

## The Impact of Seat Belts and Airbags on High Grade Renal Injuries and Nephrectomy Rate in Motor Vehicle Collisions

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**Purpose:** Motor vehicle collisions are the most common cause of blunt genitourinary trauma. We compared renal injuries with no protective device to those with seat belts and/or airbags using NTDB. Our primary end point was a decrease in high grade (grades III-V) renal injuries with a secondary end point of a nephrectomy rate reduction.

**Materials and Methods:** The NTDB research data sets for hospital admission years 2010, 2011 and 2012 were queried for motor vehicle collision occupants with renal injury. Subjects were stratified by protective device and airbag deployment. The AIS was converted to AAST renal injury grade and nephrectomy rates were evaluated. Intergroup comparisons were analyzed for renal injury grades, nephrectomy, length of stay and mortality using the chi-square test or 1-way ANOVA. The relative risk reduction of protective devices was determined.

**Results:** A review of 466,028 motor vehicle collisions revealed a total of 3,846 renal injuries. Injured occupants without a protective device had a higher rate of high grade renal injuries (45.1%) than those with seat belts (39.9%,  $p = 0.008$ ), airbags (42.3%,  $p = 0.317$ ) and seat belts plus airbags (34.7%,  $p < 0.001$ ). Seat belts (20.0%), airbags (10.5%) and seat belts plus airbags (13.3%, each  $p < 0.001$ ) decreased the nephrectomy rate compared to no protective device (56.2%). The combination of seatbelts and airbags also decreased total hospital length of stay ( $p < 0.001$ ) and intensive care unit days ( $p = 0.005$ ). The relative risk reductions of high grade renal injuries (23.1%) and nephrectomy (39.9%) were highest for combined protective devices.

**Conclusions:** Occupants of motor vehicle collisions with protective devices show decreased rates of high grade renal injury and nephrectomy. Reduction appears most pronounced with the combination of seat belts and airbags.

**Key Words:** kidney; nephrectomy; wounds and injuries; accidents, traffic; seat belts

MOTOR vehicle related injuries kill more children and young adults than any other single cause in the United States.<sup>1-3</sup> The United States Census Bureau estimated that there were 77 million MVCs in the last decade,<sup>4</sup> resulting in more than 34,000

deaths annually.<sup>5</sup> Another 3.6 million drivers and passengers were treated in emergency departments yearly as the result of being injured in MVCs.<sup>6</sup> The economic burden to society is tremendous since the lifetime cost of crash related deaths and injuries

### Abbreviations and Acronyms

AAST = American Association for the Surgery of Trauma

AIS = Abbreviated Injury Score

ICU = intensive care unit

MVC = motor vehicle collision

NTDB = National Trauma Data Bank®

OIS = Organ Injury Scale

Accepted for publication April 22, 2014.

Study received institutional review board approval.

Supported in part by Grant UL1 TR000038 from the National Center for the Advancement of Translational Science, National Institutes of Health (MAB).

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among drivers and passengers was \$70 billion in 2005.<sup>7</sup>

Seat belts, which decrease the risk of fatal injuries from MVCs by 45% and serious injuries by 50%,<sup>8</sup> are the most effective intervention to protect motor vehicle occupants.<sup>9</sup> Air bag deployment during MVCs decreases occupant mortality by 63%.<sup>10</sup> Wearing a lap belt plus a shoulder belt decreased mortality by 72% and combined use of an air bag and seat belt decreased mortality more than 80%.<sup>10</sup>

MVCs are the most common mechanism of injury resulting in renal trauma, accounting for 48% to 66% of all renal injuries.<sup>11,12</sup> However, there exists a paucity of data on the role of MVC protective devices in the reduction of renal injuries. We compared renal injuries and nephrectomies in MVC occupants with no protective device vs those with seat belts and airbags using NTDB. The primary study end point was a decrease in high grade renal injuries (AAST-OIS grades III-V). The secondary end point was a reduction in the nephrectomy rate. Because MVCs are the leading cause of unintentional injury in the United States, understanding the impact of protective devices on solid organ injury becomes increasingly important. We hypothesized that the combination of protective devices could decrease high grade renal injury and potentially the resultant nephrectomy rate compared to a single protective device or no device. Furthermore, protective device research may provide evidence for public health decision making regarding motor vehicle related injury prevention.

## MATERIALS AND METHODS

### Study Design

We performed a retrospective cohort study to determine the impact of seat belts and airbags on renal injuries and nephrectomy rates of MVCs. This study was determined to be exempt from review by our institutional review board.

### Data Source

We analyzed NTDB admission years 2010, 2011 and 2012. NTDB is a voluntary data repository that currently contains the trauma admissions of participating level I to V trauma centers throughout the United States. NTDB, managed by ACS (American College of Surgeons), has been used in multiple studies of trauma.<sup>3,4</sup> To standardize the population NTDB defines trauma patients as any patient with an ICD-9-CM discharge diagnosis of 800-959.9, excluding late effects of injuries (905-909), superficial injuries (910-924) and foreign body cases (930-939). All injury related deaths in the emergency department and deaths upon arrival were included in our study cohort.

### Study Cohort

The NDTB research data sets (admission years 2010, 2011 and 2012) were queried for MVC occupants by ICD-9-CM external cause of injury codes with renal

injury by ICD-9 code (866). Subjects were stratified by protective device (no protective device and seat belt) and airbag deployment. Seat belt was defined as wearing a lap belt and/or a shoulder belt. We used the methodology elucidated by Kuan et al to convert AIS codes for renal injury to AAST-OIS renal injury grades, excluding codes that did not match.<sup>13</sup> Surgical management was evaluated by current procedural terminology code for nephrectomy (55.5) or angioembolization (38.86). A total of 252 patients categorized as MVC occupants had no device data available and were excluded from study. Intergroup comparisons were analyzed for renal injury grade, nephrectomy, hospital length of stay, ICU length of stay, days on ventilator, discharge disposition and mortality. The relative risk reduction in high grade renal injury and nephrectomy was determined for each occupant restraint device.

### Statistical Analysis

Results were summarized as the frequency and percent for dichotomous and categorical variables, and as the mean  $\pm$  SD for continuous variables. Between group analysis of devices was performed by chi-square analysis for AAST-OIS renal injuries, nephrectomy and hospital discharge disposition. Between group analysis of devices was performed by 1-way ANOVA analysis for hospital length of stay, ICU length of stay and days on the ventilator. Analysis was done with SPSS® 18 with statistical significance considered at  $p \leq 0.05$ . Protective device relative risk reduction was calculated for high grade renal injuries and for nephrectomy.

## RESULTS

The NTDB research data sets for admission years 2010, 2011 and 2012 documented a total of 2,329,246 patient records. MVCs occurred in 466,028 patients (20.0%), resulting in 3,846 cases (0.8%) of renal injury with a calculable AAST score. Similar to prior renal trauma studies using NTDB, 52% of AIS scores mapped to AAST-OIS renal injury grades.<sup>14</sup> Table 1 lists patient demographics and presenting injury status.

AIS score was converted to AAST-OIS to allow for direct comparison of renal injury grade and nephrectomy rate among protective devices. Grade III injuries were included in our analysis since previous studies of NTDB showed that nephrectomies are not uncommon in this group.<sup>15</sup> Table 2 shows the distribution of high grade renal injuries by protective device. Comparing renal injury frequency demonstrated that injured occupants without a protective device had a higher rate of high grade renal injury (45.1%) than those with seat belts (39.9%,  $p = 0.008$ ), airbags (42.3%,  $p = 0.317$ ) and seat belts plus airbags (34.7%,  $p < 0.001$ , fig. 1). The decrease in the rate of high grade renal injury appeared most pronounced when using a seat belt plus an airbag.

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