Chemical eye injuries 1: presentation, clinical features, treatment and prognosis

Exploring initial presentation of chemical eye injuries, clinical features, outlook and prognosis, and the importance of immediate treatment

INTRODUCTION
A chemical burn occurs when a corrosive substance enters the eye. This type of injury is considered to be an ophthalmic emergency as it could lead to a permanent loss of vision if it is not treated promptly and accurately.

Kanski (2007) indicated that chemical burn was the only type of ocular injury that needed immediate treatment without first taking a history and carrying out a careful examination.

Griffith and Jones’ (1994) research was based on eye injury in the chemical industry. They concluded that 45% of all injuries were caused by chemicals.

Their article suggested that health care in the industry has recognised that most of these injuries could have been avoided.

Historically, most chemical injuries occurred at home and in the workplace, and this remains the case today.

Randleman et al (2009) said chemical injuries account for around 7% of work-related eye injuries treated at US hospital emergency departments. Furthermore, they said that more than 60% of chemical injuries occur in the workplace, 30% at home and 10% as a result of assault.

Healthcare professionals should be more proactive in promoting safety messages to the public about these injuries. They should provide support and materials to promote advice on safety at work and home.

Patients presenting to A&E and those being admitted to the ward will be extremely concerned about the possibility of going blind, especially if the injury is in both eyes.

When treating these cases, nurses need to be aware of patients’ anxiety. They should offer reassurance but must not make any comments about the outcome of the injury.

CHEMICAL AGENTS
Many chemicals used in the home and at work can cause chemical burns. Dua et al (2001) said that chemical burns may be caused by either alkaline or acid agents.

The severity of the injury depends on the type of chemical used (acid or alkaline), the volume and concentration, time of exposure, and the degree of penetration.

ACID INJURY
Melsaether and Rosen (2007) described acid burns as being usually non-progressive and superficial. This is because they cause protein coagulation in the corneal epithelium, which limits further penetration.

The only exception is hydrofluoric acid, a weak acid that penetrates the cell membrane as it becomes non-ionised. Kanski (2007) explained that, due to coagulation, a barrier is formed to prevent deep penetration and the main damage is therefore restricted to the lids, conjunctiva and cornea.

TABLE 1. TYPES OF CHEMICAL INJURY

<table>
<thead>
<tr>
<th>Chemical</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium hydroxide</td>
<td>14</td>
</tr>
<tr>
<td>Sodium or potassium hydroxide</td>
<td>14</td>
</tr>
<tr>
<td>Calcium hydroxide</td>
<td>14</td>
</tr>
<tr>
<td>Ammonium hydroxide</td>
<td>13</td>
</tr>
</tbody>
</table>

Source: Denniston and Murray (2006)

ALKALINE INJURY
Alkaline burns penetrate more rapidly than acids. Saponification of cell membrane fatty acids causes cell disruption and cellular death.

In addition, the hydroxyl ion hydrolysates intracellular glycosaminoglycans and denatures collagen.

The damaged tissues stimulate an inflammatory response, which damages the tissue further by the release of proteolytic enzymes. This is termed liquefactive necrosis (Melsaether and Rosen, 2007).

Alkaline substances can pass into the anterior chamber rapidly (in approximately...
5–15 minutes), exposing the iris, ciliary body, lens and trabecular meshwork to further damage. Irreversible damage occurs at a pH value above 11.5.

Adepoju et al (2007) and Riordan-Eva and Whitcher (2007) said that alkaline burns are more severe than acid burns. In addition, alkali continues to cause damage long after the injury has taken place.

Table 1 outlines the different types of chemical injury.

PATIENT HISTORY
Most often, patients give a history of a liquid or gas that has been splashed or sprayed into the eyes or of particles falling into the eyes. Their complaints are frequently related to the severity of the exposure.

The most common complaints are:
- Pain (often extreme);
- Foreign body sensation;
- Blurred vision;
- Excessive tearing;
- Photophobia;
- Red eye.

CLINICAL FEATURES
Mild to moderate burns
The eye may display conjunctival chemosis, hyperaemia, haemorrhages or a combination of these factors.

In addition, it may also show eyelid oedema and first- to second-degree burns of the periorcular skin with mild anterior chamber (AC) reaction.

Conveal findings may range from diffuse superficial punctate keratitis (SPK) to focal epithelial loss to sloughing of the entire epithelium.

Severe burns
Severe burns can cause pronounced chemosis and conjunctival blanching. In addition, they may also cause corneal oedema and opacification with little to no view of the AC, iris or lens, with a moderate to severe AC reaction (Ehlers and Shah, 2008). Fig 1 shows a severe burn to the eye caused by ammonia.

COMPLICATIONS
- Poor corneal healing, which might need surgical treatment to vascularise the limbus;
- Corneal opacification where corneal keratoplasty might be adequate.

OUTLOOK AND PROGNOSIS
Hughes classifies the prognosis into four categories (Denniston and Murray, 2006):
- Grade 1: only corneal epithelial loss is present. No conjunctival ischaemia is found;
- Grade 2: Some corneal oedema and haze are present. The limbal ischaemia is less than one-third, and some permanent scarring may occur;
- Grade 3: The cornea has significant haziness. Limbal ischaemia is less than half and the iris details are obscured;
- Grade 4: The cornea is opaque, the limbal ischaemia is over half and the prognosis is poor.

The impact on vision is categorised as:
- Grade 1: fully recovered;
- Grade 2: may end with some scarring, though vision should recover;
- Grade 3: vision will usually be impaired to some degree and prognosis is guarded;
- Grade 4: damage to vision is likely to be severe.

Dua et al (2001) proposed a modification of the Roper-Hall classification to take into account the limbal involvement in terms of clock hours (for example, one-quarter of the circular area around the cornea) and the percentage of conjunctival involvement.

They said that use of the new system would improve the ability to define more accurately the extent of injury and thereby plan management strategies.

In the Birmingham and Midland Eye Centre, we see patients with chemical injuries sustained at home, at work and from assaults. Initial pH is measured, followed by irrigation until the pH is within normal limits.

A complete and thorough examination is then carried out and protocol followed to grade the injury and start treatment.

In addition, decisions are made on whether to admit patients if necessary or discharge them with follow-up appointment and/or daily review.

Part 2 of this unit, to be published in next week’s issue, looks at management and nursing care of chemical eye injuries.

REFERENCES


