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A case of chemical assault in Hong Kong (case report)

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ABSTRACT

INTRODUCTION: This case report aims to raise awareness of the unique protocol developed in the Prince of Wales Hospital (PWH) in Hong Kong, for the acute management of acid assault burns. Chemical assaults are rare in the UK, although, previously there have been several high-profile cases in the past three decades. In Hong Kong, acid assaults are more common, and a unique strategy has been developed to deal with the immediate injury.

PRESENTATION OF CASE: This case report describes a 16-year-old girl assaulted with an acid solution by her 17-year-old ex-boyfriend. She sustained an 8% TBSA burn involving her face, upper-limbs and back. Immediate lavage was commenced at the local hospital prior to transfer to the PWH burn centre. She underwent urgent (<48 h) EUA in theatres and her burns were tangentially shaved to active bleeding. She then received 48 h of saline soaks changed two-hourly prior to definitive treatment.

DISCUSSION: The conventional strategy for acid burns had been continuous lavage for two to three days, followed by delayed shaving and grafting. Outcomes were often poor with disproportionate needs for reconstructive procedures compared to thermal burns. Since introducing the new protocol three-years ago, outcomes have improved and can be quantitatively assessed in terms of decreased reconstructive needs.

CONCLUSION: The benefits of urgent reduction in chemical load is intuitively obvious, and by shaving tangentially to bleeding, vital tissue is preserved. Trying to prove benefit in terms of an RCT is however ethically challenging.

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1. Introduction

Victims of chemical assault burns suffer from significant and devastating long-term psychological and physical effects. Optimal immediate management is paramount to minimize these adverse effects. In the literature, between 12 and 44% of all burn assaults are attributed to chemical agents [1–3]. Worldwide, chemical assault occurs most commonly in developing countries, where there are limited medical resources and poor law enforcements [4]. Bangladesh, for example, has the highest incidence of reported chemical assault cases [5]. Interestingly, in the UK, although relatively less common, several high-profile cases in recent years have amplified the awareness of chemical assault burns in the developed world. Hong Kong, often regarded as the capital of Asia, paradoxically, offers a unique cultural and geographic infrastructure that increases the incidence of chemical assaults compared

to their counterparts [6]. Its geographic relation with the developing mainland China results in a high influx of cross-border burns victim transfer, facilitates easier access to chemical agents, and in some cases, promotes cross-border second marriages that can lead to domestic disputes and violence. Secondly, the high population density in Hong Kong is associated with relatively high rates of domestic crime. It is concerning that despite the reduction in the overall number of assault cases in Hong Kong, the incidence of chemical assaults is increasing [6,7]. Over a ten-year period, PWH had treated 31 cases of acid assault burn [7]. The aim of this case report is to raise awareness the unique protocol, which emphasises the urgent surgical intervention in the acute management of chemical burns that have been developed in Prince Wales Hospital in Hong Kong.

2. Presentation of case

This report describes a case of an acid assault burn suffered by a 16-year-old girl. The assailant was her 17 year old ex-boyfriend. The incident took place outside the backdoor of her family residence. The acid was thrown at her face, but she raised her arms and turned away to limit the facial damage. She sustained an 8% TBSA burn

Abbreviations: EUA, examination under anaesthesia; TBSA, total body surface area; PWH, principle of Wales Hospital Hong Kong; RCT, randomised controlled trials.

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Fig. 1. Confluent burn of the face, scalp, limbs and back: Day 0 in accident emergency (top row); Day 12 urgent shaving (middle row); Day 20 post injury (bottom row).

of which 6% was deep dermal to full thickness. The burn involved the face, posterior scalp and multiple patches over her back and upper limbs (Fig. 1). She was initially taken to the nearest hospital, which commenced primary resuscitation with immediate lavage. The extent of her injuries, which included airway compromise and chemical assault, fitted the criteria for transfer to a Burns Centre for definitive care (Table 1). She was subsequently transferred to PWH. She was primarily seen in the Emergency department and the severity of injuries was assessed; immediate lavage was continued. Urgent eye consult was requested to document corneal damage and institute appropriate therapy. Her burn injuries matched the criteria for urgent examination under anaesthesia (EUA), which included confluent areas of discoloured skin greater than 20 cm² on the face and 100 cm² on the trunk or limbs (Table 1). She was taken immediately from the emergency room to the operating theatre for an EUA. Tangential test shaves were performed in all burn areas confirming that the burns were deep, and thin layers of tissue were removed until there was active bleeding (lacuna-like or punctate bleeding) (Fig. 2). Over the next forty-eight hours she had saline soaks applied that were changed every two hours. This was

followed by application of porcine skin to the wound bed to assess the suitability for grafting. At day three to five she was taken back to theatre for some supplementary shaving and definitive grafting. One year after the incident, her wounds had healed well with minimal hypertrophic scarring on the trunk and limbs. The burns on the face that had been shaved also healed with minimal hypertrophic scarring, but two linear tracks of hypertrophic scar developed in two areas of burn that were thought to be too narrow for initial tangential shave. These hypertrophic areas were attributed to where the acid had run off, and they were subsequently treated with minor revision surgery. Overall, she made a remarkable recovery psychologically and physically.

3. Discussion

The conventional acute treatment of chemical burns consists of immediate and continuous water lavage for two to three days, followed by, often within one week, excisional surgery and grafting [8–11]. Outcomes from this approach were often poor with a disproportionate need for reconstructive procedures compared to

Table 1
Protocol for acute management of acute assault burns in Prince of Wales Hospital [7].

- Determine extent and severity of injury on admission to accident and emergency department
- Commence immediate lavage with running water
- Arrange for immediate eye consultation if eye involvement is suspected
- For confluent areas of discoloured skin in the face (> 20 cm²) and trunk or limbs (> 100 cm²), arrange for urgent examination under anaesthesia (EUA) in the operating theatres
- For smaller burns, arrange for transfer to burns unit and continue lavage
- For patients undergoing EUA, perform test shaves to determine depth of injury and shave entire to achieve active bleeding (lacuna-like or punctate bleeding)
- Continue lavage by applying wet dressing changed every two hours for 48 hours
- At 48 hours, apply porcine skin to wound to test graft bed
- After further 24–48 hours, return to operating theatres for supplementary shave if necessary and definitive grafting with thick split thickness skin graft and over graft donor site



Fig. 2. Tangential shaving to active bleeding (lacuna-like or punctate bleeding) for removal of non-viable burnt skin and chemical load, and preservation of viable skin.

thermal burns [7]. Hypertrophic scarring is often the sequelae from conventionally treated acid burns, a feature of prolonged chemical inflammatory stimulation to a wound. This was inadvertently, but successfully demonstrated in our case by the dense scar that formed in the areas not shaved urgently.

Data from our centre showed that even burns that were excised as early as day two or three post-burn produced less than desirable outcomes, thus the rationale for immediate surgical intervention were postulated. A retrospective study conducted at our centre compared the need for reconstruction post-acute management of chemical burns, between urgent (within 48 h), conventional (within one week) and delayed (after one week) surgery. The study showed a significantly higher need for reconstruction in the 'delayed' group, compared to the other groups. However, it failed to show a significant difference in reconstructive needs between the 'urgent' and 'conventional' group; nevertheless, the 'urgent' group displayed subjective outcome improvement and without any adverse effects (Fig. 3) [7].

The nature of chemical injuries is that they produce a leathery-like tissue response that mandates careful tangential shaving, rather than other debridement modalities such as Versajet or dermabrader, which often markedly tears tissues. Tangential shaving removes sequential ultra thin slices of dermis until the appearance of lacuna-like or punctate bleeding, which indicate the presences of dermal elements. This technique maximally preserves healthy and viable tissue, whilst reducing the chemical load. In acid burns, the depth of tissue damage is often deeper than they appear, and is governed by acid concentration and duration of contact. Our experience has been that we usually shave to the depth of the dermal papillae, which often presences as a lacuna of oxygenated blood that had mingled with the inflammatory fluid at the dermis-adipose tissue interface; we refer to that as lacuna-like bleeding. This bleeding is not as profuse as we might see in a partial thickness thermal burn shaved to punctate bleeding, which represents an intact deep dermal layer. It is a matter of clinical judgment and there is a learning curve. We appreciate the viability of tissues at the acute setting may be more difficult to access, but with careful tangential shaving only down to lacuna-like or punctate bleeding, we achieve reduction in chemical load with minimal risk of over-debridement. The aim is to reduce the chemical load, but not eliminate it, which is why the lavage is continued. Using porcine skin to 'test the bed' prior to definitive grafting has been a useful adjunct and we have occasionally had to remove some further tissue before the definitive graft.

The principle first-aid in thermal burns is: removal of heat source and promotion of cooling; whilst chemical burns is: dilution. However, the practicality of continuous lavage for extended periods of time to achieve adequate dilution, for chemical burns of the face, is not always feasible. Thus, early tangential shaving may provide an inherent benefit for facial burns. Furthermore, laboratory research is required to clarify the efficacy of 'dilution' for coagulative necrosis, as present in acid burns.

There are a number of research limitations in the analysis of the efficacy of urgent surgical interventions for chemical burns; they include small sample sizes, patient variability i.e. severity and location of the burn, and issues with ethical approval. Whilst an RCT would be ideal, it would be ethically questionable. Having said that, the conventional treatments have evolved and are not based on scientific evidence. Prospective studies involving a trial of both interventions i.e. conventional versus urgent shaving, on an individual patient may be an alternative. This could be applied for industrial burns in anatomical locations of low aesthetic impact.

On the whole, early shaving of chemical burns reduces the progression of continuing corrosive acid tissues damage where simple lavage may fail to prevent, and shaving tangentially minimises excessive removal of viable and healthy tissues. The lack of



Fig. 3. Prominent hypertrophic scarring in non-urgent surgery > 48 h (top row); compared to reduction in hypertrophic scarring in urgent surgery < 48 h (bottom row) [7].

hypertrophic scarring and need for further reconstructive surgery demonstrated in this case report highlighted the benefit of urgent surgical intervention, as described in our protocol for the acute management of chemical burns.

4. Conclusion

The benefits of urgent reduction in chemical load is intuitively obvious. Tangential shaving to lacuna-like or punctate bleeding optimally preserves viable and healthy tissues, whilst removing residual acid-load. Our protocol for acute management of chemical burns has shown benefits in reducing hypertrophic scarring and the need for further reconstructive surgery, as demonstrated by this case report and previous retrospective comparative studies. Trying

to prove the benefit of urgent shaving in terms of an RCT would be ethically challenging. In the meantime, *primum non nocere* (do no harm), requires urgent reduction of dermal acid load, as lavage alone is not enough.

Conflict of interest

We have no conflict of interest.

Consent

We had informed and written consent from this patient for writing this paper.

Authors contribution

Billy Ching Leung: Lead author – Writer of case report.

Andrew Burd: Senior consultant author – Reviewer of case report.

References

- [1] W.S. Ho, et al., Assault by burning—a reappraisal, *Burns* 27 (5) (2001) 471–474.
- [2] G.F. Purdue, J.L. Hunt, Adult assault as a mechanism of burn injury, *Arch. Surg.* 125 (2) (1990) 268–269.
- [3] W. Brodzka, H.L. Thornhill, S. Howard, Burns: causes and risk factors, *Arch. Phys. Med. Rehabil.* 66 (11) (1985) 746–752.
- [4] A. Mannan, et al., Cases of chemical assault worldwide: a literature review, *Burns* 33 (2) (2007) 149–154.
- [5] A. Faga, et al., Sulphuric acid burned women in Bangladesh: a social and medical problem, *Burns* 26 (8) (2000) 701–709.
- [6] R.C. Young, et al., Chemical assaults in Hong Kong: a 10-year review, *Burns* 28 (7) (2002) 651–653.
- [7] A. Burd, K. Ahmed, The acute management of acid assault burns: a pragmatic approach, *Indian J. Plast. Surg.* 1 (2010) 29–33.
- [8] D.W. Mozingo, et al., Chemical burns, *J. Trauma* 28 (5) (1988) 642–647.
- [9] L.G. Leonard, J.J. Scheulen, A.M. Munster, Chemical burns: effect of prompt first aid, *J. Trauma* 5 (1982) 420–423.
- [10] K. Yano, et al., Experimental study on alkaline skin injuries—periodic changes in subcutaneous tissue pH and the effects exerted by washing, *Burns* 19 (4) (1993) 320–323.
- [11] K. Yano, et al., Effects of washing acid injuries to the skin with water: an experimental study using rats, *Burns* 21 (7) (1995) 500–502.

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