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Determination of risk factors for burn mortality based on a regional population study in Taiwan

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ARTICLE INFO

Article history:

Accepted 27 February 2018

Available online xxx

Keywords:

Burn
Epidemiology
Mortality
Risk factors

ABSTRACT

Background: Burns are not only major personal catastrophic events but also constitute a national health problem due to its associated morbidity, rehabilitation, mortality and high cost medical services. Advances in care and treatment have increased survival from major burn injury. However, information on the epidemiology and risk factors of burn mortality in Taiwan is limited. The study aim was to determine the nationwide epidemiological characteristics, trends, and mortality risk factors of burn inpatients in Taiwan.

Methods: This nationwide population-based study evaluated data retrieved from the Taiwan National Health Insurance database. Patients hospitalized for burns (ICD-9-CM codes 940-949) between 2003 and 2013 were identified from hospitalization records.

Results: A total of 73,774 patients were included. The data showed increases in age, revised Baux score, and Charlson Comorbidity Index during the study period, but it was also accompanied by a continuing decrease in burn incidence and a significant shortening of the length of hospital stay. The average in-hospital mortality was 17.5/1000 in 2003 and 12.2/1000 in 2013 but did not showed significant change. Male gender, older age, higher Charlson Comorbidity Index, presence of inhalation injury, large total burn surface area (TBSA), and higher revised Baux score were significant predictors of mortality.

Conclusion: Population-based burn epidemiology data demonstrated ongoing improvement in hospital care during the past decade. Male gender, older age, higher Charlson Comorbidity Index, presence of inhalation injury, large TBSA, and higher revised Baux score were significant predictors of mortality.

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<https://doi.org/10.1016/j.burns.2018.02.030>

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1. Introduction

Burns are not only catastrophic events for individuals, but collective morbidity and mortality and the high medical service and rehabilitation costs also constitute a national health problem [1-5]. Burns have physical, emotional, psychological, and spiritual effects, are one of the most expensive nonfatal injuries, and constitute a substantial direct socioeconomic burden [2]. In order to define the burn-related burden of disease and burn risk factors, population-based studies are optimal [6]. However, most studies in Taiwan have been conducted at a single hospital, in a specific patient series, or for a single year, which provided only limited epidemiological data [1,7-9]. An update of burn epidemiology in Taiwan since the last cohort report in 2005 [8] is therefore timely to reveal recent changes.

The study aim was to identify nationwide trends of inpatient burn injury epidemiology in the Taiwanese general population, including an analysis of epidemiological characteristics and changes, and mortality risks. To the best of our knowledge, this is the first study to assess burn prevalence in the general population of Taiwan over a 10-year period with an updated overview of regional burn epidemiology between 2003 and 2013.

2. Methods

This study was approved by the Institutional Review Board of Chang Gung Memorial Hospital (approval number 201701122B1). As the patient data was anonymized, informed consent was waived. A research grant from the Chang Gung Memorial Hospital supported this study.

2.1. Source of data and study population

The primary data source was the National Health Insurance (NHI) database. The Taiwanese NHI was established in 1995 as a single-payer system requiring all residents to enroll and in 2013 the coverage rate was estimated at 99.5% [10]. Registration and claims data are routinely collected by the NHI and entered into a single database after anonymization of personal details. Denominator data were retrieved from the Registry of Beneficiaries, a part of NHI research database that includes population demographics and the insurance status, residence, and socioeconomic data of all beneficiaries. The diagnostic coding system used by the NHI follows the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM). The validity, representativeness, and clinical consistency of this database have been previously reported.

2.2. Case identification, burn definition, and incidence

Burn cases were identified by hospitalization records with a diagnosis of ICD-9-CM codes 940-949 (supplementary Table 1). Burn severity was defined by the Baux score as age+TBSA, and +17 if inhalation injury was present. For estimating burn incidence, incident patients had no evidence of disease prior to January 1 of the calendar year but had a burn diagnosis during that year. To be eligible, beneficiaries must have been registered

in the database prior to January 1 of each calendar year. For the analysis, at-risk cohorts that included all individuals registered during a given calendar year, and who had no history of burns before January 1 of that year. Incidence was calculated using the number of patients with incident burns during a calendar year as the numerator, and the total person-years at-risk population of the same year as the denominator. To determine incidence trends age- and sex-standardized incidence were calculated using the population structure in 2013 as the reference.

2.3. Statistical analysis

The 95% confidence intervals (CIs) for incidence were calculated as summing a Poisson distribution of the observed number of incident patients. The Joinpoint Regression Program (version 4.0.4) was used to estimate trends of burn incidence and in-hospital burn mortality. The program used Bayesian criteria to generate of "joinpoints" that partitioned the linear trend into periods with statistically different slopes using best-fit data series [11]. A maximum of two joinpoints were used to determine statistical significance for the trend and annual percentage changes (APCs) were calculated for each segment. The secular trends for incidence and survival were calculated for patients with Charlson comorbidity score of 0-2 and ≥ 3 . The Charlson Comorbidity Index (CCI) was used to evaluate patient comorbidity burden and to estimate the risk of death from 17 diagnostic conditions. These were: weighted score 1, myocardial infarction, congestive heart disease, peripheral vascular disease, cerebrovascular disease, dementia, chronic pulmonary disease, connective tissue disease, peptic ulcer disease, mild liver disease, diabetes without complications; score 2, diabetes with complications, hemiplegia and paraplegia, renal disease, any malignancy including leukemia and lymphoma without metastasis; score 3, moderate or severe liver disease; score 6, malignant metastasis and acquired immune deficiency syndrome. We used a logistic regression model to estimate odds ratios (ORs) and 95% CI to identify risk factors for hospital burn mortality. Statistical analysis was performed using SAS statistical software, version 9.4. The significance level was set at 0.05.

3. Results

3.1. Patient characteristics

The clinical characteristics of patients hospitalized with burns between 2003 and 2013 are shown in Table 1. The mean age of the patients was 37.25 ± 22.40 years in 2003, but had increased to 42.13 ± 23.18 years of age in 2013 ($p < 0.0001$). The change probably reflected an increase in the proportion of elderly burn patients and decrease of burns in those less than 20 years of age. The highest prevalence (65%) was in working age adults from 20 to 65 years of age. The increase in mean age and the increased proportion of elderly patients reflects national demographic change and is consistent with the low birth rate and growth of the elderly population in Taiwan during the study period. Men predominated in each year between 2003 and 2013, comprising 59.68-62.10% of the burn population ($p = 0.0172$), giving an overall male-to-female ratio of around 1.5:1.

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