Role of Whole-Body Computed Tomography Scan to Avoid Missed Foreign Body in Patients with Multiple Stab Injury: A Rare Case of Retained Impaled Knife Blade with Intact Neurology

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Abstract

Nonmissile penetrating spine injury (NMPSI) is usually encountered in young men, secondary to knife-inflicted injuries. Such injuries often present with complete or incomplete neurodeficit. We hereby report a case of NMPSI (due to impaled knife blade) in the cervical spine, who presented with intact neurology. She was managed by foreign body removal, dural repair, and cerebrospinal fluid (CSF) diversion with lumbar drain. We performed postoperative magnetic resonance imaging with diffusion tensor imaging and tractography to ascertain the cord status. The case highlights the importance of whole-body computed tomography in patients with multiple stab wounds and the use of CSF diversion in such situations.

Key Message

Whole-body computed tomography (WBCT) scan is a useful investigation in patients with multiple stab wound. Exploration under aseptic precautions and removal gives an opportunity to debride and explore the wound thoroughly and address the dural injury.

Introduction

Penetrating spine injuries (PSI), caused by firearm or nonmissile penetrating objects, are uncommon entities faced by spine surgeons worldwide. Nonmissile penetrating spine injury (NMPSI) are usually encountered in young men secondary to knife-inflicted injuries. Such injuries often present with complete or incomplete neurodeficit.1

We hereby report a case of NMPSI (due to an impaled knife blade) in the cervical spine, who presented with intact neurology. The patient was managed by foreign body (FB) removal, dural repair and cerebrospinal fluid (CSF) diversion with subarachnoid lumbar drain. We also performed postoperative magnetic resonance imaging (MRI) with diffusion tensor imaging (DTI) and tractography to ascertain the status of the cord. The case highlights the importance of whole-body computed tomography (WBCT) in patients with multiple stab wounds and the use of CSF diversion in such situations.

Case History

A 31-year-old woman presented to our emergency department with multiple stabs wound and hypovolemic shock,
approximately 5 hours after an alleged assault with a knife. She complained of a sharp pain shooting down her back and bilateral upper extremities. On examination, there were multiple incised wounds over her back, neck, abdomen, face, scalp and extremities. There was a transverse incised wound over the left side of the neck. Her initial motor examination (of extremities) revealed a power more than or equal to Medical Research Council (MRC) grade 4/5 and sensations were intact (2/2).

She underwent WBCT which showed an impaled broken knife blade passing from the posterior aspect of the neck, through C5 lamina, across the spinal canal onto C6 vertebral body (►Fig. 1). She also had an associated grade IV right renal injury. MRI was deferred due to the presence of the metallic object.2,3

The decision was made to conservatively manage her renal injury. She was planned for wound exploration and FB removal under general anesthesia. Under prone position, an incision was made by extending the stab wound and deeper dissection was performed around the knife blade to expose the C5, C6 lamina on the left side (►Fig. 2A). The knife passed through the inferior edge of C5 lamina (►Fig. 2B). Laminotomy was performed around the metallic remnant and the FB was carefully removed. The broken piece of knife transgressed the cord and the meninges. While the posterior dural rent was sutured with 5–0 Prolene, the anterior rent was not accessible for repair (►Fig. 2C). It was then decided to perform a CSF diversion with subarachnoid lumbar drain (restricting the CSF flow to <10 mL/hour or 250 mL/day).

Postoperatively, she was electively intubated overnight in the intensive care unit and started on broad-spectrum antibiotics. Her neurological examination on a postoperative day (POD) 1 was normal (motor power—MRC 5/5, intact

**Fig. 1** Computed tomography cervical spine: (A, B) Sagittal images showing the path of impaled knife passing through C5 lamina, across the spinal canal onto C6 vertebral body. (C) Axial image showing knife resting over C5 vertebral body passing through the canal.

**Fig. 2** Intraoperative images showing (A) incised wound over the posterior aspect of the neck with a visible broken knife blade below the skin, (B) wound exploration around knife blade that was passing through the inferior part of C5 lamina, (C) status of dura after closure.
sensation [2/2]). The lumbar drain was removed on POD4. The postoperative period was uneventful. On POD5, she underwent MRI of the cervical spine with DTI and tractography. There were no signal intensity changes in the cord on T1 and T2-weighted imaging and CSF flow was intact. There was no evidence of CSF leak or collection (Fig. 3A). On DTI, fractional anisotropy (FA) at C2 (proximal), C5 (injured), and C7 (distal) levels were 411, 379.2, and 446, respectively. Tractography showed maintained thickness and density of tracts throughout the cervical cord (Fig. 3B).

Discussion

Penetrating injuries to the spine broadly include missile PSI (caused by a firearm) and NMPSI (caused by a sharp object). The prevalence of NMPSI usually reported to be less than 1%.4,5 The most common cause of NMPSI is an assault with a knife and it involves the thoracic spine in a majority of cases.1,4–11 NMPSI with impaled object occurs when the assailant finds it difficult to remove the object or when it breaks at the handle.

In NMPSI, hemisection or complete transection of cord has been reported and approximately two-thirds of patients present with incomplete neurodeficit (especially Brown-Sequard syndrome).1,4,5,11,12 The other causes for neurodeficit include cord impingement by osseous fragment, cord ischemia,13 or hematoma.14 Our patient presented with intact neurology and sharp pain radiating down the back and upper extremities.

Patients with multiple stab wounds have high chances of associated injuries.11,15,16 In cases of neck NMPSI, associated catastrophic injuries to major vessels, trachea, esophagus, or brachial plexus have been reported.15–17 It is not common for the impaled objects to be missed on the initial examination, as they may be concealed under the soft tissues. WBCT is the best modality to evaluate such patients, as it not only delineates the impaled metal or retained fragments but also provides information on associated injuries. Even in our patient, WBCT was valuable in identifying the associated renal injury as well as clearly defining the impaled weapon.

The standard treatment for retained FB includes exploration, debridement, FB removal, and closure. It may be emphasized that these aforementioned steps are performed under direct vision (after laminotomy).18–20 Such an approach is safer, as it not only enables a careful removal of the sharp object without any further damage to neural elements but also facilitates a thorough closure of the injured meninges.21–23 Wide exploration, thorough debridement, and generous irrigation may also mitigate the risk of infections in these penetrating injuries.16,24

The use of CSF diversion with the help of subarachnoid lumbar drain in patients with traumatic dural laceration is an effective strategy to reduce the intradural pressure, decrease CSF outflow, and thereby aid in timely wound healing.1,11 Postoperative MRI with DTI tractography are the best modality to evaluate the cord status and tract injuries in such scenarios.25–27 These sequences provide superior visualization of the damaged cord and have been demonstrated to correlate with neurodeficit, histologic axonal injury, and functional recovery.28

Conclusion

We would like to emphasize the role of WBCT in the preoperative evaluation of patients with NMPSI. The management of these patients includes thorough wound exploration and removal of the impaled object under direct vision (after laminotomy). Such an approach not only enables a safer removal of the FB but also facilitates an effective repair of dural rents. It is advisable to consider CSF diversion especially in patients with irreparable dural tears.

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None.

Conflict of Interest

None declared.

References

1. Peacock WJ, Shrosbree RD, Key AG. A review of 450 stabwounds of the spinal cord. S Afr Med J 1977;51(26):961–964 http://epicentrum.org/article/med/88030 cited 2021Feb15 [Internet]
2. Martinez-del-Campo E, Rangel-Castilla L, Soriano-Baron H, Theodore N. Magnetic resonance imaging in lumbar gunshot wounds: an absolute contraindication? Neurosurg Focus 2014;37(01): E13 https://pubmed.ncbi.nlm.nih.gov/25115322/ cited 2021Feb15 [Internet]
3. Kamaoui I, Maaroufi M, Benzagmout M, Sghali Houssaini N, Boujraf S, Tizniti S. MRI findings in spinal cord penetrating injury: three case reports. J Neuroradiol 2007;34(04):276–279 https://linkinghub.elsevier.com/retrieve/pii/S0150986107002520 cited 2021Feb15 [Internet]
4. Lipschitz R, Block J. Stab wounds of the spinal cord. Lancet 1962;2(7248):169–172 https://pubmed.ncbi.nlm.nih.gov/14457544/ cited 2021Feb15 [Internet]
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5 Wallace DJ, Sy C, Peitz G, Grandhi R. Management of non-missile penetrating spinal injury [Internet]. Neurosurg Rev 2019;42 (04):791–798 https://pubmed.ncbi.nlm.nih.gov/30560517/ cited 2021Feb15
6 Sarkar B, Ahuja K, Choudhury AK, Jain R. Penetrating spine injury bisecting thoracic spinal canal with no significant neurological deficits-The midline cord syndrome. Spinal Cord Ser Cases 2018; 4:102 cited 2021Feb15 10.1038/s41394-018-0136-x [Internet]
7 Groen RJM, Kafluddin EA, Hamburger HL, Veldhuizen EFH. Spinal cord injury with a stingray spine. Acta Neurochir (Wien) 2002;144 (05):507–508 https://pubmed.ncbi.nlm.nih.gov/12111510/ cited 2021Feb15 [Internet]
8 Georgiadou D, Zografos GN, Vaidakis D, et al. Swordfish bill injury involving abdomen and vertebral column: case report and review. BMC Surg 2010;10:30
9 Ye TW, Jia LS, Chen AM, Yuan W. Brown-Séquard syndrome due to penetrating injury by an iron fence point. Spinal Cord 2010;48 (07):582–584 https://pubmed.ncbi.nlm.nih.gov/20010907/ cited 2021Feb15 [Internet]
10 de Villiers JC, Grant AR. Stab wounds at the craniocervical junction. Neurosurgery 1985;17(06):930–936 https://pubmed.ncbi.nlm.nih.gov/4080126/ cited 2021Feb15 [Internet]
11 Enicker B, Gonya S, Hardcastle TC. Spinal stab injury with retained blades: 51 Consecutive patients managed at a regional referral unit. Injury 2015;46(09):1726–1733 https://pubmed.ncbi.nlm.nih.gov/26049661/ cited 2021Feb15 [Internet]
12 Prasad BC, Vemula RC, Varaprasad G. Nonmissile penetrating spinal injury with an impaled knife: case report. Indian J Surg 2013;75(03):237–238 https://pubmed.ncbi.nlm.nih.gov/24426437/ cited 2021Feb15 [Internet]
13 Rogers FB, Osler TM, Shackford SR, Wald SL. Isolated stab wound to the artery of Adamkiewicz: case report and review of the literature. J Trauma 1997;43(03):549–551 https://pubmed.ncbi.nlm.nih.gov/9314327/ cited 2021Feb15 [Internet]
14 Harris P. Stab wound of the back causing an acute subdural haematoma and a Brown-Sequard neurological syndrome. Spinal Cord 2005;43(11):678–679 https://pubmed.ncbi.nlm.nih.gov/15852056/ cited 2021Feb15 [Internet]
15 Lipschitz R. Associated injuries and complications of stab wounds of the spinal cord. Paraplegia 1967;5(02):75–82 https://www.nature.com/articles/sc19677 cited 2021Feb15 [Internet]
16 Sobnach S, Nicol A, Nathire H, Kahn D, Navsaria P. Management of the retained knife blade. World J Surg 2010;34(07):1648–1652 https://pubmed.ncbi.nlm.nih.gov/20195600/ cited 2021Feb15 [Internet]
17 Karadağ O, Gürelık M, Berkam O, Karas HZ. Stab wound of the cervical spinal cord and ipsilateral vertebral artery injury [Internet]. Br J Neurosurg 2004;18(05):545–547 https://www.tandfonline.com/doi/abs/10.1080/0268869040012590 cited 2021Feb15
18 Elgamal EA. Complete recovery of severe quadriparesis caused by stab wound at the craniocervical junction. Neurosurg Rev 2005; 28(01):70–72 https://pubmed.ncbi.nlm.nih.gov/15597213/ cited 2021Feb16 [Internet]
19 Smith C, White JB. Penetrating knife injuries to the spine: management considerations and literature review. Interdiscip Neurosurg 2014;1:3–4
20 Shahaie K, Chang DJ, Anderson JT. Nonmissile penetrating spinal injury. Case report and review of the literature. J Neurosurg Spine 2006;4(05):400–408 https://pubmed.ncbi.nlm.nih.gov/16703908/ cited 2021Feb21 [Internet]
21 Wolf SM. Delayed traumatic myelopathy following transfixion of the spinal cord by a knife blade. Case report. J Neurosurg 1973;38 (02):221–225 https://pubmed.ncbi.nlm.nih.gov/4694221/ cited 2021Feb15 [Internet]
22 Fung CF, Ng TH. Delayed myelopathy after a stab wound with a retained intraspinal foreign body: case report. J Trauma 1992; 32(04):539–541 https://pubmed.ncbi.nlm.nih.gov/1569629/ cited 2021Feb15 [Internet]
23 Castillo R, Kahn EA. Asymptomatic transfixion of spinal cord by a knife blade: report of a case. J Neurosurg 1950;7(02):179–182 https://thejns.org/view/journals/j-neurosurg/7/2/article-p179.xml cited 2021Feb15 [Internet]
24 Madhok BM, Roy DDD, Yeluri S. Penetrating arrow injuries in Western India. Injury 2005;36(09):1045–1050 http://www.injuryjournal.com/article/S00020138305001750/fulltext cited 2021Feb16 [Internet]
25 Rall JM, Gebremariam FA, Joubert G. Imaging findings of penetrating spinal cord injuries secondary to stab wounds on magnetic resonance imaging in a tertiary trauma unit, South Africa. SA J Radiol 2019;23(01):1761
26 Vedantam A, Jirjis MB, Schmit BD, et al. Diffusion tensor imaging and tractography in Brown-Sequard syndrome. Spinal Cord 2012; 50(12):928–930 https://pubmed.ncbi.nlm.nih.gov/23045298/ cited 2021Feb21 [Internet]
27 Rajasekaran S, Kanna RM, Karunanithi R, Shetty AP. Diffusion tensor tractography demonstration of partially injured spinal cord tracts in a patient with posttraumatic Brown Sequard syndrome. J Magn Reson Imaging 2010;32(04):978–981 http://doi.wiley.com/10.1002/jmri.22320 cited 2021Feb21 [Internet]
28 Zaninovich OA, Avila MJ, Kay M, Becker JL, Hurlbert RJ, Martinosh N. The role of diffusion tensor imaging in the diagnosis, prognosis, and assessment of recovery and treatment of spinal cord injury: a systematic review. Neurosurg Focus 2019;46(03): E7 https://thejns.org/doi/abs/10.3171/2019.1.FOCUS18591 cited 2021Feb21 [Internet]