

Management of chemical burns

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Abstract

Chemical burns represent a small number of burn injuries in the UK. They have the potential to be life-threatening with serious aesthetic and functional consequences, accounting for 30% of all deaths from burns. Chemical burns are caused by corrosive agents (acids and alkali) leading to extensive tissue damage. Understanding the pathophysiology of a chemical burn injury and identifying the nature of the offending agent is important for effective management. Prompt assessment and management of chemical injuries is vital to reduce the deleterious effect of the compound involved. This article reviews the pathophysiology of a chemical injury and the management of these burns.

Key words: Burn; Chemical burn; First aid

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Introduction

Caustic injuries represent a small number of burn injuries (Palao et al, 2010; Williams and Leo, 2018). In order to improve the outcome of a chemical burn injury it is important to understand the mechanism of injury and safely remove the chemical agent. This review summarises the epidemiology of burn injuries and the management of burns caused by various chemical agents.

Epidemiology

Approximately 13 000 burn injuries require hospital admission each year in England and Wales (Stylianou et al, 2015). Chemical burns account for approximately 4% of burn injuries but up to 30% of all burn deaths (Hardwicke et al, 2012; Williams and Leo, 2018). The majority of chemical burn injuries are accidental, with a higher male:female ratio (6.4:1) (Hardwicke et al, 2012).

Over 60 000 new chemicals are produced each year (Edlich et al, 2005). Domestic burns occur as a result of the availability of toxic household cleaning substances, pesticides and hydrocarbons which are inappropriately labelled and stored (Table 1) (Stylianou et al, 2015). Paediatric chemical burns occur secondarily to household chemical products, such as oven or drain cleaner. In comparison to rising numbers of domestic chemical burn injuries, the number of industrial burn injuries has reduced, mainly as a result of improved workplace health and safety (Edlich et al, 2005; Stylianou et al, 2015).

Approximately 1500 cases of vitriolage (acid attacks) are reported worldwide per annum (ActionAid, 2020). Vitriolage aims to maim, torture, disfigure or kill another individual (Lewis et al, 2020). This type of assault is usually associated with gender violence worldwide. However, in the UK and Europe, men are more commonly affected (Tan et al, 2015; Miller et al, 2018; ActionAid, 2020). Although this type of assault is described as an 'acid' attack, a wide variety of chemical solvents are used, including acids, alkalis, solvents, oxidising, reducing, alkylating and chelating agents. The UK is reported to have one of the highest rates of vitriolage in the world (Tan et al, 2015; Mann, 2017). In 2012, 228 attacks occurred in the UK which has risen incrementally each year as 601 cases occurred in 2016, although the numbers of cases declined to 187 cases in 2020 (Lewis et al, 2020). Since July 2018 the UK government has banned members of the public wishing to import, acquire or use sulphuric acid above 15% concentration (Home Office, 2018). Criminologists believe that chemical attacks are becoming more frequent because these carry more lenient prison sentences than knife crime with less risk of the offence being proved as a result of the absence of DNA evidence. The chemical can be easier to conceal than a knife or a gun (Mann, 2017).

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Self-harm accounts for a small number of chemical injuries. The main cause of death is ingestion of the chemical resulting in gastrointestinal perforation and haemorrhage (Williams and Leo, 2018).

Pathophysiology

Biological proteins are composed of amino acids in a specific sequence creating a three-dimensional structure. Changes to surrounding pH or dissolution of surrounding lipids may disrupt the function of the protein and lead to biological denaturation of structural proteins (Ganeswaran et al, 2015; Williams and Leo, 2018). Acids and alkalis cause injury by two different mechanisms. Acids cause coagulation necrosis with precipitation of proteins, while alkalis cause liquefaction necrosis (allowing deeper penetration of the alkali into the surrounding tissues). Hydroxyl ions within the tissues increases the solubility of the alkali (Seth et al, 2007).

There are six mechanisms of action by which chemical agents in biological systems denature proteins:

1. Reduction: Reducing agents bind free electrons to proteins causing denaturation
2. Oxidation: Oxidising agents are oxidised by tissue proteins causing destruction by inserting oxygen or halogen atoms into structural proteins resulting in the release of toxic components
3. Corrosive agents: Corrosive substances denature proteins forming an eschar and ulceration
4. Protoplasmic poisons: These agents bind to or inhibit calcium, affecting protein function and structure
5. Vesicants: These agents cause ischaemia and necrosis to proteins
6. Desiccants: The agents dehydrate tissue and cause exothermic reactions affecting forces between structural proteins (Williams and Leo, 2018).

The common chemical agents which cause caustic burns are described in [Table 1](#). Many different chemical injuries occur in developing countries or affecting specific industrial trades. Formic acid injuries may occur in tanning workers or glue makers, nitric acid may affect fertiliser manufacturers while phosphoric acid is used as an incendiary agent in grenades and artillery and can result in mass civilian chemical injuries during conflict (Williams and Leo, 2018).

Patients with hydrofluoric acid injuries are at risk of developing hypocalcaemia (the most common electrolyte disturbance), hypomagnesaemia and hyperkalaemia (Alper

Table 1. Common chemical agents and their mechanism of actions

Chemical	Mechanism of action	Domestic products in which this chemical is found
Hydrochloric acid	Reduction	Domestic cleaning products, for example toilet cleaner Steel industry
Hydrofluoric acid	Protoplasmic poison	(Mainly industrial: glass etching)
Sulphuric acid	Corrosive agent and a desiccant	Car batteries Drain cleaner
Sodium hypochlorite	Oxidation	Bleach, laundry or toilet cleaners
Sodium hydroxide	Oxidation and production of exothermic reaction	Drain cleaner
Calcium oxide	Desiccant	Cement
Carbolic acid (phenol)	Corrosive	Not commonly used in the UK but is used as a cleaning agent in places like rural India Used in minor medical procedures

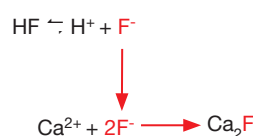


Figure 1. Dissociation of hydrofluoric acid (Seth et al, 2007).

et al, 2014). The systemic manifestations of hypocalcaemia following a hydrofluoric acid burn include paraesthesia, tetany, seizures, vomiting, diarrhoea, decreased myocardial contractility and arrhythmias, for example ventricular fibrillation and a prolonged QT interval (Dalamaga et al, 2008). Hypocalcaemia occurs as free fluoride ions are bounded to calcium ions (Figure 1). Additionally, free fluoride ions disrupt the cell membrane's sodium potassium pumps, which results in hyperkalaemia and can increase levels of cyclic adenosine monophosphate, stimulating refractory ventricular fibrillation and cardiac arrest (Dalamaga et al, 2008; McKee et al, 2014).

Assessment

Prompt assessment and management of chemical injuries is vital to reduce the deleterious effect of the compound. The assessment team should wear gloves and aprons to prevent injury to themselves when handling the patient and limit exposure to the toxic agent. Any contaminated clothes should be double bagged to prevent further inadvertent exposure to other healthcare workers (British Burn Association, 2018; Williams and Leo, 2018).

All patients should be managed using a suitable algorithm from the Advanced Life Support, Advanced Trauma Life Support or Emergency management of a severe burn framework as part of their initial assessment. The choice of algorithm depends on the specific issue being treated: if a cardiac issue ensues, Advanced Life Support would be better, whereas if an assault occurs, then other injuries could have occurred and a broad Advanced Trauma Life Support approach may be used instead of a focused burns management scenario.

Airway and breathing should be assessed to identify upper airway obstruction secondary to inhalation of the chemical or oral burns following ingestion of the toxin. Early intubation and ventilatory support may be required. Following this, circulation should be assessed for cardiovascular compromise. Electrolyte and metabolic disturbances including hypocalcaemia, hyperkalaemia or hypomagnesaemia may cause cardiac arrhythmias including ventricular tachycardia, ventricular fibrillation or cardiac arrest. In large injuries the neurological status should be recorded, including the patient's temperature because of the effects of metabolic disturbance as well as heat loss following a large cutaneous burn.

A secondary survey should be performed to assess for any other injuries. Ocular chemical injuries are classified by the Roper-Hall (Ballen) (Table 2) or the Dua classifications (Roper-Hall, 1965; Dua et al, 2001; Singh et al, 2013).

Ocular injuries should be assessed with the eyelid everted to clear away any debris (Sarabahi and Kanchana, 2014). Ophthalmologists recommend that a litmus test is used to check the pH of the tears – this should be between 6.5 and 7.4 (Abelson et al, 1981). Fluorescein eye solution identifies any corneal abrasions or ulcerations, and a slit lamp will identify any deeper structural injuries (Fitzgerald O'Connor et al, 2015).

The history should include the following:

- Time and place of the injury
- Which parts of the body were injured and the symptoms the patient is experiencing
- What the chemical was, its volume and concentration (if known) or a description of the chemical (powdered, gaseous or liquid (clear or coloured))

Table 2. Roper-Hall (Ballen) classification of ocular chemical injuries

Grade	Prognosis	Cornea	Conjunctival limbus
I	Good	Corneal epithelial damage	No limbal ischaemia
II	Good	Corneal haze, iris and details visible	Less than one third limbal ischaemia
III	Guarded	Total epithelial loss, stromal haze and iris details obscured	One third to one half limbal ischaemia
IV	Poor	Cornea opaque, iris and pupil details obscured	More than half limbal ischaemia

From Singh et al (2013)

Table 3. Demonstration of the different depths of burn injuries

Nomenclature	Burn depth	Appearance	Healing
Superficial thickness burn	Epidermis	Erythema, minimal swelling and pain	7–14 days
Superficial partial thickness burn	Papillar dermis	Wet, pink blisters and moderate pain	2–4 weeks
Deep partial thickness burn	Reticular dermis	Less wet, red blisters and minimal pain	3–8 weeks with severe scar formation, need graft
Full thickness burn	Epidermis, dermis (eschar formation)	Dry, white and insensate	Need graft

From Anaesthesia Key (2017)

- The quality of the first aid. What has been used for first aid, the length of time first aid had been performed and whether first aid was immediate or delayed
- Whether there were any witnesses to the event
- Any other past medical history, drug, social and allergy history, including the last time the person has eaten.

A painful, blistered, erythematous blanching burn is likely a superficial partial thickness burn, whereas an insensate, pale, non-blanching burn is likely to be full thickness (Table 3).

Severe pain is the first symptom following a chemical burn and is used clinically as an indicator of persistent activity of residual unbound fluoride ions. Klauder et al (1955) originally speculated that pain occurs as a result of the immobilisation of calcium by fluoride ions resulting in a local hyperkalaemic effect. This causes a persistent neuronal stimulation of the nerve which disrupts depolarisation and conductivity (Greco et al, 1988; McKee et al, 2014).

Assessment of the burn wound and referral

All wounds require evaluation before dressing the wound and referring the patient to a burns service. All blisters should be debrided at the referring hospital, a photograph taken of the wound and dressed with clingfilm. The clingfilm must not be tight around a limb nor should clingfilm be applied to the facial area as this would cause airway compromise.

All patients with chemical burns must be referred to at least a plastic surgery service for discussion. Referring hospitals should consult with the national guidelines established by the British Burns Association to direct the referral based on the size and depth of the burn (Tables 4 and 5) (NHS Specialised Services: National Network for Burn Care, 2012).

Tissue penetration of hydrofluoric acid is dependent on the length of time the skin is exposed to the chemical as well as the concentration. Fluoride penetration increases four times when the exposure time is extended from 1 minute to 3 minutes. Severe dermal injury as a result of coagulation necrosis occurs with hydrofluoric acid concentrations of >30%, resulting in greater accumulation of fluoride ions. Extensive dermal injury is

Table 4. UK paediatric burns referral thresholds

Criteria		Facility threshold	Unit threshold	Centre threshold	Note
Total body surface area	Refer	2–5%	5–30%	≥ 30%	
	Discuss		5–15% <1 year ≥20% 10% + <1 year	≥ 15% <1 years	
Depth	Refer	All full thickness burns	≥2% full thickness <10 years old or ≥1% thickness if under 6 months		All burns that are not blanching should be referred to a specialised burn service
Site	Refer		Any significant burn to special areas (hands, feet, face, perineum or genitalia) Any circumferential burn		
	Discuss	Any burns to special areas (hands, feet, face, perineum or genitalia)			
Mechanism	Discuss	Any chemical, electrical or friction burn. Any cold injury			
Other factors	Refer	Any burns not healed in 2 weeks Any significant deterioration in physiology Any burn with suspicion of non-accidental injury should be referred to a burn unit or centre for expert assessment within 24 hours	Any predicted or actual need for a high dependency unit or paediatric intensive care unit (including those predicted to require support for reasons other than the burn injury, for example smoke inhalation) Any child who is physiologically unstable as a result of burn injury	All those predicted to require assisted ventilation specifically for their burn injury for more than 24 hours	Any child requiring assisted ventilation for >24 hours must be within a paediatric intensive care unit. It is recommended that all children with smoke inhalation (irrespective of the presence of burn injury) are referred to a paediatric intensive care unit with a specialised burn care service on site
	Discuss	Unwell or febrile child with a burn Any concern regarding burn injury or any comorbidities that may affect treatment or healing of the burn	All children with major trauma + burn injury (post treatment within major trauma centre) where the burn injury meets unit level thresholds Any burn injury in a neonate should be discussed with a burn unit or centre	All children requiring respiratory support All children with major trauma + burn injury (post treatment major trauma centres) where the burn injury meets centre level thresholds Any burn injury in a neonate should be discussed with a burn unit or centre	The treatment of children with major trauma + burn injury should be agreed between the trauma service and the appropriate specialised burn service Neonates should only be admitted to burn services with an onsite neonatal intensive care unit

From British Burn Association (2012)

seen after 20 seconds exposure to 70% hydrofluoric acid (McKee et al, 2014). As a result, electrocardiograph changes occur including prolonged QT interval, torsades de pointes and ventricular tachycardia (McKee et al, 2014).

The size of the burn should be estimated using a Lund and Browder chart or using a mobile application, such as the Mersey Burn application (Barnes et al, 2015). A resuscitation burn injury is dependent on the percentage total body surface area which is burned. Burns greater than 10% in a child and 15% in an adult require referral to a burn centre. All patients should be kept warm and urine output of 0.5–1 ml/kg/hr should be achieved following a chemical injury. The management of a resuscitation burn is beyond the scope of this review.

Toxbase should be consulted for any chemical injury and the referrer should seek advice from the National Poisons Information Service (Whitaker et al, 2019). Chemical burns may

Table 5. UK adult burns referral thresholds

Criteria		Facility threshold	Unit threshold	Centre threshold	Note
Total body surface area	Refer	3–10% (including those with inhalation injury)	10–40% 10–25% with inhalation injury	≥40% ≥25% with inhalation injury	The minimum indication for inhalation injury is defined as – visual evidence of suspected upper airway smoke inhalation, laryngoscopic and/or bronchoscopic evidence of tracheal or more distal contamination/injury or unconscious at scene with suspicion of inhalation or raised carboxyhaemoglobin levels If there are any concerns regarding inhalation injury with a patient with any size burn then it should be discussed with a burn care centre
	Discuss			25%+	Special consideration should be given to referring patients >65 years with 25%+ total body surface area (especially where there are comorbidities) to the burn care centre
Depth	Refer	Any full thickness burns	5–40% if non-blanching		All burns that are non-blanching should be referred to a specialised burn service
Site	Refer		Any significant burn to special areas (hands, feet, perineum or genitalia) Any non-blanching circumferential burn		
	Discuss	Any burn to special areas (hands, feet, perineum or genitalia)			
Mechanism	Discuss	Any chemical, electrical or friction burn. Any cold injury			

Table 5. UK adult burns referral thresholds (continued)

Other factors	Refer	Any burn not healed in 2 weeks	Any predicted or actual need for high dependency unit or intensive care unit level care Any burn with suspicion of non-accidental injury should be referred to a burn unit/centre for expert assessment within 24 hours		
	Discuss	Any concern regarding burn injury and comorbidities including any comorbidities that may affect treatment or healing of the burn	Patients who are pregnant All patients with major trauma + burn injury (post treatment within major trauma centre) where the burn injury meets unit thresholds	All patients with major trauma + burn injury (post treatment within major trauma centre) where the burn injury meets centre level thresholds Patients assessed as requiring end of life care should be discussed with a consultant burn specialist at a burn centre (to discuss the appropriateness of local palliative care vs transfer to a centre)	The treatment of patients with major trauma + burn injury should be agreed between the trauma service and the appropriate specialised burn service (in accordance with the total body surface area, depth, site and mechanism criteria listed above)

From British Burn Association (2012)

have typical characteristics. Acid burns are likely to result in a brown appearing wound surface (eschar) while an alkali burn may result in a necrotic or ulcerative appearance. These burns may be more difficult to assess than non-chemical injuries. Burn care specialists use laser Doppler imaging to assess the vascularity of the burn wound and the depth of the burn injury, but this has limited effectiveness in chemical burns.

Management

The management of a caustic burn follows the basic principles of removal of the agent, irrigation, the use of neutralising agents, treatment of systemic toxicity, assessment and referral of the patient to a burns service (Williams and Leo, 2018). However, specialised treatment is required for certain agents as shown in [Table 6](#). This is not an exhaustive list but describes the common caustic injuries referred in the UK.

Removal of a powder agent

Following stabilisation of the patient after initial assessment, the chemical should be removed if it has not already been done at the scene of the injury. The aim of first aid is to remove the source of injury without spreading it to other areas of the body. Any residues or powdered chemical should be brushed off the skin, taking care not to transpose the chemical onto unaffected areas of the body. Irrigation should only be performed once the chemical powder has been removed to prevent the conversion of powder into a solution (Tan and Wong, 2015; Williams and Leo, 2018).

Irrigation

Irrigation should be performed as a continuous lavage (for example, a shower) onto the affected area. The patient must not bathe the burned area as this will further spread the

Table 6. Management of individual chemical agents

Agent	Management
Hydrochloric acid and sulphuric acid	Immediate irrigation of the burn wound and consideration for early excision of non-viable tissue
Cement	Typically cement burns present late. The cement powder is brushed off and irrigated with saline or water (Williams and Leo, 2018). These often require surgical excision because of the depth of the burns, which are typically deep dermal or full thickness
Tar	Hot tar causes liquefactive necrosis if not removed immediately. Using baby oil or peanut butter aids removal. The wound bed is irrigated with water (Williams and Leo, 2018)
Hydrofluoric acid	<p>Immediate application of calcium gluconate at the moment of injury followed by irrigation of the wound. Calcium gluconate gel can be reapplied every 4–6 hours. If the hand is affected, it can be placed in a glove of calcium gluconate gel to provide relief, or calcium gluconate can be injected into the wound if no relief is provided. Hydrofluoric acid burns as small as 2.5% total body surface area can be lethal (Greco et al, 1988). An electrocardiogram should be performed and serum electrolyte levels investigated. The electrocardiogram should be checked for a prolonged QT interval which may occur before potentially fatal arrhythmias</p> <p>The concentration of hydrofluoric acid will determine the onset of injury (>50% immediate injury, 20–50% several hours, <20% up to 24 hours)</p> <p>Early excision is warranted to remove the hydrofluoric acid before severe toxicity ensues. If fingertips are involved, the nail plates can either be removed or trimmed under local anaesthetic (Yoshimura et al, 2011)</p>
Alkali agents	Immediate irrigation with consideration for early excision of devitalised tissues (Williams and Leo, 2018)

agent to unaffected areas of the body (Tan and Wong, 2015; Williams and Leo, 2018). There is limited evidence for prolonged irrigation. The only available evidence for the length of time to irrigate a caustic burn is just 20 minutes (Walsh et al, 2016). Some hospitals, without any supporting evidence, apply continuous irrigation until the pH of the skin is neutral. However, the pH of skin ranges between 4–6 depending on the site of the body, race and integrity (such as the presence of a dermatological condition) (Ali and Yosipovitch, 2013). In addition, wounds have a different pH to that of normal skin. Deep dermal and full thickness burns have an alkaline pH, while more superficial burns have lower pH levels (Sharpe et al, 2013). Therefore, there is no rationale for continuous irrigation for cutaneous caustic burns as it will be unachievable to obtain a pH of 7 and will put the patient at risk of hypothermia (Ali and Yosipovitch, 2013). Some studies recommend the use of hypertonic solutions (such as saline) instead of water (which is hypotonic) in the belief that the hypertonic solution drives the chemical out of the subcutaneous fat across an osmotic gradient, but there is limited clinical evidence for this. Use of water rather than hypertonic agents should be encouraged at the time of injury (Kuckelkorn et al, 2002; Hayek et al, 2010; Sharpe et al, 2013; Wang and Han, 2014).

Neutralisation agents

Neutralisation with agents like diphoterine and calcium gluconate should be used when appropriate. Diphoterine is a hypertonic, amphoteric, polyvalent and chelating solution which binds the chemical agent. Diphoterine is becoming more readily available in industrial factory settings, burns unit and ambulances (Alexander et al, 2018).

Diphoterine is safe to be used in the treatment of cutaneous and ocular injuries. Pre-clinical studies have shown a faster resolution of skin pH and reduced tissue necrosis. Although a small number of clinical studies have shown this, their methodologies are poor with a high risk of bias. It is advisable that in the absence of diphoterine, immediate decontamination is performed via irrigation with water or saline (Kalson and Dheansa, 2013; Alexander et al, 2018).

Calcium gluconate is a specific agent for the treatment of hydrofluoric acid injuries. Calcium gluconate chelates the free fluoride ions, forming an insoluble salt which neutralises its toxic effect and reduces pain. Calcium gluconate is manufactured as a gel, and an injectable eye wash as well as an injectable solution (McKee et al, 2014; Williams and Leo,

2018). Fluoride ions will continue to be released after the acid has penetrated within the skin. Calcium prevents the gel being absorbed into the skin and therefore multiple applications are required throughout the day for the gel to be effective at chelating the fluoride ions (Williams and Leo, 2018). Owing to this limitation of the gel, calcium gluconate injection can also be injected into the skin.

Hexafluorine is a new solvent developed for the decontamination of hydrofluoric acid. It is an amphoteric substance used to neutralise or chelate free hydrogen and fluoride ions limiting tissue damage (Mathieu et al, 2001; Lewis et al, 2020). Case reports have demonstrated encouraging results for its use in hydrofluoric acid burns (Yoshimura et al, 2011; Siéwé et al, 2012). However, similar to diphoterine, there is limited evidence of its effectiveness (Hultén et al, 2004).

Treatment of systemic toxicity

While first aid is ongoing, systemic toxicity should be investigated and managed (Hultén et al, 2004). The most common finding following a large chemical burn is an acid–base imbalance. This will require monitoring with routine venous blood gas analysis. This may require escalation of care to a high dependency unit or an intensive care ward for respiratory support or haemofiltration. Serum electrolyte levels should be monitored every several hours for electrolyte disturbances, to reduce the risk of cardiac arrhythmia or seizures (Gnaneswaran et al, 2015).

Patients with hydrofluoric acid injuries are at risk of developing hypocalcaemia (most common electrolyte disturbance), hypomagnesaemia and hyperkalaemia. Acute hypocalcaemia is managed with intravenous 10–20 ml of 10% calcium gluconate in 50–100 ml of 5% dextrose over 10 minutes with electrocardiogram monitoring. This is repeated until normocalcaemia has been achieved (Turner et al, 2016).

Surgery

Surgery is performed to debride non-viable burn tissue until a healthy bed is established and is subsequently skin grafted. Surgical management for burn wounds may be determined by factors relating to the wound or the patient. Immediate surgery is typically reserved to debride burnt skin in patients with a high concentration chemical burn or not showing signs of improvement despite aggressive non-surgical management or resuscitation (Williams and Leo, 2018). Surgery may be delayed in cases where the burn depth is difficult to assess and time is allowed for the wound to demarcate over 2 or 3 days. In cases where there is doubt as to whether the wound is superficial a ‘test shave’ is performed. If the burn is deep then the wound is debrided, otherwise the wound may be simply dressed.

Psychological support

There is limited research on the psychological sequelae following a chemical injury or attack. However, psychological consequences of facial trauma or burn injuries include post-traumatic stress disorder, poor body image, addiction, depression, stigmatisation and social isolation (Lewis et al, 2020). According to the National Burn Care Standards, all patients should be assessed for psychological distress by a clinically trained psychologist or psychiatrist. The four main domains for targeted psychological therapy include post-traumatic stress disorder, grief and adjustment, coping with the patient’s new visible difference and to provide psychological pain management strategies. The key components of targeted psychological therapy are described in [Table 7](#) (Lewis et al, 2020).

Conclusions

Caustic burns represent a small percentage of burn injuries which occur each year across the UK. As these injuries can have significant consequences, are relatively uncommon to emergency departments, involve complex compounds and affect specialised areas of the body it is in the best interest that patients are discussed with or referred to a burns service. However, a good assessment of the injury with details of the agent and initiating immediate first aid will improve the outcome for the patient.

Table 7. Psychological aspect of burns

Psychological domain	Targeted therapy
Post traumatic stress disorder	Cognitive behavioural therapy (to facilitate the processing of traumatic memories) Eye movement desensitisation and reprocessing therapy. Similar to cognitive behavioural therapy but eye movements are triggered which are associated with processing neural mechanisms in memory (Lewis et al, 2020)
Grief and adjustment	To facilitate the grieving process to complete four key tasks: 1. Accept the reality of loss 2. Process the pain of loss 3. Adjust to life without loss 4. To connect the loss with a continuing life (Lewis et al, 2020)
Visible difference	Improve social communication skills, building self confidence, learning how to live with a changed appearance in the pursuit of other values (Lewis et al, 2020)
Pain	Distraction therapies, guided imagery, cognitive behavioural therapy, relaxation therapy (Lewis et al, 2020)

From NHS Specialised Services: National Network for Burn Care (2012)

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Conflicts of interest

The authors declare that there are no conflicts of interest.

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Key points

- A chemical burn is a burn sustained from a variety of many different types of chemical agents (not just by acids).
- Early first aid removes the agent, reducing the risk of deleterious effects.
- Many different first aid agents have limited evidence for their effectiveness in neutralising the chemical substance.
- Hydrofluoric acid burns (as small as 2.5% of the total body surface area) can be fatal.

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