Abdominal and Pelvic Vascular Injury: A National Trauma Data Bank Study

ETHAN TALBOT, M.D., SUZANNE EVANS, M.D., NICHOLAS HELLENTHAL, M.D., DAPHNE MONIE, PH.D., PAUL CAMPBELL, R.N., SHELBY COOPER, M.D.

From the Department of Surgery, Bassett Medical Center, Cooperstown, New York

The aim of this study was to characterize the outcomes of traumatic abdominal and pelvic vascular injuries. Using the 2012 National Trauma Data Bank, we identified 5858 patients with major abdominal and/or pelvic vascular injury. Patients were stratified by age group, gender, race, Injury Severity Score (ISS), and mechanism of injury. We evaluated the percentage of patients with blunt and penetrating trauma by demographic and correlated the mechanism of injury to the ISS score, emergency room disposition, and hospital disposition. We performed a logistic regression analysis to calculate predictors of death. In the final cohort, 1458 patients (25%) with abdominal/pelvic vascular injury died of trauma. In total, 3368 patients (57%) had a blunt mechanism of injury, whereas 2353 (40%) were victims of a penetrating trauma. Patients with penetrating injuries were 1.72 times more likely to die from their injuries than those with blunt traumas. Patients with higher ISS scores (>16) were more likely to die from their injuries than patients with lower ISS scores. Men were more likely to experience a penetrating vascular injury than women (48% *vs* 17%). Similarly, 77 per cent of black patients had a penetrating mechanism of injury compared with 20 per cent of white patients. There were 1910 patients with penetrating injuries (81%) that went immediately from the emergency room to the OR, compared with 1287 patients with blunt injuries (38%). Of the patients with blunt injuries, 695 (21%) died, whereas 727 (31%) patients with penetrating injuries died. Abdominal and pelvic traumatic vascular injuries carry a high mortality rate. Penetrating mechanism of injury, ISS score, and race are independent predictors of mortality.

TRAUMATIC ABDOMINAL AND pelvic vascular injuries are highly lethal. Some series have shown a mortality rate of 39 per cent for traumatic abdominal vascular injuries,[1] and outcomes are worse for patients aged 55 years and older.[2] Several authors have reported on the outcomes of selected groups of patients, such as the pediatric population.[3] Others have shown that the most frequently injured vessels are the abdominal aorta and the inferior vena cava.[1, 4] However, there is presently no overarching review of all traumatic injuries to the abdominal and pelvic vasculature. The goal of this study was to characterize the outcomes of traumatic abdominal and pelvic vascular injuries.

To do this, we performed a retrospective database analysis using the 2012 National Trauma Data Bank (NTDB). Although these data are now more than five years old, the 2012 Research Data Set were the newest data available at the time of analysis. The NTDB was queried for patients with a major abdominal or pelvic vascular injury using ICD-9 codes between 902 and 902.9. All statistical analyses were performed using STATA® statistical software version SE 12 (College Station, TX) and all testing was two-sided. Patients were stratified by age group, gender, race, Injury Severity Score (ISS), and mechanism of injury. We evaluated the percentage of patients with blunt and penetrating trauma by demographics and correlated the mechanism of injury to the ISS, emergency room disposition, and hospital disposition. We performed logistic regression analysis to calculate the predictors of death.

In total, 5858 patients met the inclusion criteria for this study. The five most prevalent injuries were injury to the iliac artery (n = 1039), injury to an unspecified vessel (n = 697), injury to the inferior vena cava (n = 601), injury to the abdominal aorta (n = 502), and injury to the renal artery (n = 417).

The mechanism of injury varied widely based on subject characteristics. Of the male patients with abdominal and pelvic vascular injuries, 48 per cent experienced penetrating injuries, whereas only 17 per cent of female patients presented with a penetrating mechanism of injury. In addition, only 20 per cent of the patients identified as white experienced a penetrating injury, whereas 77 per cent of the patients identified as black suffered a penetrating injury. There

Address correspondence and reprint requests to Ethan Talbot, M.D., Department of Surgery, Bassett Medical Center, One Atwell Road, Cooperstown, NY 13326. E-mail: ethan.a.talbot@gmail.com.

were also variations in the mechanism of injury based on age, with patients in the age group 16–20 years having the highest rate of penetrating injury at 61 per cent.

Patient disposition after the ED was found to be quite different when comparing patient groups. The majority (81%) of patients with a penetrating injury went straight to the operating room, whereas a minority (38%) of blunt injury patients went directly to the operating room. The largest cohort of blunt mechanism patients (41%) went directly to the ICU. Also, patients were more likely to survive the hospitalization if experiencing a blunt injury, as 21 per cent of blunt injury patients died *versus* 31 per cent of penetrating injury patients. Although most penetrating injury patients went directly from the Emergency Room to the OR, there is a small portion of these patients (7%) who went directly to a hospital floor. It is unclear why many of these patients with a penetrating injury resulting in trauma to an abdominal or pelvic vessel would bypass the OR, but this may be related to the increasing use of selective nonoperative management for penetrating abdominal injuries that has been reported by some authors. This would likely be true for many pelvic venous injuries.

When comparing injury severity by gender, female patients were more likely to have an ISS of 25 or greater (53%), whereas only 46 per cent of male patients experienced this severity of injury. This likely is because of the predominantly blunt mechanism of injury of female patients (81% blunt injuries) because blunt injury patients were more likely to have ISSs of 25 or greater. The higher ISS in blunt injury likely results from the associated injuries incurred when the body absorbs a blunt force large enough to result in an abdominal or pelvic vascular injury.

We then determined predictors of mortality based on patient and injury characteristics. Black patients were significantly more likely to die from their injuries compared with white patients (odds ratio 1.94, $P < 0.001$). Much of this increase in mortality likely results from the predominantly penetrating mechanism of injury seen in this group, as all patients with a penetrating injury had a significantly higher mortality when compared with blunt injury patients (odds ratio 1.72, $P < 0.001$). Patients aged 16 years and older were more likely to die from their injuries than patients younger than the age of 16 years ($P < 0.001$). For patients aged 16–44 years, this likely results from their predominantly penetrating mechanism of injury and the higher associated mortality rates. For patients aged 45–64 years, and particularly those aged 65 and older, the higher mortality rate is likely multifactorial. Contributing factors may include lower baseline functional status and comorbid medical conditions. Finally, patients with higher ISSs were more likely to die from their injuries than those with lower scores ($P < 0.001$). All of these predictors remained significant on multivariate analysis.

This study has several limitations. We used the NTDB Research Data Set from one calendar year. Although our sample size was relatively large, the data are from a single snapshot in time. In addition, although we used the most recent data available at the time of the analysis, practice patterns continue to evolve in the modern era. All data are retrospective in nature, which limits its predictive value. Also, there is inherently some selection bias because there is significant mortality in the prehospital phase of care. In addition, any human-entered database is prone to reporting and clerical errors which may skew one's conclusions. Finally, we used pooled data from a variety of abdominal and pelvic vascular injuries. Future studies are needed to analyze specific management strategies and patient outcomes for each of the injured vessels because the appropriate therapy will likely differ.

In conclusion, abdominal and pelvic vascular trauma results in serious injuries with a high mortality rate. Penetrating mechanism of injury, ISS, and race are independent predictors of mortality. We have provided an analysis of the demographic and outcome data for these patients. This demonstrates a need to develop predictive models of survival and specific injury management guidelines.

REFERENCES

1. Davis TP, Feliciano DV, Rozycki GS, et al. Results with abdominal vascular trauma in the modern era. Am Surg 2001;67:565–70.

2. Ottochian M, Salim A, Dubose J, et al. Does age matter? The relationship between age and mortality in penetrating trauma. Injury 2009;40:354–7.

3. Jackson MR, Olson DW, Beckett WC, et al. Abdominal vascular trauma: a review of 106 injuries. Am Surg 1992;58:622–6.

4. Hamner CE, Groner JI, Caniano DA, et al. Blunt intra-abdominal arterial injury in pediatric trauma patients: injury distribution and markers of outcome. J Pediatr Surg 2008;43:916–23.