

**Penetrating Neck Injury
EVIDENCE TABLE**

Reference	Study Type	Patients/ Events	Study Objective (Purpose of Study)	Study Results	Study Quality
1. O'Brien PJ, Cox MW. A modern approach to cervical vascular trauma. <i>Perspect Vasc Surg Endovasc Ther.</i> 2011;23(2):90-97.	Review/Other-Tx	N/A	To review modern approaches to workup and therapy to cervical vasculature trauma.	No results stated in abstract.	4
2. Saito N, Hito R, Burke PA, Sakai O. Imaging of penetrating injuries of the head and neck:current practice at a level I trauma center in the United States. <i>Keio J Med.</i> 2014;63(2):23-33.	Review/Other-Dx	N/A	To review common penetrating injuries to the head and neck, the anatomic classification of the neck zone, and CTA findings of vascular/extravascular injuries and to describe the traditional diagnostic algorithm and the impact of CTA on the diagnostic algorithm and injury management.	Knowledge of management of penetrating neck injuries and their imaging characteristics is essential for making an accurate diagnosis and facilitating prompt treatment.	4
3. Steenburg SD, Sliker CW, Shanmuganathan K, Siegel EL. Imaging evaluation of penetrating neck injuries. <i>Radiographics.</i> 2010;30(4):869-886.	Review/Other-Dx	N/A	To evaluate the value, roles, and limitations of MDCT angiography and other imaging modalities in the care of patients with penetrating trauma to the neck.	An appreciation of the value, roles, and limitations of MDCT angiography and other imaging modalities can position the radiologist as a vital participant in the care of patients with penetrating trauma to the neck.	4
4. Bagheri SC, Khan HA, Bell RB. Penetrating neck injuries. <i>Oral Maxillofac Surg Clin North Am.</i> 2008;20(3):393-414.	Review/Other-Dx	N/A	To review both historic and recent articles that have formulated the current management of penetrating injuries to the neck.	No results stated in abstract.	4

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5. Inaba K, Branco BC, Menaker J, et al. Evaluation of multidetector computed tomography for penetrating neck injury: a prospective multicenter study. <i>J Trauma Acute Care Surg.</i> 2012;72(3):576-583; discussion 583-574; quiz 803-574.	Observational-Dx	453 neck injuries	To evaluate a clinical protocol integrating MDCT angiography as the initial screening examination for the workup of penetrating neck injury.	453 penetrating neck injuries were evaluated. Hard signs of vascular or aerodigestive tract injury were observed in 8.6% with an 89.7% incidence of clinically significant injury. 41.7% had no signs of injury and were observed with no missed injuries (follow-up, 2.6 days +/- 1.1 days [1-58 days]). The remaining 225 (49.7%) underwent MDCT angiography (stab wound, 61.3%; gunshot wound, 37.8%; shotgun, 0.9%). The external wounds were in zone II (38.2%), multiple (28.9%), zone I (16.9%), and zone III (16.0%). 28 injuries were found in 22 patients (5 internal jugular-V, 2 external jugular-V, 1 vertebral-A, 7 common carotid-A, 2 internal carotid-A, 3 external carotid-A, 2 subclavian-A, 3 esophagus, and 3 tracheas). 5 patients had false-positive findings (2 vascular and 3 aerodigestive tract). The 194 negative studies (follow-up, 5.5 days +/- 7.5 days [1-27 days]) had no delayed diagnosis of injury. MDCT angiography was nondiagnostic in 4 patients (1.8%), secondary to artifact. One of these had a vertebral-A injury diagnosed at angiography. MDCT angiography achieved 100% sensitivity and 97.5% specificity in detecting all clinically significant injuries.	3
6. Shiroff AM, Gale SC, Martin ND, et al. Penetrating neck trauma: a review of management strategies and discussion of the 'No Zone' approach. <i>Am Surg.</i> 2013;79(1):23-29.	Review/Other-Dx	N/A	To discuss the evolution of the evaluation of stable patients with penetrating neck trauma and emphasize the use of a "No Zone" approach to their initial assessment and management.	Continued reliance on zone-based algorithms leads to increased use of invasive diagnostic modalities as well as a higher incidence of nontherapeutic neck exploration. Describing neck injuries by "zone" may no longer be necessary; physicians evaluating these patients should consider departing from these antiquated, invasive algorithms in favor of CTA-based triage to screen hemodynamically stable patients with penetrating neck injuries.	4

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7. Low GM, Inaba K, Chouliaras K, et al. The use of the anatomic 'zones' of the neck in the assessment of penetrating neck injury. <i>Am Surg.</i> 2014;80(10):970-974.	Observational-Dx	N/A	To characterize the association between external wounds and the corresponding internal injuries after penetrating neck trauma to identify the clinical use of the anatomic zones of the neck.	In total, 146 patients sustaining a penetrating neck injury were analyzed; 126 (86%) male. The mechanism of injury was stab wounds in 74 (51%) and gunshot wounds in 69 (47%). Mean age was 31 years (range, 9 to 62 years). 37 (25%) patients sustained had a total of 50 internal injuries. There was a high incidence of noncorrelation between the location of the external injury and the internal structures that were damaged in patients with hard signs of vascular or aerodigestive injury.	3
8. Sperry JL, Moore EE, Coimbra R, et al. Western Trauma Association critical decisions in trauma: penetrating neck trauma. <i>J Trauma Acute Care Surg.</i> 2013;75(6):936-940.	Review/Other-Dx	N/A	To present the recommended algorithm of the Western Trauma Association for the management of penetrating neck trauma that has penetrated the platysma muscle of the neck.	No results stated in abstract.	4
9. Brennan J, Lopez M, Gibbons MD, et al. Penetrating neck trauma in Operation Iraqi Freedom. <i>Otolaryngol Head Neck Surg.</i> 2011;144(2):180-185.	Review/Other-Tx	112 neck explorations	To examine the surgical outcomes of penetrating neck trauma patients in Operation Iraqi Freedom (OIF) and compare treatment and perioperative survival to historical data with low-velocity penetrating neck trauma seen in a noncombat clinical setting.	112 neck explorations for penetrating neck trauma were performed in OIF over 30 months. 98% of these neck injuries were due to high-velocity projectiles. In patients, zone 1 injuries occurred in 10%, zone 2 injuries in 77%, zone 3 injuries in 5%, combined zone 1/2 injuries in 5%, and combined zone 2/3 injuries in 3%. The positive exploration rate (patients with intraoperative findings necessitating surgical repair) was 69% (77/112). The mortality of patients undergoing neck exploration for high-velocity penetrating neck trauma was 3.7%.	4
10. Stallmeyer MJ, Morales RE, Flanders AE. Imaging of traumatic neurovascular injury. <i>Radiol Clin North Am.</i> 2006;44(1):13-39, vii.	Review/Other-Dx	N/A	To present a general approach to the patient with suspected neurovascular injury. This includes a discussion of the histopathologic spectrum, clinical presentation, mechanisms, radiologic workup, pertinent issues of the most common lesions, and some of the endovascular techniques used in their management.	No results stated in abstract.	4
11. Burgess CA, Dale OT, Almeyda R, Corbridge RJ. An evidence based review of the assessment and management of penetrating neck trauma. <i>Clin Otolaryngol.</i> 2012;37(1):44-52.	Review/Other-Dx	N/A	To assess recent evidence relating to the assessment and management of penetrating neck trauma, highlighting areas of controversy with an overall aim of formulating clinical guidelines according to a care pathway format.	No results stated in abstract.	4

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12. Brywczyński JJ, Barrett TW, Lyon JA, Cotton BA. Management of penetrating neck injury in the emergency department: a structured literature review. <i>Emerg Med J</i> . 2008;25(11):711-715.	Review/Other-Tx	122 citations	To review the medical literature and provide current recommendations for the management of patients with penetrating neck injury.	122 citations were identified that met the criteria for emphasis on emergency department care, cervical spine immobilization, use of MDCT angiography or airway management. After excluding case series, nonpeer reviewed articles and editorials, 20 articles were identified and reviewed.	4
13. Munera F, Cohn S, Rivas LA. Penetrating injuries of the neck: use of helical computed tomographic angiography. <i>J Trauma</i> . 2005;58(2):413-418.	Review/Other-Dx	N/A	To evaluate the authors' current protocol for penetrating neck wounds and identifies indications for helical CTA.	The authors believe helical CTA can replace conventional angiography for the initial evaluation of stable patients with penetrating neck injuries. As compared with conventional angiography, CTA is less costly and faster, does not require assembly of an angiographic team for performance of the study, and has fewer potential complications.	4
14. Patterson BO, Holt PJ, Cleanthis M, Tai N, Carrell T, Loosemore TM. Imaging vascular trauma. <i>Br J Surg</i> . 2012;99(4):494-505.	Review/Other-Dx	58 articles	To define optimal first-line imaging in patients with suspected vascular injury in different anatomical regions.	Of 1,511 titles identified, 58 articles were incorporated in the systematic review. Most described the use of CTA. The application of duplex ultrasound, magnetic resonance imaging/angiography and transesophageal echocardiography was described, but significant drawbacks were highlighted for each. CTA displayed acceptable sensitivity and specificity for diagnosing vascular trauma in blunt and penetrating vascular injury within the neck and extremity, as well as for blunt aortic injury.	4
15. Munera F, Danton G, Rivas LA, Henry RP, Ferrari MG. Multidetector row computed tomography in the management of penetrating neck injuries. <i>Semin Ultrasound CT MR</i> . 2009;30(3):195-204.	Review/Other-Dx	N/A	To review the use of MDCT in the management of penetrating neck injuries.	No results stated in abstract.	4

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16. Meghoo CA, Dennis JW, Tuman C, Fang R. Diagnosis and management of evacuated casualties with cervical vascular injuries resulting from combat-related explosive blasts. <i>J Vasc Surg.</i> 2012;55(5):1329-1336; discussion 1336-1327.	Observational-Dx	172 patients	To characterize the vascular injuries associated with penetrating blast injuries to the neck and provides recommendations on the early management of these casualties for the surgeon unfamiliar with these injuries.	Query of the Landstuhl Regional Medical Center Trauma Registry initially identified 252 patients, of which 53 were excluded because their injuries arose from other mechanisms or were only superficial. Among the remaining 199 patients, 38 (19.1%) sustained 44 vascular injuries requiring treatment. Compelling physical examination findings (“hard signs”) were present in 15 (7.5%), who underwent immediate neck exploration. Another 12 patients also underwent neck exploration without any prior imaging studies. CT or CTA examinations were done in 172 patients without hard-sign physical examination findings. Of these, the result of the imaging study was negative in 106 patients, and no further investigation or treatment for cervical vascular trauma was initiated. Of 66 patients who underwent CT/CTA before operative neck exploration, CT/CTA identified a vascular injury in 26 that was later confirmed on neck exploration. The combination of physical examination and CT/CTA resulted in a sensitivity of 96.3% and a specificity of 97.2% in diagnosing cervical vascular injury.	3
17. Woo K, Magner DP, Wilson MT, Margulies DR. CT angiography in penetrating neck trauma reduces the need for operative neck exploration. <i>Am Surg.</i> 2005;71(9):754-758.	Observational-Dx	130 patients	To review our experience over 10 years with the management of penetrating neck injury.	130 cases were reviewed with 34 undergoing CTA (Group CTA) and 96 with no CTA (Group nCTA). Group CTA had significantly fewer neck explorations, 1 (3%) versus 32 (33%), $P<0.001$. Negative explorations were significantly higher in nCTA as well, with a rate of 22% versus 0 in CTA ($P<0.01$). The use of angiogram and esophagram was also significantly lower in CTA versus nCTA ($P=0.02$ and $P=0.04$). Of the 34 patients in CTA, 4 (12%) also underwent angiography and 4 (12%) received a contrast esophagram. Of the 64 patients in nCTA who did not undergo a neck exploration, 19 (29%) underwent angiography, and 17 (26%) received a contrast esophagram.	3

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18. Schroll R, Fontenot T, Lipcsey M, et al. Role of computed tomography angiography in the management of Zone II penetrating neck trauma in patients with clinical hard signs. <i>J Trauma Acute Care Surg.</i> 2015;79(6):943-950; discussion 950.	Observational-Dx	183 patients	To examine whether selective nonoperative management of Zone 2 penetrating neck trauma patients with clinical hard signs by CTA results in fewer negative NE results.	Of 183 penetrating neck trauma patients, 23 had hard signs and underwent CTA. Of the 23, 5 had a positive CTA finding and underwent neck exploration, while 17 had a negative CTA finding and did not require neck exploration. There was 1 false-negative in a patient who developed an expanding hematoma following negative neck CTA finding. Sensitivity, specificity, positive predictive value, and negative predictive value for CTA in the presence of hard signs were found to be 83%, 100%, 100%, and 94%, respectively. The addition of CTA to the Western Trauma Association algorithm for this patient group significantly decreased the rate of negative neck exploration (0 of 23 vs 18 of 23, $P<0.001$) without a significant increase in the rate of missed injury (1 of 23 vs 0 of 23, $P=0.323$). The use of CTA prevented 17 unnecessary neck explorations.	3
19. American College of Radiology. <i>Manual on Contrast Media</i> . Available at: http://www.acr.org/Quality-Safety/Resources/Contrast-Manual . Accessed March 1, 2017.	Review/Other-Dx	N/A	Guidance document on contrast media to assist radiologists in recognizing and managing risks associated with the use of contrast media.	N/A	4

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20. Cox MW, Whittaker DR, Martinez C, Fox CJ, Feuerstein IM, Gillespie DL. Traumatic pseudoaneurysms of the head and neck: early endovascular intervention. <i>J Vasc Surg.</i> 2007;46(6):1227-1233.	Review/Other-Tx	11 patients	To review the management of patients with trauma to the head and neck caused by military munitions.	Between February 2003 and March 2007, 124 patients were evaluated for significant penetrating trauma to the head and neck. 13 pseudoaneurysms of the head and neck were found in 11 patients: 2 in the internal carotid artery, 1 of the vertebral artery, and 10 involving branches of the external carotid. 7 pseudoaneurysms were symptomatic, of which 2 presented with episodes of massive bleeding and airway compromise. 7 pseudoaneurysms were treated with coil embolization, 1 with Gelfoam (Upjohn, Kalamazoo, Mich) embolization, 2 with stent grafts, 2 with open repair, and 1 with observation alone. None of the patients undergoing embolization had complications; however, a stent graft of the internal carotid artery occluded early, without stroke. All of the pseudoaneurysms had resolved on follow-up CTA or angiogram.	4
21. Greer LT, Kuehn RB, Gillespie DL, et al. Contemporary management of combat-related vertebral artery injuries. <i>J Trauma Acute Care Surg.</i> 2013;74(3):818-824.	Review/Other-Tx	11 casualties	To examine the contemporary management of combat-related penetrating vertebral artery injuries during current United States military operations.	11 casualties with a mean age of 26 years (mean [SD] ISS, 18 [7.0]) were found to have vertebral artery injuries from gunshot wounds (6, 55%) or blast fragments (5, 45%). Cervical spine fractures (8, 72%), facial fractures (5, 45%), and spinal cord injury (3, 27%) were not uncommon. One casualty experienced a posterior cerebellar and parietal infarcts. All injuries were evaluated with digital subtraction angiography, 64-slice MDCT, or both. Casualties were noted to have vertebral artery occlusion (4, 36%), pseudoaneurysms (5, 45%), dissection (1, 9%), or arteriovenous fistula (1, 9%), with most injuries occurring in the V2 segment (6, 55%). Pseudoaneurysms were treated with coiling or stent-assisted coiling. Of 11 casualties, 6 were managed nonoperatively, half of whom with anticoagulation or antiplatelet therapy.	4

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22. Fox CJ, Gillespie DL, Weber MA, et al. Delayed evaluation of combat-related penetrating neck trauma. <i>J Vasc Surg.</i> 2006;44(1):86-93.	Review/Other-Dx	63 patients	To review the delayed evaluation of combat-related penetrating neck trauma in patients after evacuation to the United States.	Suspected vascular injury from penetrating neck trauma occurred in 63 patients. Injuries were to zone II in 33%, zone III in 33%, and zone I in 11%. The remaining injuries involved multiple zones, including the lower face or posterior neck. Explosive devices wounded 50 patients (79%), 13 (21%) had high-velocity gunshot wounds, and 19 (30%) had associated intracranial or cervical spine injury. Of the 39 patients (62%) who underwent emergent neck exploration in Iraq or Afghanistan, 21 had 24 injuries requiring ligation (18), vein interposition or primary repair (4), polytetrafluoroethylene graft interposition (1), or patch angioplasty (1). Injuries occurred to the carotid, vertebral, or innominate arteries, or the jugular vein. After evacuation to the United States, all patients underwent radiologic evaluation of the head and neck vasculature. CTA was performed in 45 patients (71%), including 6 zone II injuries without prior exploration. 40 (63%) underwent diagnostic arteriography that detected pseudoaneurysms (5) or occlusions (8) of the carotid and vertebral arteries. No occult venous injuries were noted. Delayed evaluation resulted in the detection of 12 additional occult injuries and 1 graft thrombosis in 11 patients. Management included observation (5), vein or polytetrafluoroethylene graft repair (3), coil embolization (2), or ligation (1).	4
23. Schroeder JW, Baskaran V, Aygun N. Imaging of traumatic arterial injuries in the neck with an emphasis on CTA. <i>Emerg Radiol.</i> 2010;17(2):109-122.	Review/Other-Dx	N/A	To review the clinical and imaging features of vascular injuries of the neck with special emphasis on CTA.	No results stated in abstract.	4

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<p>24. Demetriades D, Theodorou D, Cornwell E, et al. Evaluation of penetrating injuries of the neck: prospective study of 223 patients. <i>World J Surg.</i> 1997;21(1):41-47; discussion 47-48.</p>	<p>Observational-Dx</p>	<p>223 patients</p>	<p>To assess the role of clinical examination, angiography, color flow Doppler imaging, and other diagnostic tests in identifying injuries to the vascular or aerodigestive structures in patients with penetrating injuries to the neck.</p>	<p>Altogether 223 patients were entered in the study. After physical examination 176 patients underwent angiography and 99 of them underwent color flow Doppler imaging. Angiographic abnormalities were seen in 34 patients for an incidence of 19.3%, but only 14 (8.0%) required treatment. Color flow Doppler imaging was performed on 99 patients with a sensitivity of 91.7%, specificity 100%, positive predictive value 100%, and negative predictive value 99%. These values were all 100% when only injuries requiring treatment were considered. None of the 160 patients without clinical signs of vascular injury had serious vascular trauma requiring treatment (negative predictive value 100%), although angiography in 127 showed 11 vascular lesions not requiring treatment. “Hard” signs on clinical examination (large expanding hematomas, severe active bleeding, shock not responding to fluids, diminished radial pulse, bruit) reliably predicted major vascular trauma requiring treatment. Among 34 of the 223 total patients (15.2%) admitted with “soft” signs, 8 had angiographically detected injuries, but only 1 required treatment. An esophagram was performed on 98 patients because of proximity injuries (49 patients) or suspicious clinical signs (49 patients), and 2 of them showed esophageal perforations. None of the 167 patients without clinical signs of esophageal trauma had an esophageal injury requiring treatment.</p>	<p>2</p>

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25. Demetriades D, Theodorou D, Cornwell E, 3rd, et al. Penetrating injuries of the neck in patients in stable condition. Physical examination, angiography, or color flow Doppler imaging. <i>Arch Surg.</i> 1995;130(9):971-975.	Observational-Dx	82 patients	To evaluate and compare the roles of physical examination, color flow Doppler imaging, and angiography in the identification and management of penetrating neck injuries.	82 patients fulfilled the criteria for inclusion in the study. Angiography demonstrated vascular lesions in 11 patients (13.4%), but only 2 (2.4%) of them required treatment. Serious injuries were detected or suspected during physical examination, but 6 lesions not requiring treatment were missed. When injuries not requiring treatment were excluded, the sensitivity was 100% and the specificity was 91%. With color flow Doppler imaging, 10 of the 11 injuries were identified, for a sensitivity of 91% and a specificity of 98.6%. The sensitivity and specificity were 100% for clinically important lesions.	3
26. Becker M, Leuchter I, Platon A, Becker CD, Dulguerov P, Varoquaux A. Imaging of laryngeal trauma. <i>Eur J Radiol.</i> 2014;83(1):142-154.	Review/Other-Dx	N/A	To provide a comprehensive approach to the radiologic interpretation of imaging studies performed in patients with suspected laryngeal injury.	No results stated in abstract.	4
27. Ahmed N, Massier C, Tassie J, Whalen J, Chung R. Diagnosis of penetrating injuries of the pharynx and esophagus in the severely injured patient. <i>J Trauma.</i> 2009;67(1):152-154.	Observational-Dx	33 patients	To compare detection of injuries to the hypopharynx and esophagus by each method (videoendoscopy or a radiologic study with water-soluble contrast and a thin barium suspension) and to assess complications resulting from intervention.	33 patients were included in the study. Contrast study detected all esophageal injuries, but failed to detect any hypopharyngeal injuries particularly in the intubated patients. Videoendoscopy detected all injuries, hypopharyngeal and esophageal in intubated and nonintubated patients.	3
28. American College of Surgeons. <i>Advanced Trauma Live Support (ATLS) for Doctors Student Course Manual.</i> 9th ed. Chicago, IL: American College of Surgeons; 2012.	Review/Other-Dx	N/A	Book.	N/A	4
29. Bodanapally UK, Shanmuganathan K, Dreizin D, et al. Penetrating aerodigestive injuries in the neck: a proposed CT-aided modified selective management algorithm. <i>Eur Radiol.</i> 2016;26(7):2409-2417.	Observational-Dx	38 patients in study and 64 control patients	To determine the specific CT findings of penetrating neck wound profile predicting aerodigestive injuries, diagnostic performance of CTA and to propose a modified selective management algorithm to reduce nontherapeutic invasive procedures. No intravenous contrast was administered.	Trajectory of the wound extending into the aerodigestive tract (sensitivity 76%, specificity 97%) and trajectory of the wound violating the suprahyoid deep neck spaces or the infrahyoid visceral space (sensitivity 97 %, specificity 55 %) were the best predictors of injury on regression analysis. The most specific “conventional” CT signs were “wall defect” and “active mucosal bleed”, but had very low sensitivity. The sensitivity of CTA for detecting an injury ranged from 89.5% to 92%, specificity ranged from 62.5% to 89%.	3

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30. Conradie WJ, Gebremariam FA. Can computed tomography esophagography reliably diagnose traumatic penetrating upper digestive tract injuries? <i>Clin Imaging</i> . 2015;39(6):1039-1045.	Observational-Dx	104 Patients	To determine the sensitivity and specificity of CT esophagography in diagnosing penetrating esophageal and hypopharyngeal injuries in trauma patients and to see if it can be used as the only imaging method in diagnosing these injuries. The confidence of radiologists using only CT esophagography was also measured. Oral contrast was administered in this study.	Between December 2012 and November 2014, 102 patients were included, of which 93 (91.2%) were male. Stab wounds were responsible for 85.3% (n=87) of penetrating wounds. 94 patients (92.2%) had CTA in conjunction with CT esophagography. There were 20 confirmed upper digestive tract injuries; 11 (55.0%) in the hypopharynx and 9 (45.0%) in the esophagus. With the exception of 1 case, all upper digestive tract injuries were diagnosed using only CT esophagography. No upper digestive tract injuries were correctly identified in 70 and 75 out of 82 true negative cases respectively, suggesting a sensitivity of 95.0% for both radiologists and specificity of 85.4% and 91.5% for CT esophagography. A number of false positive diagnoses were reported when CT esophagography was done in conjunction with CTA, resulting in a positive predictive value of 61.3% and 79.1% for this technique. Reviewers were positive to very confident about the CT esophagography findings in 90.0% and 100% of patients with injuries and 79.0% and 87.0%, respectively, in the no injury group.	2
31. Montalvo BM, LeBlang SD, Nunez DB, Jr., et al. Color Doppler sonography in penetrating injuries of the neck. <i>AJNR Am J Neuroradiol</i> . 1996;17(5):943-951.	Observational-Dx	52 patients	To determine whether color Doppler sonography can be a sensitive alternative to screening arteriography for identifying arterial injury in patients with penetrating traumatic neck injuries.	Color Doppler sonography correctly detected all serious injuries of the carotid arteries (n = 6; 5 diagnosed at angiography and 1 at surgery) and all injuries of the vertebral arteries (n = 4; all diagnosed at angiography). Sonography missed 1 instance of reversible narrowing of the internal and external carotid arteries and did not show 2 normal vertebral arteries.	1
32. American College of Radiology. ACR–ASNR–SNIS–SPR Practice Parameter for the Performance of Cervicocerebral Magnetic Resonance Angiography (MRA). Available at: http://www.acr.org/~media/ACR/Documents/PGTS/guidelines/Cervicocerebral_MRA.pdf . Accessed March 1, 2017.	Review/Other-Dx	N/A	Guidance document to promote the safe and effective use of diagnostic and therapeutic radiology by describing specific training, skills and techniques.	N/A	4

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33. American College of Radiology. ACR Appropriateness Criteria® Radiation Dose Assessment Introduction. Available at: http://www.acr.org/~media/ACR/Documents/AppCriteria/RadiationDoseAssessmentIntro.pdf . Accessed March 1, 2017.	Review/Other-Dx	N/A	Guidance document on exposure of patients to ionizing radiation.	N/A	4

Evidence Table Key

Study Quality Category Definitions

- *Category 1* The study is well-designed and accounts for common biases.
- *Category 2* The study is moderately well-designed and accounts for most common biases.
- *Category 3* There are important study design limitations.
- *Category 4* The study is not useful as primary evidence. The article may not be a clinical study or the study design is invalid, or conclusions are based on expert consensus. For example:
 - a) the study does not meet the criteria for or is not a hypothesis-based clinical study (e.g., a book chapter or case report or case series description);
 - b) the study may synthesize and draw conclusions about several studies such as a literature review article or book chapter but is not primary evidence;
 - c) the study is an expert opinion or consensus document.
- M = Meta-analysis

Dx = Diagnostic

Tx = Treatment

Abbreviations Key

CT = Computed tomography

CTA = Computed tomography angiography

MDCT = Multidetector computed tomography