

The nonoperative management of penetrating internal jugular vein injury

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Objective: The objective of this study was to review the outcome of nonoperative treatment for penetrating internal jugular vein (IJ) injuries in a continuous series of prospectively identified, hemodynamically stable patients.

Methods: All penetrating neck injuries assessed from February 1, 2004, to August 31, 2004, were prospectively identified. Patients without an indication for urgent neck exploration underwent diagnostic assessment with multislice helical computed tomographic angiography with or without vascular ultrasonography. All IJ injuries with no other indication for surgical exploration were treated nonoperatively. All patients were discharged home and followed up for a minimum of 1 week to document outcomes.

Results: From 51 neck injuries penetrating the platysma, 7 required urgent neck exploration, during which 2 IJ injuries were ligated. Forty-four patients underwent multislice helical computed tomographic angiography. Eight IJ injuries (two gunshot wounds and six stab wounds) with no other indication for neck exploration were identified and managed nonoperatively. One external wound was in zone 1, five were in zone 2, one was in zone 3, and one traversed all three zones. The average length of stay was 4.5 days. At follow-up, ranging from 1 week to 5 months, all patients were asymptomatic, and no patient required delayed operation for IJ injury.

Conclusions: In hemodynamically stable patients with no other indication for exploration, the nonoperative management of penetrating jugular vein injuries should be considered as a safe alternative. (*J Vasc Surg* 2006;43:77-80.)

The optimal management strategy for penetrating venous injuries of the neck is currently unknown. Traditionally, mandatory neck exploration would have resulted in the identification of these injuries and subsequent ligation or repair. As the approach to penetrating neck trauma has evolved, however, the management options for injuries to all three zones of the neck have expanded to include observation and the selective use of imaging and endoscopy.¹⁻⁷ Multislice helical computed tomographic angiography (M-CTA) has dramatically improved our ability to noninvasively image the soft tissues of the neck.⁸⁻¹³ This has resulted in the identification of isolated penetrating internal jugular vein (IJ) injury in patients with no other indications for surgical exploration. The clinical implications of isolated venous injury in this context are unclear. A MEDLINE search for all English-language articles published on this subject since 1985 found no study examining the outcome of the nonoperative management of these injuries.

The objective of this study was to prospectively identify hemodynamically stable patients with penetrating IJ injuries and no other indication for surgical exploration and to examine the outcomes associated with the nonoperative management of these injuries. We hypothesized that this is a safe treatment option for penetrating jugular venous injuries.

METHODS

This study protocol was approved by the Institutional Review Board of the University of Miami and Jackson Health System. All patients with penetrating neck injuries assessed at the Ryder Trauma Center from February 2004 through August 2004 were prospectively identified and entered into this study. Each patient was evaluated by a trauma fellow and attending trauma surgeon. All injuries penetrating the platysma without an indication for immediate surgical exploration (hemodynamic instability, active bleeding, pulsatile or expanding hematoma, hematemeses, hemoptysis, stridor, or air leak) went on to diagnostic assessment by M-CTA.

One hundred milliliters of nonionic contrast material was injected at a rate of 4 mL/s through an 18-gauge catheter placed in an antecubital vein. Images were obtained with a collimation of 2 to 3 mm and an interval reconstruction of 1 to 1.6 mm with a four-row multislice computed tomographic scanner (Phillips MX 8000; Phillips, Bothell, Wash). An automated triggering device was used to determine the adequate scan delay. Two- and three-dimensional reconstructions were obtained on a separate workstation.

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Competition of interest: none.

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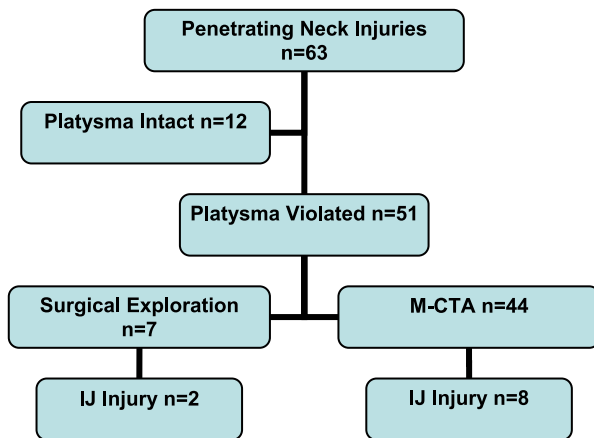


Fig 1. Overview of patients with penetrating neck injuries. M-CTA, Multislice helical computed tomographic angiography; IJ, internal jugular vein.

The M-CTA was read by the attending emergency radiologist. M-CTA results were available within 6 hours of the initial assessment. The diagnosis of an IJ injury required a penetrating injury in the region of the M-CTA finding of IJ injury, indirect soft tissue evidence on M-CTA of injury, including a hematoma immediately adjacent to the venous structure or visible tract in the region of the vessel, direct evidence of vessel disruption or absence of flow, and, finally, contrast opacification of the contralateral, uninjured IJ to exclude artifact due to a delay in the venous contrast phase. Color flow pulse Doppler imaging and grayscale images of the vessels were used early in the study to confirm the diagnosis; however, because no additional clinical information was being provided, these were then omitted. All patients diagnosed with an IJ injury and no other indication for surgical exploration were managed nonoperatively with local wound care. All patients were followed up to a minimum of 1 week after discharge. Two patients who were not seen in the follow-up clinic were contacted by telephone for follow-up assessment. Descriptive statistics include means and ranges.

RESULTS

From February 2004 through August 2004, 63 patients with penetrating neck injuries were evaluated: 51 of these injuries penetrated the platysma (Fig 1). Of these patients, 7 were immediately explored in the operating room, and 44 underwent diagnostic screening by M-CTA (Fig 2). Two of the seven patients undergoing immediate surgical exploration (for active bleeding) had IJ injuries (both zone 2 injuries). One was an isolated injury, and the other was associated with a common carotid and tracheal injury. Both venous injuries were ligated, and at follow-up (12 and 21 days), both patients were doing well, with no complications. From the 44 patients undergoing M-CTA, IJ injuries were diagnosed in 8 (18.2%) patients (Table I). None of these patients had other indications for operative neck exploration and were treated nonoperatively.

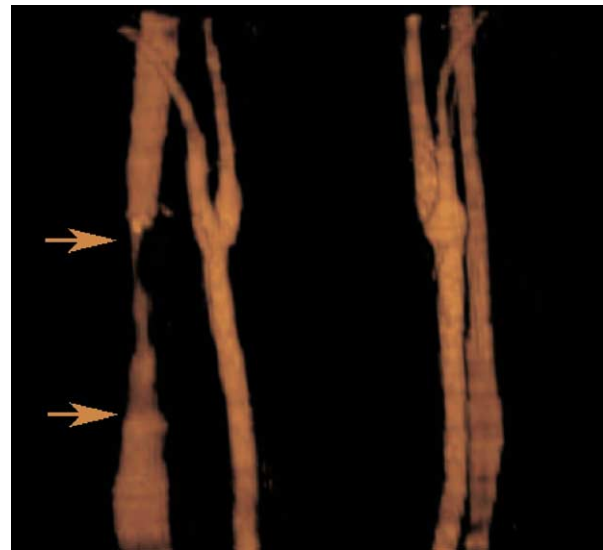


Fig 2. Coronal three-dimensional volume-rendered reconstruction of the neck vasculature demonstrates an abrupt change in the caliber of the right internal jugular vein at the midcervical level (between arrows). Note the increased distance between the vein and the right common carotid artery and its branches as a result of an adjacent hematoma.

The average age of the patients with IJ injuries managed nonoperatively was 37.1 years (range, 15-65 years), and 87.5% were male. Seventy-five percent were stabbed, and the remainder were gunshot victims. Five of the entrance wounds were in zone 2, one was in zone 1, one was in zone 3, and one traversed all three zones of the neck. Two of the patients were completely asymptomatic apart from the external wound; five had nonpulsatile, nonexpanding hematomas (one associated with Brown-Sequard syndrome); and one had minimal bleeding from the wound at presentation that stopped during the primary survey with the application of pressure. All injuries were diagnosed on M-CTA. Early in the study, confirmatory vascular ultrasound studies were performed. Three of the injuries had confirmatory ultrasonography. Because no additional clinical information was being provided by the ultrasonography, it was omitted in subsequent patients.

Associated injuries were seen in five of eight patients. Two patients had facial fractures, one had a humerus fracture and laceration of the thyroid, and two had cervical spine injuries. The facial fractures and humerus fracture required open reduction and internal fixation.

All nonoperative patients remained hemodynamically stable, with a mean admission systolic blood pressure of 135 mm Hg (range, 118-172 mm Hg), a mean heart rate of 89 beats per minute (range, 61-98 beats per minute), and a mean base deficit of 0 (range, -5 to 1) correcting to a mean of 0 (range, 0-1). The initial hematocrit was 38% (range, 26.6%-47.1%). No blood was transfused during the study period.

The average length of hospital stay for patients treated nonoperatively was 4.5 days (range, 6 hours to 10 days).

Table 1. Demographic data: nonoperative IJ injuries

Patient No.	Age (y)/sex	Mechanism	Zone	Physical examination	Associated injury	Follow-up
1	35M	SW	2	Asymptomatic	None	3mo
2	65M	SW	3	Bleeding	Maxilla, mandible, zygoma Fx	5 wk
3	43M	GSW	1	Hematoma	Thyroid, humerus Fx	5mo
4	37 F	SW	2	Hematoma	C6 facet Fx	3 wk
5	33M	SW	2	Hematoma	None	1 wk
6	15M	GSW	2	Hematoma/BSS	Cervical cord contusion	4 wk
7	25M	SW	2	Asymptomatic	None	1 wk
8	44M	SW	1-3	Hematoma	Maxilla Fx	2 wk

IJ, Internal jugular vein; SW, stab wound; GSW, gunshot wound; Fx, fracture; BSS, Brown-Sequard syndrome.

Follow-up after discharge ranged from 1 week to 5 months. At follow-up, all patients were asymptomatic from their IJ injury. No patient required delayed operation or further treatment for their nonoperatively managed IJ injury.

DISCUSSION

Venous injury as a result of penetrating trauma to the neck is common. The incidence of IJ injury in this prospectively screened series was similar to that found in two other prospective series of patients undergoing mandatory surgical exploration and identification of injury. In the first study of 393 stab wounds, 65 (16.5%) patients had IJ injuries.⁷ Then, in 2003, Gonzalez et al¹⁰ documented 7 (16.7%) IJ injuries in a prospective series of 42 stab and gunshot wounds to the neck undergoing mandatory exploration.

Patients sustaining IJ injury presented in one of two ways: those requiring immediate exploration and those able to undergo further diagnostic imaging. For patients undergoing immediate exploration, exposure of the IJ and exclusion of injury remains critical. If an injury is detected, ligation or repair, depending on the complexity of the injury and the physiological status of the patient during surgery, have both been associated with successful outcomes.¹⁴⁻¹⁶ Endovascular management of actively bleeding penetrating IJ disruption has also been described.¹⁷ Successful embolization is possible with *n*-butyl cyanoacrylate retrograde through the femoral approach via the contralateral IJ and lateral and sigmoid sinuses. In our series, both injuries requiring immediate operative management presented with ongoing bleeding and were both ligated. Both patients were doing well at follow-up.

For the other group of patients, those who present hemodynamically stable with no immediate indication for surgical exploration, the optimal management strategy remains controversial. Traditionally, particularly in zone 2 injuries, mandatory exploration and the identification and definitive repair or ligation of venous injury would have been an option. However, the approach to the evaluation of penetrating neck injury is evolving and is increasingly taking advantage of advances in noninvasive imaging technology. Whether mandatory imaging-directed or physical examination-directed selective management is practiced,¹⁻⁷ imaging modalities such as vascular ultrasonography and M-CTA^{8-13,18} will increasingly identify IJ injuries

that are not acutely bleeding in hemodynamically stable patients with no other indication for operative exploration.

In these patients, the nonoperative management of the IJ injury would avoid the risks, cost, and time associated with surgical exploration. Unlike arterial injury, which requires prompt localization and operative or endovascular repair, the venous system is a low-flow, low-pressure system that would be expected to tamponade with the application of pressure. As a clinical parallel, iatrogenic IJ laceration occurs regularly during the insertion and subsequent blind removal of percutaneous access devices for central venous catheters, dialysis portals, and a variety of interventional procedures. These large-bore introducers are routinely removed without follow-up imaging or surgical repair. In fact, in this era of nonoperative management of penetrating neck injuries, at centers that either observe or selectively image the vasculature by using only four-vessel angiography, many of these IJ injuries are likely being missed and effectively are being treated nonoperatively at this time.

By carefully imaging all patients with M-CTA, in this study we were able to prospectively identify and follow up a continuous series of penetrating IJ injuries with no other indications for neck exploration. The eight patients identified were successfully treated nonoperatively and discharged home. Follow-up, ranging from 1 week to 5 months, demonstrated no adverse effects from this nonoperative management strategy for penetrating IJ injuries.

CONCLUSION

As the approach to penetrating neck injury evolves, the liberal use of noninvasive screening diagnostics such as M-CTA will result in the increasing identification of hemodynamically stable venous injuries. Patients presenting with an IJ injury and an indication for immediate operative intervention will continue to require vascular control and ligation or repair. In hemodynamically stable patients who have no other indication for exploration, the nonoperative management of these injuries should be considered as a safe alternative.

AUTHOR CONTRIBUTIONS

Conception and design: KI, FM, MM
Analysis and interpretation: KI, FM, MM, LR, EM, MD,
TO, LP, SC

Data collection: KI, MD, TO
 Writing the article: KI, FM, MM, LR, EM, MD, TO, LP, SC
 Critical revision of the article: KI, FM, MM, LR, EM, MD, TO, LP, SC
 Final approval of the article: KI, FM, MM, LR, EM, MD, TO, LP, SC
 Statistical analysis: KI, MM, MD, TO
 Overall responsibility: KI

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