

Frostbite presentations during the hottest Australia summer on record: A retrospective case series.

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Background:

The summer of 2012/2013 saw the hottest summer in Australian history since records started in 1910. It would therefore seem unimaginable for an Australian Paediatric Burns Unit to have a spate of frostbite injuries throughout this heat wave.

Frostbite is defined as the acute freezing of tissues when exposed to temperatures below the freezing point of intact skin.^[1] Once seen as a military phenomenon, the frequency in the civilian population has risen over the past three decades. Reports of frostbite injuries in Canada found alcohol consumption (46%), psychiatric illness (17%) and vehicular trauma (19%) as risk factors.^[2] Studies of urban frostbite populations have suggested the overall rate of psychiatric illness occurrence in frostbite cases to be even higher with one paper reporting 100% overt or covert psychiatric disease.^[3]

The pathophysiology of frostbite represents a spectrum of injury severities ranging from irreversible cellular destruction to the reversible changes seen after rewarming. Two distinct mechanisms are responsible for tissue injury, cellular death occurring at the time of exposure with ice crystal expansion causing mechanical destruction^[4] and deterioration and necrosis attributable to progressive dermal ischemia.^[1] This poster presents 6 cases of frostbite encountered over the 2012/13 summer.

Case One:

15-year-old female presented to the Paediatric Burns Unit with mid dermal burns to the plantar surface, toes, mid heel and distal dorsal surface of her feet bilaterally (Figure.1) 24 hours after submerging her feet in a bucket of ice for as long as possible in a peer group dare.



Figure.1

Figure.2

Figure.3

Case Two:

13-year-old female presented with 1% Total Body Surface Area (TBSA) infected superficial to mid dermal burns to her left thigh. A week earlier, while on school holidays, she competed with friend to apply ice blocks to their thigh for as long as possible. The ice was covered in salt in an attempt to prevent the ice melting. After receiving the burn the patient went for a swim in a murky river to escape the heat and later presented to her general practitioner with an infected wound before referral to the Paediatric Burns Unit.

Case Three:

15-year-old female known to the Paediatric Burns Unit presented for unrelated wound review of the

upper body. It was the height of a heat wave with ambient temperatures above 35 degrees Celsius and the patient was noted to be wearing denim jeans and thick socks with boots. The socks were noted to be weeping and a pungent stench was obvious. On examination she had infected 2-3% TBSA mid dermal burns to the dorsal and plantar surface of both feet from deliberate self-harm from application of ice (Figure.2).

Cases Four to Six:

Three further teenage females were treated for mixed depth burns to the forearms as a result of "frothing", where each had sprayed their skin with an aerosol, holding the nozzle approximately 1 cm from the skin surface, for period of 20-30 seconds. All were known to the hospital's psychiatric team (Figure.3).

Discussion:

Aerosol sprays contain a chemical propellant stored in pressurised liquid form with evaporation points at subzero temperatures. With the rapid expansion and evaporation of the aerosol propellant during spraying, a cryogenic injury occurs when applied to the skin.^[5] Spraying aerosol for 20 seconds at a distance of 15 cm can result in a skin temperature -40C^[5] which results in formation of both intra and extra-cellular ice crystals within the tissues with subsequent tissue cell membrane lysis. This is followed by an inflammatory reaction similar to that of a hot thermal injury.^[1]

Cryogenic burns are extremely uncommon. These injuries are almost universally associated with occupational exposure of adults to agents known to represent a hazard, such as liquid nitrogen or pressurised ammonia.^[6] Although recently there has been an alarming increase in reported cryogenic skin burns in adolescents from deliberately spraying with an aerosol can at short distance or application of ice.^[5-7]

Self-inflicted burns are uncommon in Australia, making up just 4.1% of our total number of burns admissions.^[8] Previous studies have reported frequencies of self inflicted burns ranging from 0.5 to 2% in those 18 years and under, with the adult incidence being estimated as high as 25% of the total burn admissions.^[9]

A review by Stefanutti in 2010, reported 7 patients presenting with intentional cryogenic burns with a median age of 12.5 years and all with delayed presentation and 4 had infections.^[6] Management of these self inflicted cryogenic burns in adolescence are complicated due to the severity of the initial injury, the universal lack of first aid, the delay in seeking medical advice,^[6] infection and the poor compliance to the recommended treatment and follow-up possibly due to psychiatric illness.

There is a unique and complex biopsychosocial predisposition to such self inflicted cryogenic injuries in this adolescent age group including, decreased self-esteem, low or high parental support or restrictions, susceptibility to peer influence and sensation-seeking personality traits.^[10] Affective and thought disorders have been among the most consistent findings in self inflicted burns previously^[11] and a review incorporating 27 studies and 582 patients found that the most frequent psychiatric diagnoses in self inflicted burns were affective disorder (21%), schizophrenia (12%) and personality disorder (7%).^[12]

This is supported by 3 of the 6 patients in this study being known to the paediatric psychiatric team at Princess Margaret Hospital for Children.

Recent research suggests that during adolescence, individuals become increasingly more difficult in their personal attributes, behaviour (greater aggression and antisocial traits) and social competence (less cooperative, responsible, and self-controlled).^[6]

A disturbing study on deliberate self-injury of 30 subjects found a higher percentage of women with more than half of the patients aged less than 18. Single parent families were reported in 30% of cases and 30% of patients had been physically or sexually abused while 60% had a co-morbid psychiatric disorder and 63% had been hospitalised previously. Addictive disorders, such as substance abuse and eating disorders were often associated with a deliberate self-harm syndrome.^[13]

Conclusions:

During the hottest Australian summer on record, children, many early to mid teens have succumbed to peer group pressure and engaged in alarming and potentially disfiguring games using ice and pressurised gas canisters on their skin. These practices have led to a sudden spike in frostbite burns presentations and added to an already stretched burns care system.

These self-inflicted burns admissions in Australia are normally uncommon in the adult population and even more so in the paediatric population. A psychiatric history is a risk factor for self inflicted burns of a cryogenic nature.

Adequate preventative measures need to be instituted and further education of the families of the patients with known psychiatric disorders are required in order to reduce the incidence of self-inflicted injuries.

References:

- Murphy, J.V., et al., Frostbite: pathogenesis and treatment. J Trauma, 2000. 48(1): p. 171-8.
- Valnicsek, S.M., L.R. Chasmar, and J.B. Clapson, Frostbite in the prairies: a 12-year review. Plast Reconstr Surg, 1993. 92(4): p. 633-41.
- Pinzur, M.S. and F.M. Weaver, Is urban frostbite a psychiatric disorder? Orthopedics, 1997. 20(1): p. 43-5.
- Heggens, J.P., et al., Experimental and clinical observations on frostbite. Ann Emerg Med, 1987. 16(9): p. 1056-62.
- Lacour, M. and C. Le Coultrre, Spray-induced frostbite in a child: a new hazard with novel aerosol propellants. Pediatr Dermatol, 1991. 8(3): p. 207-9.
- Stefanutti, G., J. Yee, and A.L. Sparnon, Cryogenic burns from intentional use of aerosol spray in children: an emerging phenomenon. Burns, 2010. 36(5): p. 665-7.
- Camp, D.F., A. Ateaque, and W.A. Dickson, Cryogenic burns from aerosol sprays: a report of two cases and review of the literature. Br J Plast Surg, 2003. 56(8): p. 815-7.
- Szeoighe, D.M., et al., Self-inflicted burns in the Irish National Burns Unit. Burns, 2011. 37(7): p. 1229-32.
- Malic, C.C., et al., Burns inflicted by self or by others—an 11 year snapshot. Burns, 2007. 33(1): p. 92-7.
- Petridou, E., et al., Adolescents in high-risk trajectory: clustering of risky behavior and the origins of socioeconomic health differentials. Prev Med, 1997. 26(2): p. 215-9.
- Pham, T.N., et al., Predisposing factors for self-inflicted burns. J Burn Care Rehabil, 2003. 24(4): p. 223-7.
- Horner, B.M., et al., Case-controlled study of patients with self-inflicted burns. Burns, 2005. 31(4): p. 471-5.
- Baguellin-Pinaud, A., C. Seguy, and F. Thibaut, [Self-mutilating behaviour: a study on 30 inpatients]. Encephale, 2009. 35(6): p. 538-43.