Original research

Bicycle trauma and alcohol intoxication ☆

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HIGHLIGHTS

- We examine the effect of alcohol intoxication on injury burden following bicycle-related crashes.
- The incidence of bicycle crashes is increasing and more than a 1/3 of injured patients screened for alcohol are intoxicated.
- Intoxicated cyclists are significantly less likely to wear a helmet and less likely to be involved in a motor vehicle crash.
- There is no difference in injury burden between intoxicated patients and non-intoxicated cyclists.

ARTICLE INFO

ABSTRACT

Introduction: As bicycling has become more popular, admissions after bicycle trauma are on the rise. The impact of alcohol use on bicycle trauma has not been well studied. The aim of this study was to examine the effect of alcohol intoxication on injury burden following bicycle-related crashes.

Methods: A retrospective review of trauma patients presenting to a Level I trauma center after bicycle-related crashes from January 2002 to December 2011 was conducted. Demographics, injury data, alcohol intoxication, helmet use, and clinical outcomes were reviewed. Blood alcohol level (BAL) was considered positive if >0.01 g/dL. Variables were compared between patients based on BAL: negative, 0.01–0.16 g/dL, and >0.16 g/dL.

Results: During the 10 year study period, 563 patients met study criteria; mean age was 33.5 ± 16.5 years, 87% were male, and mortality was 1%. On average, bicycle crashes increased over the study period by 4.4 collisions per year. BAL was tested in 211 (38%) patients. Mean BAL was 0.24 g/dL, with 37% of these patients being intoxicated (BAL ≥0.010 g/dL). Intoxicated patients were significantly less likely to wear a helmet (4.7% vs. 22.2%, $p = 0.002$) and to be involved in motor vehicle crash (59.0% vs. 81.2%, $p < 0.001$). There was no difference noted in the injury burden including ISS ≥16 (14.3% vs. 19.5%, $p = 0.335$) and AIS Head ≥3 (17.9% vs. 21.8%, $p = 0.502$). When comparing patients according to their BAL, there was a decreasing risk of motor vehicle collision with increasing BAL (81.2% for undetected, 76.5% for BAL ≤0.16 g/dL and 54.1% for BAL >0.16 g/dL, $p < 0.001$). The risk for a severe head injury (AIS Head ≥3) was significantly lower in helmeted patients (8.4% vs. 15.8%, $p = 0.035$).

Conclusions: The incidence of bicycle-related crashes is increasing and more than a third of patients tested for alcohol after bicycle-related crashes are found to be intoxicated. The injury burden in intoxicated patients, including head trauma, was not different compared to non-intoxicated patients. In addition, the risk for a collision with a motor vehicle was significantly lower. Nonetheless, these patients rarely utilize a helmet. The findings from this study can be used for the development and implementation of preventive strategies to minimize the injury burden associated with bicycle crashes and intoxicated cyclists.

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1. Introduction

Bicycling is an increasingly popular mode of transportation with approximately 800 million bicycles in use throughout the world [1]. Potential factors contributing to this trend include increased health consciousness, economic changes such as the rising cost of fuel, and

public awareness of greenhouse emission threats. Not surprisingly, as the number of cyclists increases, so does the number of cycling-related injuries. The risk of injury while bicycling is difficult to assess. However, one large prospective study of American cyclists found that the incidence of 'any bicycle crash' and 'bicycle crash that required medical attention' were 15.0 and 3.9 per 100,000 miles, respectively [2]. The risk of death associated with cycling is estimated as 12 times that of riding in a car [3]. This data suggests that cycling related injuries are a serious public health concern. In 2010, 618 cyclists were killed and an additional 52,000 were injured in motor vehicle related crashes. These deaths accounted for 2 percent of all motor vehicle traffic fatalities, and made up 2 percent of all the people injured in traffic crashes during the year [4].

The patterns of injury associated with bicycle crashes are well studied [5]. Most injuries are minor, such as skin and soft tissue wounds, followed by orthopedic injuries such as fractures and sprains, although a significant number of face and head injuries do occur as well [6]. For this reason, patterns of helmet use and related outcomes receive considerable attention [7]. Helmet use reduces serious head and upper facial injuries, with a 75% reduction in death from head injury [8]. The effectiveness of helmet laws on adults is controversial [9], although it is well supported in children [10,11].

How alcohol intoxication alters injury patterns and helmet use in cyclists is not well understood. A previous study observed that out of all the patients treated in the emergency department for cycling related injuries, 8% were noted to have elevated blood alcohol levels [12]. It is unclear whether elevated blood alcohol increases injury severity after a bicycle crash, how the injury patterns of the intoxicated bicyclist differ, and whether alcohol intoxication impacts helmet use. The purpose of this study was to characterize alcohol related cycling injuries in a large, urban metropolitan Level 1 Trauma center during a ten-year period.

2. Patients and methods

A prospectively maintained database of all trauma patients admitted to a large metropolitan, Level 1 Trauma center was queried for patients involved in a bicycle crash between January 1, 2002 and December 31, 2011 according to the International Classification of Diseases (ICD-9) External codes E826.0 to E826.9. Data regarding age, gender, race, injury severity score (ISS), abbreviated injury scale (AIS), helmet use, involvement of a motor vehicle in the crash,

admission Glasgow coma scale (GCS), systolic blood pressure (SBP), and blood alcohol levels (BAL) were collected.

Patients with a BAL ≥0.01 g/dL were considered to be intoxicated and compared to those with undetected BAL. Patients were then stratified into 3 groups, based on BAL: undetected, ≤0.16 g/dL and >0.16 g/dL. The legal blood alcohol level for operating a motor vehicle in the United States is 0.08 g/dL. Patients were stratified at twice this legal limit (BAL of 0.16 g/dL) to identify those who were extremely impaired. These groups were compared with regards to demographics, injury patterns, and clinically relevant cut points, including AIS for all body regions ≥3, ISS ≥16, GCS ≤8, and SBP <90 mmHg. Outcomes analyzed included hospital length of stay (LOS), intensive care unit (ICU) LOS, and mortality. A subgroup analysis was conducted to compare helmeted patients to their non-helmeted counterparts to identify differences in injury patterns. Finally, patients admitted after a bicycle-related crash involving a motor vehicle were compared to those who were not in collisions involving a motor vehicle.

Descriptive statistics were summarized using raw percentages, means, standard deviations (SD) and medians. Analysis of variance (ANOVA) was used to compare the 3 BAL groups. Chi-square or Fisher exact test and t-test or Mann–Whitney test were utilized for the subgroup analyses for dichotomous and continuous variables, respectively. All statistical analyses were performed using the IBM SPSS Statistics for Windows, Version 20.0 (Armonk, NY: IBM Corp.). This study was approved by the Institutional Review Board of Cedars-Sinai Medical Center.

3. Results

During the 10-year study period, 563 patients were evaluated after a bicycle-related crash. The mean age ± SD was 33.5 ± 16.5 years, 87.6% (493/563) were male and 73.5% (414/563) were involved in a collision with a motor vehicle. Over the study period, the number of bicycle crashes increased by an average of 4.4 collisions per year. Most bicyclists (74.1%) were involved in a collision with a motor vehicle and this followed a similar trend of increased rates per year [Fig. 1].

Severe injuries, defined as ISS ≥16 were sustained by 13.2% (74/559) of the patient population: 14.9% (84/563) had a severe head trauma (AIS Head ≥3) and 11.5% (65/563) had severe extremity injuries. Overall, 16.0% (90/563) required admission to the ICU. The
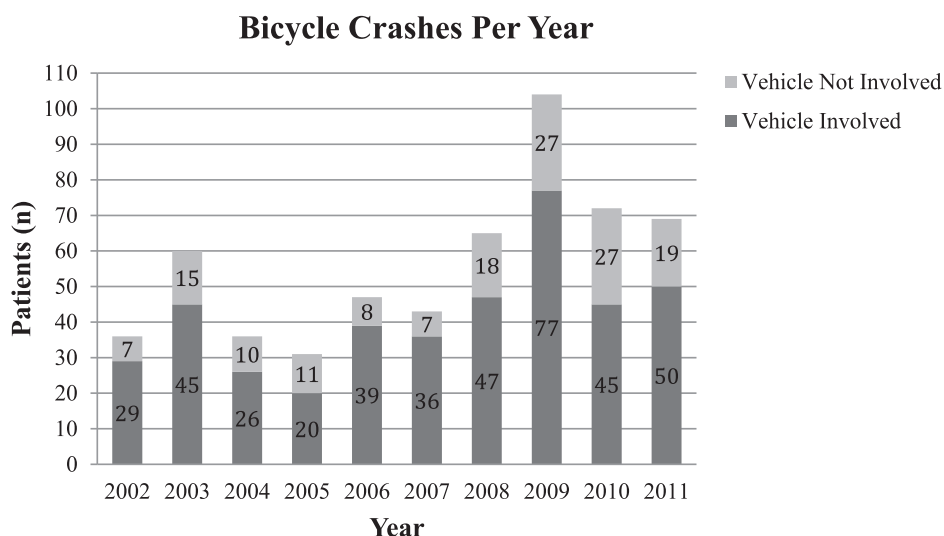

Fig. 1. Number of bicycle crashes per year, with and without a vehicle involved.