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Case report

Severe burns due to biofuel heater injury: A case series

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ABSTRACT

Background: Biofuel heaters are a new form of flame heating for indoor and outdoor use. Fuelled by methylated spirits, they are simple structures with few safety features, and can be associated with severe burn. We report five cases of severe burns in adults that occurred when refilling these heaters.

Methods: We undertook a retrospective audit of all adults presenting to the Royal Brisbane and Women's Hospital (RBWH) with a biofuel heater-related burn between 20 and 30th June 2014.

Results: Five patients required admission for management of their burns. Three were admitted to ICU for greater than 3 weeks, and remained inpatients for up to 78 days. Two did not require ICU and were managed in the burns unit. Average total body surface area (TBSA) burned was 24.7%, and patients went to theatre up to seven times for debridement and skin grafting. Average length of stay was 41.8 days.

Conclusions: Biofuel heaters are easily accessible yet there is no Australian Standard to ensure they are safe or perform in the way they were intended. As such, people using them are at undue risk of severe burn, even when following the operating instructions. These products should be removed from the market to prevent further harm and potential mortality.

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1. Introduction

Biofuel heaters are a new product aimed to provide an attractive and eco-friendly heat source for use indoors and outdoors. Also known as bio ethanol flames, mood flames, or eco flames, they are widely sold in stores and on the Internet. Marketed as being a carbon neutral fuel source with 90% efficiency, biofuel heaters are advertised as being 'gentle on the environment' and 'easy to fill, light, and switch off' [1]. Several companies specialise in these products, with prices

ranging from \$40 to over \$3000. Cheaper alternatives are available from international manufacturers online.

Consisting of a simple round or rectangular reservoir with a slit like opening in the top (Fig. 1), biofuel heaters have minimal safety features and can be particularly dangerous during refilling. Fuelled by methylated spirits (also known as denatured ethanol), they are filled by pouring liquid into the reservoir from the top aperture. In most cases there is no lid that can be removed to inspect the reservoir for residual flame or fuel. This is particularly dangerous as denatured ethanol frequently burns clear and is invisible. If liquid ethanol is

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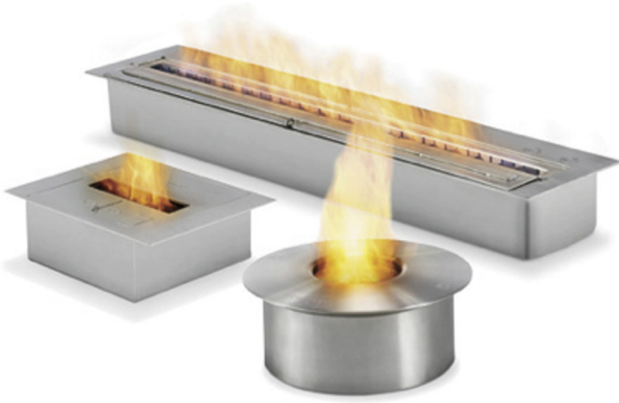


Fig. 1 – Various models of biofuel heaters with reservoir opening at top.

poured into a warm but extinguished reservoir, or directly onto an open flame, an explosion and fireball can result. Operating manuals suggest waiting 20–30 minutes prior to refilling an extinguished heater, but the safe waiting time differs depending on the manufacturer. As there are no Australian Standards regulating these products, their safety and quality cannot be assured.

We report a case series of five adults severely burned by these products in a 10-day period in June 2014. Three patients were bystanders when another person was refilling the heater. They were not in contact with the product themselves. All were admitted to hospital, and three required lengthy intensive care unit (ICU) admissions. All patients face lifelong scarring, and four will endure lengthy rehab and potentially chronic disability.

2. Methods

We undertook a retrospective audit of five adult patients admitted with burns after a biofuel heater accident occurring between 20 and 30th June 2014. No patients were excluded and all provided written consent for their information and clinical photographs to be used in this study. The project was assessed by the chair of the RBWH Human Research Ethics Committee. It was deemed exempt from full ethical review as it did not meet the National Statement definition of research, and instead was treated as a clinical audit. No funding from any organization was required. Four patients were treated at the Royal Brisbane and Women's Hospital Burns Unit (RBWHBU). One patient was injured in Northern Queensland and so advice was sought from the RBWHBU. She went on to receive conservative treatment at a hospital closer to her usual place of residence.

3. Results

3.1. Case 1

A 28-year-old male was sitting at an outdoor table when his friend refilled an extinguished tabletop heater. The heater was

believed to have been extinguished for 20–30 min. During refilling, there was a large fireball and explosion onto Case 1 and Case 2, who were both sitting opposite the heater. Case 1 sustained 43% TBSA deep partial and full thickness burns to his face, neck, anterior and posterior trunk, arms, legs and left foot. He was intubated due to suspicion of inhalational injury, and extubated 20 days later. He initially failed discharge to the ward due to respiratory failure and sepsis, and required a 6-day readmission to ICU with hospital-acquired pneumonia. Case 1 underwent five lengthy operations for debridement and grafting of his burns. His admission was complicated by heterotopic ossification of both elbows, hospital-acquired pneumonia with associated pseudomonas bacteraemia, unplanned return to ICU, corneal ulceration secondary to facial scar contracture, and splitting of his contracted R axillary graft, requiring re-grafting. He was successfully discharged home after a 57-day admission.

3.2. Case 2

A 22-year-old female was involved in the same incident as Case 1. She sustained 31% TBSA deep partial and full thickness burns to her face, neck, anterior and posterior trunk, arms, and left leg. She was prophylactically intubated due to suspicion of inhalational injury, and required a tracheostomy at day 25. This was successfully removed at day 43. Case 2 required five lengthy operations for debridement and grafting of her burns. Her admission was complicated by delirium, corneal irritation secondary to eyelid contracture, and infected donor sites of her right leg. She was discharged home after a 78-day admission.

3.3. Case 3

An 18-year-old male was refilling an outdoor biofuel heater when it exploded. It was unclear if the flame was extinguished at the time of refilling, or if the appliance was still warm. He sustained 45.5% TBSA deep partial and full thickness burns to his anterior face, neck, trunk, arms, hands, and legs (Fig. 2 a–c). Similar to the previous cases, he was intubated and ventilated due to suspicion of inhalational injury. He was successfully extubated 26 days later. He required seven operations for debridement and grafting of his burns. His admission was complicated by delirium, heterotopic ossification of his right elbow, and right external ear infection requiring two operative debridements. He was discharged home after a 63-day admission.

3.4. Case 4

A 48-year-old male was refilling an indoor coffee table biofuel heater (Fig. 3). According to the patient, the flame had been extinguished for 40 min or more prior to refilling. As he poured methylated spirits into the reservoir, a fireball engulfed him and the container of fuel he was holding. He found it very difficult to extinguish himself, and had to remove his burning clothing. He sustained 10% TBSA superficial and deep partial thickness burns to his face, neck, right arm and hand, and right leg (Fig. 4). There was no evidence of inhalational injury, and he was not intubated.

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