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Isolated iliac vascular injuries and outcome of repair versus ligation of isolated iliac vein injury

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ABSTRACT

Objective: The incidence of morbidity and mortality for iliac vascular injuries in the literature are likely overestimated owing to associated injuries. Data for isolated iliac vascular injuries are very limited. No large studies have reported the incidence of morbidity for repair versus ligation of isolated iliac vein injuries.

Methods: Patients in the National Trauma Data Bank (NTDB; 2007-2012) with at least one iliac vascular injury were analyzed. Isolated iliac vessels were defined as cases with Abbreviated Injury Scale severity score of greater than 3 for extraabdominal injuries and an Organ Injury Scale grade of greater than 3 for intraabdominal injuries.

Results: Overall, 6262 iliac vascular injuries (2809 penetrating, 3453 blunt) were identified in 271,076 patients with abdominal trauma (2.3%). There were 3379 patients (1841 penetrating, 1538 blunt) with isolated iliac vascular injuries (1.2%) and 557 patients (514 penetrating, 43 blunt) with combined iliac artery and vein injuries (0.2%). The 30-day mortality rate was 16.5% for isolated iliac vein injury, 19.3% for isolated iliac artery injury, and 48.7% for combined isolated iliac artery and vein injury. The 30-day mortality rate was 23.4% for isolated iliac vascular injuries compared with 39.0% for nonisolated iliac vascular injuries ($P < .001$). Patients with isolated iliac vein injuries had morbidity rates of deep venous thrombosis (repair, 14.6%; ligation, 14.1%; $P = .875$), pulmonary embolism (repair, 1.8%; ligation, 0.5%; $P = .38$), fasciotomy (repair, 9.3%; ligation, 14.6%; $P = .094$), amputation (repair, 1.8%; ligation, 2.6%; $P = .738$), acute kidney injury (repair, 5.8%; ligation, 4.7%; $P = .627$). Multivariate logistic regression demonstrated that ligation of isolated iliac vein injuries had an odds ratio of 2.2 for mortality compared with repair (95% confidence interval, 1.08-4.66).

Conclusions: Isolated iliac vascular injuries are associated with a high incidence of mortality, especially for combined venous and arterial injury, but mortality is significantly lower than in patients with nonisolated iliac vascular injuries. In patients with isolated iliac vein injuries, mortality was higher in patients who underwent ligation compared with repair; however, the rates of deep venous thrombosis, pulmonary embolism, fasciotomy, amputation, and acute kidney injury were not different between the treatment groups. These data lend credence to the assessment that repair of iliac vein injuries is preferable to ligation whenever feasible. (J Vasc Surg 2018;67:254-61.)

Iliac vascular injuries are relatively uncommon with an incidence of less than 2% of all vascular trauma reported in the literature but they are associated with significant morbidity and mortality.[1] The mortality rate in patients with iliac vascular injuries reported in the literature ranges from 25% to 80%.[2-17] Penetrating trauma is far more often the cause of iliac vascular injury than blunt trauma.[3,6,7,11,17] A penetrating wound in the lower abdomen or pelvis associated with hypotension and abdominal distension is highly suggestive of an iliac vascular injury. Common and external iliac artery injuries usually present with a unilaterally absent or diminished femoral pulse.[1,2,18]

One of the major limitations of the available literature is that most reports combine blunt and penetrating injuries, and include patients with or without associated injuries. This conglomeration happens because these injuries are relatively uncommon and are frequently associated with other injuries.[1,7,11,15,17,19-21] The true outcomes and prognostic factors for mortality, deep venous thrombosis (DVT), pulmonary embolism (PE), and the need for fasciotomy or amputation in isolated iliac vascular injuries are not well-known, and the morbidity and mortality rates for iliac vascular injuries in the literature are likely overestimated owing to associated injuries.

To our knowledge, there have been no major studies evaluating the morbidity and mortality associated with isolated iliac vascular injuries. Another controversy in the literature is the morbidity of iliac vein ligation as

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compared with repair.[22] A common finding in the literature is that vascular surgeons recommend complex repairs, whereas trauma surgeons believe ligation is a safe alternative for complicated iliac vein injuries.[7,11,23]

METHODS

This analysis uses the National Trauma Data Bank (NTDB), which contains 4,093,451 medical records between 2007 and 2012. All data provided by the NTDB are deidentified and subjected to quality screening for consistency and validity. The use of NTDB data is in strict compliance with the Health Insurance Portability and Accountability Act of 1996. No informed consent was necessary because the study involved a retrospective analysis of deidentified data in the NTDB. The study was approved by the University of Southern California's Institutional Review Board.

The study population consisted of all patients with at least one documented diagnosis of an iliac vascular injury. To identify these patients, we used the Abbreviated Injury Scale (AIS) codes of 1998 version from NTDB, which were 520802∼521099. "Isolated iliac vascular injuries" were defined as cases with neither an AIS severity score of greater than 3 for extraabdominal injuries nor an Organ Injury Scale grade of greater than 3 for intraabdominal injuries; the AIS severity score was used in the case of the intraabdominal organs that do not have Organ Injury Scale grade. Penetrating trauma was gunshot wounds and stab wounds, and blunt trauma was traffic-related motor vehicle trauma and falls. Motor vehicle trauma included motor vehicle accidents and automobile versus pedestrian injuries.

Data abstracted for the these patients included demographic characteristics, mechanism of injury, systolic blood pressure (SBP) and Glasgow Coma Scale (GCS) on admission, Injury Severity Score (ISS), and AIS. Outcomes included DVT, PE, inferior vena cava filter insertion (38.70 of the *International Classification of Diseases, Ninth Revision* [ICD-9] codes without inferior vena cava or superior vena cava injuries in patients with DVT or PE), fasciotomy, amputation (level of below the knee or higher; ICD-9 codes 84.15∼84.18), acute lung injury, acute kidney injury (AKI), and 30-day mortality.

The outcome measures were incidence of iliac artery and vein injuries, incidence of combined iliac artery and vein injuries, incidence of isolated iliac vascular injury, mortality in patients with isolated iliac vascular injury, and incidence of DVT, PE, red blood cell transfusion, fasciotomy, amputation, and AKI in patients with isolated iliac vascular injury.

For subgroup analysis, patients with isolated iliac vein injuries were classified into a repair group and ligation group for comparison. Among 38.00∼39.99 vascular procedure codes from the ICD-9, the following codes were selected as iliac vascular procedures according to ICD-9 code dictionary: 38.06, 38.16, 38.36, 38.46, 39.30, 39.31, 39.56, 39.57, and 39.58 for iliac arterial repair; 38.66 and 38.86 for iliac arterial ligation; 39.30, 39.56, 39.57, 39.58, 38.07, 38.37, 38.47, and 39.32 for iliac venous repair; 38.67 and 38.87 for iliac venous ligation. Some of these codes were described as just "vessels," not "the name of vessel." Because of this limitation, patients with other vascular injuries were excluded for comparison according to procedures. Other vascular injuries were vascular injuries of the head, face, neck, thorax, abdomen exclusive of iliac vessels, upper extremity, and lower extremity. Patients who underwent both repair and ligation were included in the ligation group.

Our hypotheses were that (1) the rate of morbidity and mortality of isolated iliac vascular injuries is lower than previously reported, (2) combined isolated iliac artery and vein injuries will be associated with significantly higher rates of compartment syndrome, fasciotomy, and amputation than for isolated iliac vein injuries, (3) ligation of iliac veins will lead to a higher rate of compartment syndrome and need for fasciotomy and amputation, and (4) repair of iliac veins will be associated with a higher rate of DVT and PE. By analyzing patients with isolated iliac vascular injuries, it will be possible to determine the effect of these injuries and their type of repair without having to deal with confounding associated injuries, such as fractures and bowel injuries, which can themselves lead to these same morbidities.

Descriptive statistics were calculated for all variables. Kolmogorov-Smirnov test was performed to confirm normal distribution in the continuous data. The independent t test was used for continuous data, which were reported as mean ± standard deviation. Fishers exact and χ^2 tests were used for categorical data, which were reported as percentages. Statistical significance was defined as $P < .05$. All analyses were performed using

ARTICLE HIGHLIGHTS

- **Type of Research:** Retrospective review of prospectively collected data of the National Trauma Data Bank (NTDB)
- **Take Home Message:** Among 6262 iliac vascular injuries, mortality was 16.5% for isolated iliac vein injuries and 48.7% for combined iliac arterial and venous injuries. Patients with iliac venous injuries and other concomitant nonvascular injuries had the highest mortality. Ligation of isolated iliac vein injury was associated with a 2.2 odds ratio for mortality compared with primary repair after correcting for confounding differences at presentation.
- **Recommendation:** When technically feasible, an attempt should be made to repair isolated iliac venous injuries to reduce mortality.