paste</td>
<td>First treatment is unsuccessful, finger remains pale and cold</td>
<td>Sellens and Morrison (1991)</td>
</tr>
<tr>
<td></td>
<td>Second treatment: local injection of 0.5mg phentolamine</td>
<td>After second treatment, normal colour returns after five minutes</td>
<td></td>
</tr>
<tr>
<td>12 A ten-year-old boy has been injected in the hand with adrenaline</td>
<td>Local injection of 0.5mg phentolamine and warm soaks</td>
<td>Hand returns to normal within five minutes but patient reports that sensation is altered after six weeks</td>
<td>Turner and Purushotham (2004)</td>
</tr>
</tbody>
</table>

Adapted from Fitzcharles-Bowe et al (2007)
Phentolamine is a short acting alpha 1 and alpha 2 adrenergic receptor blocker that is used to control blood pressure in intensive care settings (Velissariou et al. 2004). There is evidence that phentolamine digital block, intra-arterial administration and local infiltration have been used successfully to reverse the effects of digital injection of adrenaline (Burkhart 1992, El Maraghy et al. 1998, Hardy and Agostini 1995, Maguire et al. 1990, McGovern 1997). Local injections of between 0.5mg and 1.5mg phentolamine, at intervals of between 20 and 30 minutes, have been used safely in adults (McGovern et al. 1997). Velissariou et al (2004) describe a different dosing regimen, however, of 1.5mg in 1ml of 2 per cent phentolamine injected subcutaneously into the site until the skin becomes pink, and suggest this regimen is appropriate for children as well as adults. McGovern (1997) suggests that, due to the potential side effects of phentolamine, which include arrhythmias and profound hypotension, all patients should undergo blood pressure and electrocardiographic (ECG) monitoring after phentolamine administration. This is not recommended by other researchers studies, however, perhaps because, when phentolamine is administered locally rather than intravenously, the risk of systemic side effects is low.

Of the cases of accidental injection of adrenaline into digits reviewed by Fitzcharles-Bowe et al (2007), and adapted in Table 1, there was no evidence of necrosis. Fifty five per cent of the patients concerned received no treatment, while 24 per cent received phentolamine and reported normal colour within an hour of injection. Only one patient, a child, reported a continued altered sensation at six-week follow-up after phentolamine treatment.

Fitzcharles-Bowe et al (2007) conclude that the likelihood of high, or 1:1,000, dose or low, or 1:10,000, dose adrenaline being accidentally injected into digits to cause finger infarction is low. They suggest, however, that the use of phentolamine for high dose injuries might decrease ischaemia reperfusion pain and possible neuropraxia, and that this treatment option could be considered in patients with pre-existing finger vascular insufficiency.

The patient described in this article did not receive any treatment other than immersion of her thumb in warm water, and this form of management is supported by the literature review. This is reassuring because sometimes taking no action can be as challenging to nurses as undertaking new procedures. Use of phentolamine was considered but ruled out because the patient did not report any pain or sensory loss.

For many patients with this type of injury but no known peripheral vascular disease, reassurance and effective discharge advice is the best treatment. But, if ED staff choose to treat patients by using phentolamine, they should use evidenced-based guidelines such as those compiled by Velissariou et al (2004).

References


