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CASE SERIES BURNS

Chemical burns to scalp from hair bleach: a retrospective case series

Omar Noori BSc (Hons), MPhil, MD 0000-0002-0913-6022,[1,a] Peter Maitz AM, MD, FRACS (Plast) 0000-0002-8257-7414,[1,2,3] Jeon Cha BMedSci (Hons), MBBS, FRACS (Plast) 0000-0002-3184-1932,[4] Andrea C Issler-Fisher MD, PhD, EBOPRAS 0000-0002-7453-1248[1,2,3]

[1] Burns Unit, Concord Repatriation General Hospital, Sydney, New South Wales, AUSTRALIA. [2] ANZAC Research Institute, Concord Repatriation General Hospital, Sydney, New South Wales, AUSTRALIA. [3] Concord Clinical School, University of Sydney, New South Wales, AUSTRALIA. [4] Royal North Shore Hospital, St Leonards, New South Wales, AUSTRALIA.

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Abstract

Background: Hair bleaching has become a common cosmetic procedure and the use of cytotoxic chemicals can cause serious burns to the skin.

Methods: A retrospective case series from 2016 to 2020 in the two major statewide tertiary referral burns centres in Sydney, New South Wales, Australia.

Results: We present 14 patients (mean age 27 years) with skin burns secondary to hair-bleaching procedures. The majority of these burns had full thickness components (71%, n = 10) requiring grafting surgery (n = 6). The mean size of all burns was 0.6 per cent (0.1%–2.5%) of total body surface area. One patient received adequate first aid at the time of injury. Most burns occurred in a professional setting (71%, n = 10).

Conclusion: This case series highlights the dangerous nature of hair-bleaching chemicals. Rigorous education, training, first aid management, and clear informed consent between proceduralists and clients are needed in order to prevent this physiologically and psychologically debilitating accidental injury.

Introduction

Hair bleaching is a very common procedure and with the growth of various hairstyling products, adverse events such as chemical or thermal burns have become a reality.[1] Thermal burns are caused by direct heat from straighteners, curling irons, blow dryers and heated aluminium foils.[1–4] Chemical burns are caused by the caustic chemicals in hair care products, including persulphates and hydrogen peroxide, which can result in allergy-like reactions to full thickness burns.[5,6] Although allergy-associated dermatitis caused by hair care products has been reported in the literature,[7–10] there are fewer studies reporting on chemical burns.[11] Burns from bleaching products can occur as an isolated alkaline burn or, if used with foils and heat, as a mixed thermal and chemical burn. These type of burns and associated scarring can present a huge psychological and physiological burden for patients. Full thickness burns can cause alopecia and often require hospitalisation, excisional surgery and grafting, which can result in visual

[a] Corresponding author: Omar Noori BSc (Hons), MPhil, MD; onoo8711@alumni.sydney.edu.au

skin defects and the need for ongoing scar revision procedures.[3,7] As part of reconstruction, tissue expanders may be used which are psychologically draining to patients.[12]

Bleach is commonly used to lighten hair colour. It typically uses an alkaline solution that opens up the hair shaft. This allows chemicals such as hydrogen peroxide to react with melanin in the hair and render it non-reactive to light so that hair appears lighter.[13] Bleach may be applied directly onto all the hair or just to specific strands of hair using aluminium foil. The bleaching process is often accelerated by the use of hair dryers.[3,6,11,14] The bleaching products used on hair are also used for cleaning and disinfection and they can react with biological tissue leading to skin irritation and/or cell death via protein denaturation.[15] Alkaline burns typically cause liquefactive necrosis in affected tissue and can cause deeper burns as alkaline chemicals continue to penetrate skin following initial contact.[16]

This study was designed to investigate characteristic features of chemical and/or thermal burns secondary to a hairstyling procedure, in order to identify preventative measures, counsel patients and discuss implications for society. Given the scarcity of literature and prevailing lack of awareness, this study's core purpose was to highlight the noteworthy fact that hair colouring in a professional salon setting can result in substantial wounds necessitating surgical intervention. This underscores the imperative need for enhanced education among both patients and salon practitioners.

Methods

Patients referred to either Royal North Shore Hospital or Concord Repatriation General Hospital were clinically assessed by a surgical trainee and/or a specialist surgeon. Data was retrospectively collected via medical records from 2016 to 2020. Ethics approval was granted from the Research Ethics and Governance Information System (2021/PID02336).

Fourteen patients were included with chemical burns secondary to a hairstyling procedure. Cases were excluded if burns were non-chemical in nature or not a direct consequence of a hairstyling procedure. Sensitive data were de-identified and each patient was allocated a study ID. Parameters analysed included demographic data and burn injury details—adequate first aid use, burn mechanism, percentage of total body surface area (% TBSA) burnt, burn depth (superficial, mid-dermal, full thickness), and site of injury. Information about management included operative versus non-operative, admission, number of operations, complications (graft loss, wound infection, dehiscence), and hospital length of stay.

Results

This retrospective analysis included 14 patients. The majority of patients were female (n = 13, 93%) and the mean age was 27 years (range 16–51). No patients had pre-existing skin conditions or debilitating morbidities. All patients presented with accidental chemical burns secondary to hairstyling procedures. Ten cases (71%) occurred in the professional setting. All patients exhibited burns to the scalp/head with one patient additionally presenting with neck burns. **Figure 1** demonstrates some patient burns.

Fig 1. Clinical photographs of patient burns

One patient (7%) administered first aid which included removing the bleach and running the affected area under cool running water for 20 minutes. The average time between the incident and presentation to our clinic was 23.1 days (n = 14, range 1–65). Six patients (43%) described a stinging/burning sensation during the procedure. All burn wounds were small with an average of 0.6 per cent TBSA affected (range 0.1–2.5%). Ten patients had full thickness components to their burns (n = 10, 71%). Three patients (21%) sustained mid-dermal thickness burns and one patient (8%) had superficial (purely epidermal) depth burns.

Six patients (43%) were managed operatively, three patients were managed conservatively (21%) and five patients were lost to follow-up (36%). No complications were reported during their treatment. Only one patient with a full thickness burn requiring grafting needed an overnight stay (7%). All others were discharged on the same day of the operation. Further details about the cases and burn features are described in **Table 1**.

Discussion

Although rarely reported in the literature, the presented case series shows that chemical burns secondary to hairstyling procedures do occur. In line with the present literature, our results confirm that hairstyling-related burns are often full thickness in depth and involve the scalp and occasionally the neck.[7, 11, 14, 17] Although operator error when applying these products to hair can precipitate these injuries, the presented study suggests that the majority of cases (n = 10, 71%) occur in professional hair salons. Interestingly, one study reported that hairdressers frequently observe transient redness caused by the application of bleaching chemicals, and often counsel their clients that symptoms do resolve within hours and most certainly within days.[4] Additionally, concentrations of bleach can potentially play a role as concentrations of hydrogen peroxide above 9 per cent can decrease the pH from 5.3 (10% hydrogen peroxide) to 4.5 (50% hydrogen peroxide) in an attempt to speed up the treatment process.[5] Many of our patients (n = 6) were symptomatic with pain during the procedure which is atypical for hair bleaching and could potentially serve as a warning sign.

Only one patient (7%) applied first aid with cool running water for at least 20 minutes. It is a well-established fact that first aid is proven to stop the burning process and thus reduce progression of the burn into deeper skin layers.[18] Thorough irrigation with water flow is the mainstay of immediate treatment and can reduce the occurrence of a full thickness injury and hospital stay by fivefold and twofold respectively.[18] Thus, identifying symptomatic clients during the hairstyling procedure itself and commencing first aid as soon as possible could reduce the severity and burden of burns when they occur.

The skin-grafting procedures exclusively involved split-thickness skin grafts, which were performed in a delayed manner. The rationale behind this approach primarily stems from the intrinsic nature of chemical burns, particularly alkaline burns, which tend to manifest gradually, culminating in liquefactive necrosis days subsequent to the initial incident. There were no reported complications encountered in this study.

While most clients displayed symptoms immediately after application of chemicals, there was significant variation in the number of days between injury and presentation (mean of 15 days; range 1–65 days). This supports the theory that chemical burns progress in depth over time and may not manifest until later, particularly if there is inadequate first aid at the time of the incident, which can contribute to deeper and more severe burns.[19] Lack of education about the severity of this type of chemical burn among primary healthcare providers may also contribute to delayed presentation and treatment. Regardless, hairstylists who use these chemicals should be aware of the early warning signs of a chemical burn and the first aid principles that need to be administered. These findings indeed support the introduction of preventative measures and the need for education among both individuals performing such procedures and clients receiving these treatments.

Given the depth and location of these burns, it can be very challenging for patients, as the injury itself is often long-lasting and frequently requires several operative interventions, such as grafting then reconstructive surgery. This, along with the cosmetic impact of scar-related alopecia, particularly in young females, can present a great physiological and psychological burden. The mechanism by which these burns occur has been well described in literature. Chemical burns cause damage by chemical reactions rather than heat. Hair-bleaching chemicals contain oxidising agents such as potassium and ammonium persulphates in concentrations of 25 to 60 per cent. When these chemicals come into direct contact with skin, it results in necrosis due to protein denaturation and cytotoxic effects.[6] Persulphates, which are also commonly found in these bleaching solutions, are

Table 1. Characteristics of patients and burns sustained

Sex	Age (years)	Mechanism of burn; location of incident	Days until presentation	Anatomical location	TBSA affected (%)	Depth of burn	First aid	Management
Female	39	Direct application of bleach; professional salon	26	Scalp	0.1	Full thickness (100%)	No	Skin grafting
Female	22	Direct application of bleach; professional salon	2	Scalp	1	Partial thickness (100%)	No	Conservative
Female	22	Direct application of bleach; onset of pain was immediate; professional salon	1	Scalp	0.3	Superficial thickness (100%)	No	Conservative
Female	33	During application of bleach with foils; onset of pain was immediate; professional salon	65	Scalp	0.3	Full thickness (100%)	No	NS
Female	41	During application of bleach with foils; onset of pain was the next day; location not disclosed	16	Scalp	0.3	Full thickness (100%)	No	NS
Female	51	Direct application of bleach; onset of pain was immediate; professional salon	4	Scalp + neck	1	Partial thickness (100%)	No	NS
Female	25	During application of bleach with foils; professional salon	37	Scalp	0.2	Full thickness (100%)	Yes	Skin grafting
Male	28	During application of bleach with foils; onset of pain was immediate; professional salon	39	Scalp	0.2	Full thickness (100%)	NS	Skin grafting
Female	16	During application of bleach with foils; professional salon	58	Scalp	0.1	Full thickness (100%)	No	Skin grafting
Female	20	During application of foils; onset of pain was immediate; location not disclosed	32	Scalp	0.2	Full thickness (100%)	No	NS
Female	21	Direct application of bleach; onset of pain was immediate; occurred at home	7	Scalp	2.5	Mixed (full thickness 80%; partial thickness 20%)	NS	Skin grafting
Female	18	During application of bleach with foils; professional salon	12	Scalp	1	Full thickness (100%)	NS	NS
Female	16	During application of bleach with foils; professional salon	14	Scalp	1	Full thickness (100%)	No	Skin grafting; serial excision and closure
Female	25	During application of bleach with foils; occurred at home	10	Scalp	1	Partial thickness (100%)	No	Conservative

NS =not specified

often added to make hair porous thus facilitating hair dye absorption. These chemicals, however, can cause irritant contact dermatitis, allergic contact dermatitis, urticaria, rhinitis and syncope, and have been deemed hazardous materials by regulators.[5] Hydrogen peroxide is often found in concentrations two to three times the limit of accepted norms and, at these concentrations, it has a lower pH that is more irritating and corrosive to the skin.[6]

Limitations of this study include the retrospective nature and small number of cases included in this review. Further studies could examine the long-term outcomes of these burns including graft take rates, scarring and longer-term complications.

Conclusion

This case series highlights the serious nature of chemical burns caused from hair-bleaching procedures. Recognising the scarcity of literature in this field, the intent of this study was to provide modest yet meaningful insights into the presentation and severity of injuries arising from hair-bleaching incidents. Further, we believe these injuries can be avoided by educating proceduralists, clients and primary healthcare providers on the warning signs and first aid principles that need to be applied early when such events occur. Clients should be notified prior to these procedures of the risks involved when being subjected to such hairstyling procedures. Regulatory bodies should ensure hydrogen peroxide concentrations are within acceptable limits to minimise damage. Hair product suppliers and hairstylists should also be educated and encouraged to clearly disclose the potential hazards of these chemicals. All these preventative measures could collectively reduce the incidence and/or severity of this injury.

Patient consent

Patients/guardians have given informed consent to the publication of images and/or data.

Conflict of interest

The authors have no conflicts of interest to disclose.

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References

1 Mehta S, Barnes D, Edwin A, Pape S. Burns in children caused by hair straighteners: epidemiology and investigation of heating/cooling curves. *J Burn Care Res*. 2008;29(4):650–54. https://doi.org/10.1097/BCR.0b013e31817db9a5 PMid:18535465

2 Qazi K, Gerson LW, Christopher NC, Kessler E, Ida N. Curling iron-related injuries presenting to US emergency departments. *Acad Emerg Med*. 2001;8(4):395–97. https://doi.org/10.1111/j.1553-2712.2001.tb02121.x PMid:11282678

3 Peters W. The hair color-highlighting burn: a unique burn injury. *J Burn Care Rehabil*. 2000;21(2):96–98. https://doi.org/10.1097/00004630-200021020-00003 PMid:10752740

4 Forster K, Lingitz R, Prattes G, Schneider G, Sutter S, Schintler M, Trop M. Hair bleaching and skin burning. *Ann Burns Fire Disasters*. 2012;25(4):200–202.

5 Sosted H, Johansen JD, Andersen KE, Menné T. Severe allergic hair dye reactions in 8 children. *Contact Dermatitis*. 2006;54(2):87–91. https://doi.org/10.1111/j.0105-1873.2006.00746.x PMid:16487280

6 Chan HP, Maibach HI. Hair highlights and severe acute irritant dermatitis ('burn') of the scalp. *Cutan Ocul Toxicol*. 2010;29(4):229–33. https://doi.org/10.3109/15569527.2010.509852 PMid:20854194

7 Wilson DI. Scalp burns in elderly women—the perils of the perm. *Burns*. 1999;25(2):182–83. https://doi.org/10.1016/S0305-4179(98)00127-2 PMid:10208396

8 Kerner E, Matheney K, Boertman JA, Sullivan WG. Facial and scalp burns from hair activator products. *J Burn Care Rehabil*. 1988;9(5):524–25.

9 Jensen CD, Sosted H. Chemical burns to the scalp from hair bleach and dye. *Acta Derm Venereol*. 2006;86(5):461–62. https://doi.org/10.2340/00015555-0102 PMid:16955201

10 Boucher J, Raglon B, Valdez S, Haffajee M. Possible role of chemical hair care products in 10 patients with face, scalp, ear, back, neck and extremity burns. *Burns*. 1990;16(2):146–47. https://doi.org/10.1016/0305-4179(90)90177-X PMid:2350412

11 Goon P, Misra A. A possible chemical burn to the scalp following hair highlights. *Burns*. 2005;31(4):530–31. https://doi.org/10.1016/j.burns.2004.11.020 PMid:15896523

12 Motamed S, Niazi F, Atarian S, Motamed A. Post-burn head and neck reconstruction using tissue expanders. *Burns*. 2008;34(6):878–84. https://doi.org/10.1016/j.burns.2007.11.018 PMid:18375071

13 Smith RAW, Garrett B, Naqvi KR, Fülöp A, Godfrey SP, Marsh JM, Chechik V. Mechanistic insights into the bleaching of melanin by alkaline hydrogen peroxide. *Free Radic Biol Med*. 2017;108:110–17. https://doi.org/10.1016/j.freeradbiomed.2017.03.014 PMid:28323131

14 Maguina P, Shah-Khan M, An G, Hanumadass M. Chemical scalp burns after hair highlights. *J Burn Care Res*. 2007;28(2):361–63. https://doi.org/10.1097/BCR.0B013E318031A1E9 PMid:17351461

15 Benzoni T, Hatcher J. Bleach toxicity. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; [Cited 8 July 2022]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK441921/.

16 Boutefnouchet T, Moiemen N, Papini R. An atypical cause of alkali chemical burn: a case report. *Ann Burns Fire Disasters*. 2010;23(4):216–18.

17 Fischer H, Caurdy-Bess L. Scalp burns from a permanent wave product. *Clin Pediatr (Phila).* 1990;29(1):53. https://doi.org/10.1177/000992289002900111 PMid:2293953

18 Leonard LG, Scheulen JJ, Munster AM. Chemical burns: effect of prompt first aid. *J Trauma*. 1982;22(5):420–23. https://doi.org/10.1097/00005373-198205000-00013 PMid:7077702

19 Akelma H, Karahan ZA. Rare chemical burns: review of the literature. *Int Wound J*. 2019;16(6):1330–338. https://doi.org/10.1111/iwj.13193 PMid:31446674 PMCid:PMC7949277