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Domestic bioethanol-fireplaces–a new source of severe burn accidents

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ABSTRACT

Background: Bioethanol-fueled fireplaces are popular interior home decoration accessories. Although their safety is promoted frequently, actual presentations of severe burn injuries in our burn intensive care unit (ICU) have focused the authors on safety problems with these devices. In this article we want to explore the mechanisms for these accidents and state our experiences with this increasingly relevant risk for severe burn injuries.

Materials and Methods: The computerized medical records of all burn intensive care patients in our burn unit between 2000 and 2014 were studied. Since 2010, 12 patients with bioethanol associated burn injuries were identified. Their data was compared to the values of all patients, except the ones injured by bioethanol fireplaces that presented themselves to our burn ICU between the years 2010 and 2014.

Results: At time of admission the bioethanol patients had a mean ABSI-score of 4.8 (+/− 2.2 standard deviation (SD)). A mean of 17 percent (+/− 9.1 SD) body surface area was burned. Involvement of face and hands was very common. An operative treatment was needed in 8 cases. A median of 20 days of hospitalization (range 3–121) and a median of 4.5 days on the ICU (range 1–64) were necessary. No patient died. In most cases the injuries happened while refilling or while starting the fire, even though safety instructions were followed.

In the control group, consisting of 748 patients, the mean ABSI-score was 5.6 (+/− 2.7 SD). A mean of 16.5 percent (+/- 10.1 SD) body surface area was burned. Treatment required a median of 3 days on the burn ICU (range 1–120). Regarding these parameters, the burden of disease was comparable in both groups.

Conclusion: Bioethanol-fueled fireplaces for interior home decoration are a potential source for severe burn accidents even by intended use.

1. Introduction

Burn injuries often lead to massive physical trauma accompanied by devastating psychological damage. In our burn patients the leading injury mechanism is an accident by direct flame. In cases of flame burns, involvement of flammable liquids is quite common. A positive correlation between the use of liquid burn accelerants and increased severity of burns has been advocated [1]. Since 2010 burns caused by bioethanol

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from bioethanol-fueled fireplaces were treated in the burn unit of BG Trauma Centre, Ludwigshafen, Germany. This article is supposed to increase attention to the hazard that results from the use of this substance.

Bioethanol is a natural alcohol. The most important application is its use as a gasoline additive to save mineral oil. Because bioethanol does not generate smoke while burning it is becoming more and more popular for decorative home fireplaces. For this application bioethanol is available as liquid and as gel in preformed containers. In its liquid state the substance is highly volatile. Its high vapor density and its low flash point constitute the danger that should be indicated here. Adding such flammable liquids to existing fires or starting a fire with them can cause a deflagration or even an explosion.

Bioethanol-fueled fireplaces are not effective heaters and are mostly intended to be design elements only. They are promoted as smokeless, safe and ecologically friendly. A professional installation with technical venting is not mandatory. In the United States and in Europe these devices are becoming more and more popular. Although their safety is promoted frequently, actual presentations of severe burn injuries in our burn intensive care unit (ICU) have focused the authors on the safety issues with these devices. Fig. 1 shows an example of a commercially available bioethanol stove for decorative purpose. While the fuel is added from the top, it is important that the fire is off and that the device cooled down completely before refueling.

Until recently the use of flammable liquids was limited to technically regulated applications such as the utilization as motor fuel. Mostly, risky behavior such as the misuse of these liquids as barbeque fire starter leads to severe burn accidents [2,3]. Many of these accidents could be observed in young male victims with incautious behavior or in patients with mental disorders [4]. In contrast, bioethanol is now on the way to be established for domestic application by the whole family.

In Europe bioethanol-fueled fireplaces have to be tested for their safety before admission. However there are heterogeneous safety seals available on the market. Often the safety is only tested by intended use without regard to frequent application errors. Only one available European safety seal involves tests with failures like false lighting-up or mistakes while refilling. Since only the safe use according to instructions has to be tested by law, many of these tests are not statutory.

Although device safety of bioethanol design fireplaces is being promoted, first published clinical presentations of severely injured consumers have alluded to the significant danger for (incautious) users [5]. In this article we want to explore the mechanisms for these accidents and state our experiences with this relatively new risk for severe burn injuries.

2. Materials and methods

We retrospectively reviewed the computerized medical records of all patients that were admitted to our burn intensive care unit between 2000 and 2014 for bioethanol associated burn injuries. The first case of a bioethanol associated burn injury presented itself in 2010. Between 2010 and 2014, 12 patients were identified with a bioethanol-associated burn injury whereas a total of 760 patients were admitted to our burn intensive care unit in this period.

Figure 1 – Example of a commercially available bioethanol stove.
Shown is an exemplary device for decorative use only. While the fuel is added from the top, it is important that the fire is off and that the device completely cooled down before refueling.

The computerized database allowed the identification of demographic data, the severity of the trauma and the course in hospital including the length of stay on the burn intensive care unit and in our hospital. Documented were the abbreviated burn severity index score (ABSI) [6], the extent, localization and depth of the burned surface and the operative treatment. Burn depth was clinically assessed on admission and every other day by visual and tactile inspection [7]. To rule out an inhalation injury laryngoscopic inspection and blood gas analysis of carbon monoxide level were performed. The indication for fiberoptic bronchoscopy were suspicious findings in those tests. The database also included anamnestic information that allowed clarifying the circumstances that led to trauma. Hereby we focused on whether there were handling errors or the use of the bioethanol fireplaces was correct, and under which general circumstances the accidents happened. In all cases photographic documentation was part of the computerized medical record.

In our burn intensive care unit we typically deal with an adult population. Comparable data is collected annually for all burn ICU patients to compare it with the statistics of other European burn centers. Since we could identify a large range of