H61 Characteristics of Traffic Crash-Related Blunt Traumatic Aortic Injury (BTAI)

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The goal of this presentation is to provide an overview of crash-related BTAIs, the characteristics of the occupants who sustain them, the crashes in which they occur, and the survival outcomes for those victims.

This presentation will impact the forensic science community by describing the distribution and characteristics of a relatively common cause of death in traffic accidents.

Traumatic rupture of the aorta is associated with a high risk of death and results from high-energy blunt trauma of the chest. Prior studies have estimated that traffic crashes account for 50% to 90% of BTAI with injury found on autopsy in one in three crash-related deaths.[1,2] The most common location of aortic rupture, typically a transection, is at the aortic isthmus, near the location of the ligamentum arteriosum. The injury mechanism is related to the fact that the descending thoracic aorta is fixed to the posterior chest wall while the heart and great vessels are relatively mobile, resulting in shear and tension forces at the site of the rupture.

While the death rate from BTAI has been reported to be as high as 90%, the actual rate is difficult to judge because of a lack of large studies and the fact that study populations tend to be biased toward survival (hospital cohorts) or death (autopsy studies).

To address this gap in knowledge, this study queried the National Automotive Sampling System-Crashworthiness Data System (NASS-CDS) of the National Highway Traffic Safety Administration for crash-related BTAI occurring from 1993 through 2011. The NASS-CDS investigates approximately 5,000 crashes every year in 36 geographic Primary Sampling Units (PSU). The data are weighted to provide a national estimate of all police-reported crashes and associated injuries occurring in the United States and involving passenger vehicles.

The results of the analysis were as follows: There were an estimated 61,209 cases of BTAI during the 19-year period, an average of 3,222 cases per year, with the number of cases decreasing over the study period (see Figure 1). There were 39,170 of the cases that were reported as fatalities (64%) and 22,039 (36%) reported as non-fatal (Figure 2). The majority were transections (52%), followed by major ruptures with hemorrhage outside the mediastinum (31%) and confined to the mediastinum (16%).

The average age among the fatalities and non-fatal cases was 40.5 years and 33.2 years, respectively. Men comprised 58.5% of the group and women 41.5%. There was no gender disparity in the fatality rate.

Among all of the BTAI cases, front and side impact crashes accounted for half of the collision types (23.7% and 23.4%, respectively). Ejections were relatively common in the population: 10.6% were completely ejected and another 6.7% were partially ejected. Even more common was the failure to use a seatbelt: 65.5% of BTAI occurred in unrestrained occupants. Drivers comprised 56.7% of the occupants and 26.6% were front seat passengers.

Injuries were most commonly attributed to impact with the steering wheel (22.4% of all cases, accounting for half of all driver's injuries), followed by right interior (21.1% of all cases and approximately 80% of all front passenger injuries).

For the crashes that could be reconstructed for speed change (the non-rollovers primarily), the average delta V of the collision was 32.3mph (51.7 km/h). The relationship between delta V and fatality risk can be seen in the binomial logistic regression represented in Figure 3. Vehicle-to-vehicle impacts comprised 74.0% of the collisions and 20.1% were impacts with narrow objects such as trees or poles.

The present investigation represents the first analysis of BTAI based on national crash data and provides new insight into the nature of these injuries.

*Presenting Author

Figure 1. Estimated annual number of crash-related BTAI cases in the United States 1994-2011

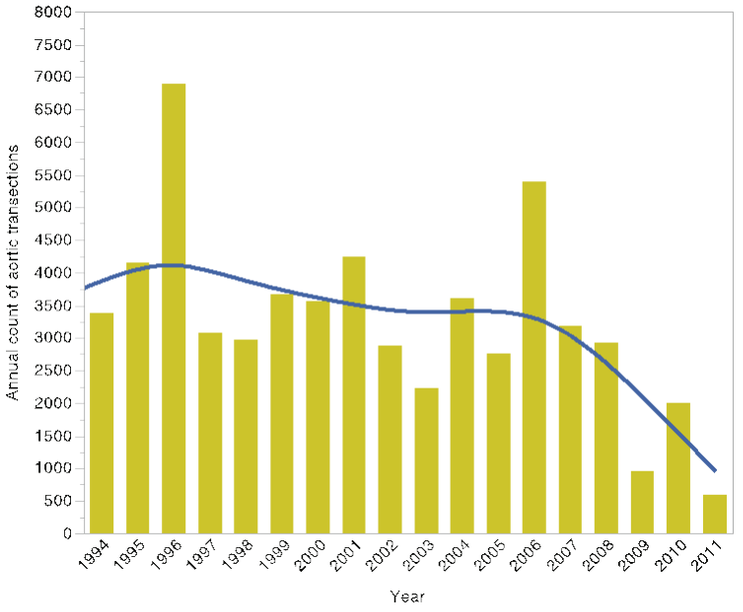

Figure 2. Estimated annual number of all crash-related BTAI and BTAI fatalities versus the total number of crash related deaths

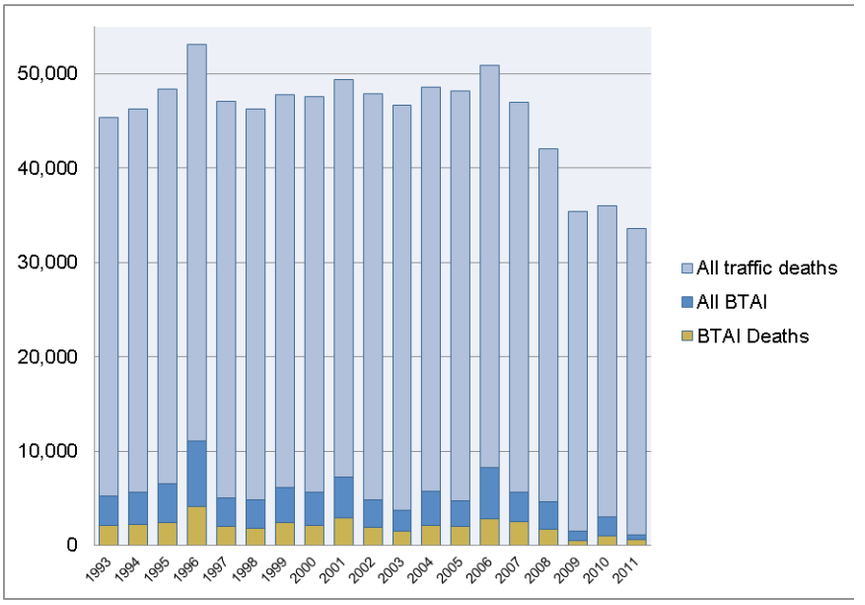

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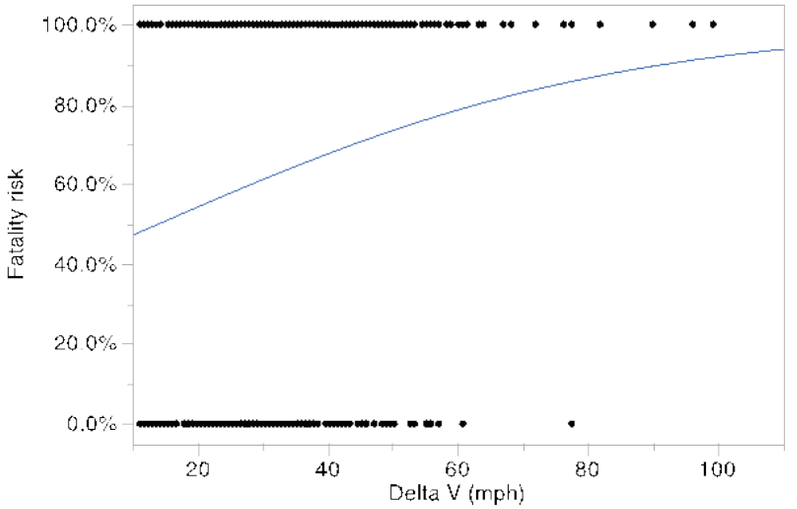
Figure 3. Risk of fatal versus non-fatal BTAI as a function of crash severity (delta V in mph)



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1. Shkrum M.J., McClafferty K.J., Green R.N., Nowak E.S., Young J.G. Mechanisms of aortic injury in fatalities occurring in motor vehicle collisions. *J Forensic Sci*. 1999 Jan;44(1):44-56.
2. Ripple M.G., Grant J.R., Mealey J., Fowler D.R. Evaluation of aortic injury in driver fatalities occurring in motor vehicle accidents in the State of Maryland for 2003 and 2004. *Am J Forensic Med Pathol*. 2008 Jun;29(2):123-7.

Blunt Traumatic Aortic Injury, Rupture, Transection

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