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Etiology, incidence and gender-specific patterns of severe burns in a German Burn Center – Insights of 25 years

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ABSTRACT

Introduction: Burns often require special treatment in specialized burn centers. One of the specialized German burn centers is located in Cologne-Merheim. Only little is known about the etiology of burns in Germany, their monthly distribution and changes over the past 25 years. **Methods:** We therefore retrospectively analyzed the etiology for all patients treated at the burn intensive care unit (BICU) of Cologne in the last 25 years and categorized them into groups. Thereafter all groups were analyzed according to distribution of age, gender and occurrence.

Results: In this way we were able to show that the number of severe burns did not decrease over the time under evaluation and that it did not show seasonal variation. Injured females were older than males but fewer in number. The highest numbers of burns were related to fire, followed by electricity, hot liquids, chemicals and heat contact. Work-related burns occurred mostly with males. However, most of the burns were not work-related for either gender.

Conclusion: The number of burns in Germany and in the world is still high, and prevention strategies do not always have the desired effect. This study aims to fill the gap in published burn knowledge in Germany by way of describing the gender differences and etiology characteristics. It can therefore help to identify risks and expand effective burn prevention strategies.

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1. Introduction

Burns are among the most frequent unintentional injuries all over the world [1]. The International Society of Burn Injuries has defined a burn as an injury to the skin or other organic

tissue primarily caused by thermal or other acute trauma. Burns occur when some or all cells of the skin or other soft tissues are destroyed by hot liquids (scalds), hot solids (contact burns) or flames (flame burns). Injuries to the skin or other organic tissues due to radiation, radioactivity, electricity,

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friction or contact with chemicals are identified as burns as well [2]. It is estimated that worldwide 6 million seek medical help due to burns every year, the majority of them in outpatient clinics. Whether a patient is treated in a specialized burn unit usually depends on the severity of the burn, the concomitant trauma and the patient's general condition [3].

Moreover, burns are one of the most expensive traumatic injuries due to costly wound treatment as well as long hospitalization and rehabilitation [4,5]. Prevention of burns is therefore of high interest [6], a point that Dr. Keswani from India made in 1986: "The challenge of burns lies not in the successful treatment of a 100% burn, but in the 100% prevention of all burns" [7]. In order to prevent burns, knowledge about their etiology needs to be spread [1,8,9]. In particular data concerning the etiology and gender-specific patterns of burns are scarce in Germany [6]. We therefore decided to analyze our data retrospectively to gain improved insights into burns in Germany, especially concerning their etiology, gender-specific patterns and month-by-month occurrence.

2. Patients and methods

2.1. Patients

A retrospective data analysis was performed on all patients admitted to the burn intensive care unit (BICU) at Cologne-Merheim Medical Center and University Hospital of Witten/Herdecke between 1989 and 2013.

In total 2105 patients with burns were admitted to the BICU in the period under evaluation. Patients suffering from epidermal necrolysis (TEN) or other injuries not associated with burns as well as patients with incomplete data sheets were excluded from the study. A total of 2023 patients met the conditions for inclusion.

2.2. Setting

The burn center of the Cologne-Merheim Medical Center, University Hospital of Witten/Herdecke is one of the specialized burn centers in Germany. Cologne is located in North-Rhine-Westphalia in the western part of Germany and has more than one million inhabitants. According to the German Association for Burn Treatment's guidelines, in Germany all patients with severe burns are to be taken to specialized hospitals.

2.3. Data collection

Clinical data on all patients admitted to the BICU were collected by the attending surgeons, a distinction being made between thermal, electrical and chemical injury and entered into a web-based data collection platform specifically adapted to this purpose. Data were added during treatment in the BICU and completed after transfer from the BICU or death. Data integrity was evaluated by means of assessing missing values, range checks, plausibility checks and internal consistency. Additionally all patients included were categorized according to the etiology of the injury based on the injury description found in the database.

2.4. Statistical analysis

Statistical analysis was performed using the "open source" software "R" (Version 3.1.2). After analysis of regression and variance, $p < 0.05$ was considered to indicate a statistically significant difference. The results were confirmed using the Students T-test.

3. Results

A total of 2023 patients with severe burns admitted to the Cologne burn Center between 1989 and 2013 were included in this study (Fig. 1). 1458 patients were male (72.1%) and 565 were female (27.9%). Age ranged from 1 to 96, and the mean age was 41.6 ± 19.3 years (Fig. 2). Here significant gender differences were found in the mean age distribution of patients admitted to the BICU: the age of females ranged from 1 to 93 years with a mean age of 47.2 ± 22.3 years (Fig. 3), whereas the males were between 1 and 96 years old and had a mean age of 39.3 ± 17.5 years (Fig. 4). The total burned body surface area (TBSA) ranged from 0 to 100% for males and 0 to 99% for females with a mean TBSA from $23.4 \pm 22.0\%$ for males and $20.4 \pm 19.3\%$ for females.

The number of patients admitted to the BICU per year showed only little variation over the last 25 years. The maximum of 137 patients were admitted in 1992 and the minimum of 43 patients in 1995 (Fig. 1). The mean admission number of patients was 80.9 ± 22.1 per year. The mean admission age was 22.6 ± 8.3 years for females and 58.3 ± 15.4 years for males.

Over the years the mean age of admitted patients rose: females admitted in 1989 had a mean age of 46.6 years compared to 55.7 years in 2013, and the admitted males had a mean age of 37.8 years in 1989 compared to 42.4 years in 2013.

Burns occurred at every time of the year with only little monthly variation (Fig. 5). The highest overall total of burn admissions by month was registered in the month of August (200), followed by May (189) and July (188). The mean number of overall admissions to the BICU by month was 168.6 ± 19.8 . The mean number of admitted females was 47.1 ± 8.5 compared with 121.5 ± 21.4 males.

3.1. Work-related burns

Altogether 510 patients were admitted due to work-related burns, while 1513 cases were non-work-related burns. The mean number of work-related burns per year was 20.4 ± 6.7 , and 60.5 ± 17.8 was the number of non-work-related burns per year. Most patients admitted to the BICU due to work related injuries were males (Fig. 6). However, more males were admitted due to non-work-related burns than due to work-related injuries (Fig. 7). The mean TBSA of work-related burns was $21.2 \pm 21.9\%$ for males and $12.8 \pm 8.0\%$ for females compared to a mean TBSA of non work-related burns of $24.5 \pm 22.0\%$ for males and $20.7 \pm 19.5\%$ for females.

All burns were categorized into 5 groups (fire, electricity, chemicals, hot liquids and heat contact). By doing this we were able to show that fire caused the highest number of burns

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