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# Effect of primary admission to burn centers on the outcomes of severely burned patients

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## ABSTRACT

**Objective:** Burns represent a special form of severe trauma. Due to long hospitalization, rehabilitation, and extensive scar treatment, severe burn injuries rank among the most expensive traumatic injuries regarding associated health care costs. The presented single-burn-center experiences evaluated the effects of primary versus secondary burn intensive care unit (BICU) admissions on outcomes in severely burned patients.

**Methods:** Within 30 months, 186 patients were admitted to the BICU. The cases were divided into two groups depending on their admission type: “primary” vs. “secondary”. All patients were analyzed retrospectively regarding the need for surgery, encountered complications, time of hospitalization and overall survival.

**Results:** The incidence of primary BICU-admissions was 65.1%. Both patient groups were comparable regarding demographics, comorbidities, % TBSA burn, associated inhalation injuries, ABSI scores and intubation rates ( $p > 0.05$ ). Both groups received similar numbers of operations and had overall comparable mortality rates ( $p > 0.05$ ). However, duration until first burn excision, length of ventilation, as well as BICU- and overall hospital length of stay were significantly shorter in the “primary”- compared to the “secondary” group ( $p < 0.05$ ).

**Conclusion:** Several burn societies have published precise criteria of when a patient needs to be referred to a burn center. In the presented series, patients that were primarily treated at a BICU showed significantly better outcomes regarding several parameters. In order to further optimize treatment of burn patients it therefore appears that precise initial assessment and if appropriate respective primary transport to dedicated burn centers needs to be re-emphasized, especially among first- and emergency care providers.

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## 1. Introduction

Burns represent a special form of severe trauma which can negatively affect nearly every organ system [1]. Despite

considerable advances regarding intensive care at burn centers, severe burns remain associated with high long-term morbidity- and mortality rates [2,3]. On a global scale, current estimates indicate that annually about 6 million patients

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worldwide need medical treatment for various extends of burns [4]. Depending on the local circumstances, the majority of burn victims receive initial care at local hospitals prior to transfer to a burn center or are entirely treated at non-specialized peripheral hospitals [4-6].

In Western industrialized countries, the incidence of burns is estimated to range between 5-10% [4]. Therefore, burn injuries remain a relatively common type of traumatic injury, with about 40,000 burn injuries occurring per year in the U.S. [7], and about 20,000 in Germany [8]. Within the German healthcare system, about 4000 of these patients require inpatient treatment, and about 1200 are treated at burn intensive care units (BICU) [8]. Given that most European countries do not yet have a national registration system of hospitalized burn victims, the exact incidence is not known, however [9].

Providing optimal burn care is resource intensive, requiring a specialized treatment team, knowledge and equipment [5]. Due to the need for long hospitalization and rehabilitation, as well as for subsequent wound- and scar treatment, severe burn injuries rank among the most expensive traumatic injuries [10]. The prerequisites to treat extensive burn injuries are usually only fulfilled at dedicated burn centers. In recent years, the American Burn Association as well as the German burn society have promulgated a list of criteria for referral to burn centers (Table 1) [8,11]. Ideal treatment strategies have also been recommended for outpatient clinics and non-specialized peripheral hospitals [4,7,9,10]. Only few studies have evaluated however, if patients transferred from other facilities have worse outcomes than those directly admitted from the site of injury to a burn center [5].

We therefore analyzed our single-burn-center experiences in order to further evaluate the effects of primary versus secondary BICU-admissions on outcomes of severely burned patients.

## 2. Patients and methods

Approval for the study was granted by the local medical ethics committee. Between January 2015 and July 2017, 186 burned

patients were primarily or secondarily admitted to our BICU in South-Germany.

Medical files and patient data were retrospectively screened for details of admission (primary or secondary), patients' demographics, percentage of total body surface area affected (% TBSA), initial and secondary fluid management (overall quantity as well as amount according to ml/kg/% TBSA), core temperature at admission, initial outcomes, length of hospitalization (at BICU as well as overall), mortality rates, and other pre- and peri-hospital details.

Distinct inclusion criteria were admission to BICU within a maximum of 168h after the burn injury, that patients must have suffered 2nd and/or 3rd degree burns, and that they fulfilled at least one criterion for referral to a burn center. To evaluate whether extensive TBSA burns had a significant effect on the outcomes, patients having suffered burns of  $\geq 20\%$  TBSA were evaluated separately. A total of 181 patients were included in the analysis. 85 of those patients suffered more extensive burns of TBSA  $\geq 20\%$ , and were thus evaluated separately as well.

The abbreviated burn severity index (ABSI) is validated as an accurate predictor of mortality in burn patients and was calculated in all patients [12].

The cases were divided into two groups ("primary" vs. "secondary"), depending on whether the patients were primarily or secondarily admitted. The "primary" group included patients that were primarily admitted to the BICU and were not primarily treated at another clinic. The "secondary" group included patients that were not primarily admitted to the BICU; however, with no more delay than a maximum of 168h after the initial burn accident.

Taking into account the possible influence of preoperative medical conditions on outcomes (gender, age, comorbidities such as diabetes, coronary heart disease, peripheral arterial disease, cardiac insufficiency, COPD, body-mass-index and smoking status), the medical status of each patient was assessed according to the Charlson comorbidity index [13].

Additionally, in order to evaluate a possible correlation between length of time of secondary admission to the BICU, patients that were secondarily transferred within  $\leq 24$ h (short delay — SD), and those  $> 24$ h (long delay — LD) after burn injury were evaluated separately.

**Table 1 – American Burn Association burn center referral criteria modified to the German burn society burn center referral criteria [3,10].**

<ol style="list-style-type: none"> <li>1. Partial thickness burns <math>&gt; 10\%</math> TBSA</li> <li>2. Burns that involve the face, hands, armpits, feet, genitalia, perineum, major joints, or miscellaneous complicatedly localizations</li> <li>3. 3rd degree burns in any age group</li> <li>4. Electrical burns, including lightning injury</li> <li>5. Chemical burns</li> <li>6. Inhalation injury</li> <li>7. Accompanying mechanical trauma</li> <li>8. Burn injury in patients with preexisting medical disorders that could complicate management, prolong recovery, or affect mortality</li> <li>9. Patients under the age of 8 years or over the age of 60 years</li> <li>10. Any patients with burns and concomitant trauma, in which the burn injury poses the greatest risk of morbidity or mortality. In such cases, if the trauma poses the greater immediate risk, the patient may be initially stabilized in a trauma center before being transferred to a burn unit.</li> <li>11. Burned children in hospitals without qualified personnel or equipment for the care of children</li> <li>12. Burn injury in patients who will require special social, emotional, or long-term rehabilitative intervention</li> </ol>
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TBSA: total body surface area.

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