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Case report

Gunshot wound to the spine without neurological loss – A case report

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ABSTRACT

The role of surgery in the treatment of penetrating spinal injury has been controversial.

Neurological outcome of the gunshot wounds to the spine depends firstly on the initial traumatic neurological deficit. The extent of such injuries depends primarily on the bullet energy deposited on target. The spine injuries caused by the military high velocity bullets are of much more extensive damage comparing to the civilian injuries such are those inflicted by the handguns.

The patient injured by the bullet fired from the handgun that penetrated right parasternal thoracic area and lodged into the body of the T2 vertebra is presented. There was no neurological loss from this injury. The ballistic analysis is provided. The bullet lodged in the vertebral body protruding to the spinal canal was removed from the posterior approach employing laminectomy.

1. Introduction

The gunshot injuries to the spine are among most devastating human injuries. The role of surgery in the treatment of penetrating spinal injury has been controversial. It is believed that decompressive laminectomy should be considered for patients with incomplete neurological injury and continued spinal canal compromise. It is questionable what should make indication for surgery in neurologically intact patients. The bullet lodged intracanally or onset of neurological decline are considered as rationale indications for operative decompression and/or bullet removal.[1] Surgical debridement is required in the case of persistent cerebrospinal fluid leaks also.

Neurological outcome of the gunshot wounds to the spine depends firstly on the initial traumatic neurological deficit. Operative decompression, as a rule, does not improve neurological function in complete injuries. There is no definite guidelines and standard of care regarding the role and timing of surgical decompression. Whereas there is biological evidence from experimental studies in animals that early decompression (<24 h) may improve neurological recovery after spinal cord injury, the relevant time frame in humans remains unclear.[2]

Spine fractures caused by the low velocity missile are usually stable and rarely require stabilization.[3] In the series of 37 patients suffered low velocity gunshot wounds to the spine only in 4 (11%) spinal instability was recorded, while in other report among 49 patients sustained gunshot wounds 6 (12%) undergone stabilization.[4,5] The spine injuries caused by the military high velocity bullets are of much more extensive damage comparing to the civilian injuries such are those

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inflicted by the handguns. The extent of such injuries depends primarily on the energy deposited on target.[6,7]

1.1. *Case report*

A 19-year-old man, suffered gunshot injury to the chest, from the close range (approx. 2 m) in a homicide attempt. The bullet fired from the handgun penetrated right parasternal thoracic area traversing the chest cavity and lodged into the body of the T2 vertebra. There was no neurological loss from this injury. The primary treatment was provided by the thoracic surgeon in the territorial hospital. After thoracic drainage that release blood from the pleural cavity was done, the patient was referred to the neurosurgical trauma unit for further treatment. On admission, the patient was stable, without any neurological loss.

CT reconstruction of the spinal canal revealed that the bullet, lodged into the vertebral body, penetrated spinal canal (Figs. 1 & 2).

The bullet was deemed to be anchored in the bone, but it was believed that there is a risk of bullet migration due to the long-term trophic changes of the surrounding bone.

Based on the radiographic evidence of spinal canal compromise (Fig. 3), the decision on decompressive surgery from the posterior approach and removal of the bullet was done. After laminectomy of T2 was completed, the bullet was found protruding from the anterolateral wall of the spinal canal just under the lateral aspect of the thecal sac Fig. 4 that was covered with thin layer of coagulated blood.

There was no deformation of the wall of the spinal canal in its circumference except for the protruding bullet that narrowed diameter of the canal. No movement of the bullet was possible.

The technique of the bullet removal included circular drilling of the bone just around the surface of the bullet using small cutting bit. Thus the bullet was mobilized and removed Fig. 5. The long-term outcome was favorable without late deformity of the spine or neurological loss.

2. Discussion

The factors that determine whether the projectile will penetrate the spinal canal are the energy at impact on bone, the contact area between the projectile and bone and the thickness of bone and at the area of impact.[7] However, the destructive capacity of the bullet itself has been shown to be related to the kinetic energy deposited on the target organ. The energy release and the patterns of damage depend primarily on the speed of the bullet.[7] CT revealed that the projectile impacted on bone with its tip penetrating spinal canal at the level of the body of T2 vertebra (Fig. 1).

The pressure at the tip of the advancing bullet termed as juxtamissile pressure is highest.[6]

Projectiles traveling at the speed of less than 2000 feet/sec are considered low velocity missiles, while those traveling above this speed are termed high velocity missiles. The kinetic energy contained in the missile increases directly with the square of its velocity (KE = mV2/2).[7]

In the theory of terminal ballistic, the direct hit of a high velocity bullet with high energy capacity that is being deposited on target are capable of producing shock and cavitation

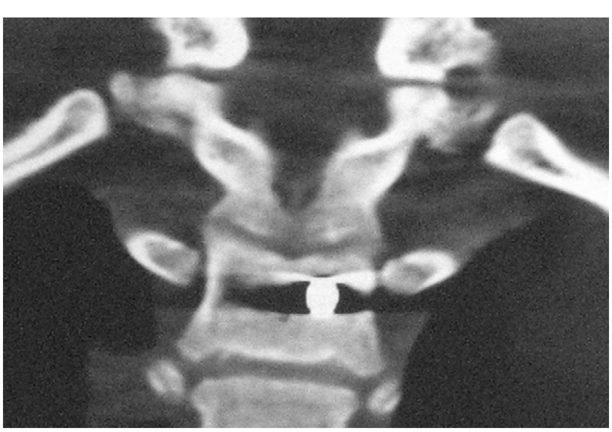

Fig. 1 – CT scan, coronal slice: bullet lodged in the body of the T2 vertebra.

Fig. 2 – CT scan, sagittal slice.

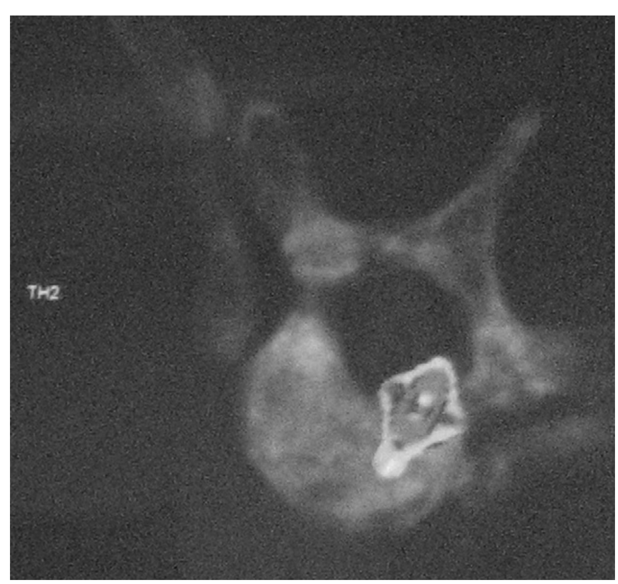

Fig. 3 – CT scan, axial slice: bullet penetrated spinal canal in its ventrolateral section.

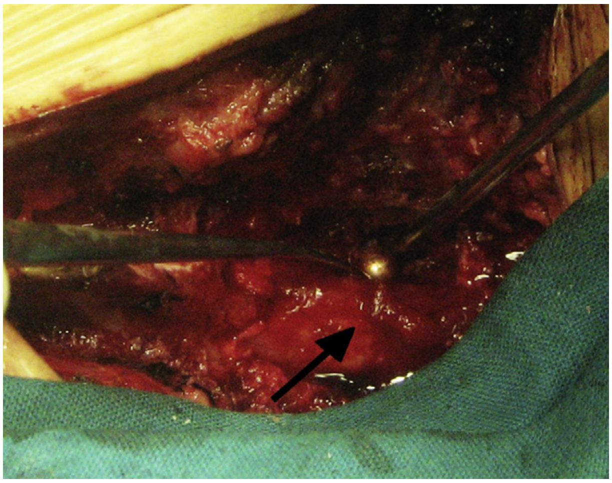

Fig. 4 – Operative photograph: disector and succer tip point on the bullet, arrow – thecal sac covered with coagulated blood.

waves described as the hydrodynamic strike, that cause damage apart from the bullet trajectory.[8]

Thus the damage is much more extensive compared to the wounds caused by the low velocity bullets.[9] Accordingly, the direct hit to the spinal column of such bullet, of necessity, rendered complete destruction of the spinal cord with resultant paraplegia. The low velocity bullets carry much lower energy thus the destruction on impact is more confined. Such bullet destroys tissue just on the path of its penetration. In this particular case, the bullet fired from the close range did not cause neurological loss, neither from the direct hit nor from the destruction resulted from the energy deposit.

The bullet fired from the handgun caliber 6.35 mm has a relatively low subsonic velocity of about 220–240 m/s (722–787 ft/sec), and carries energy of about 85 J (62,7 ft lb). Thereafter, the bullet produces its damage on target by tissue penetration whereas there is no hydrodynamic strike effect on target. The analysis of the loss of the energy capacity of the bullet, based on the resistance of the soft tissues while these bullet traversing chest cavity, revealed that the estimated energy on impact to the bone was about 8 J. This energy suffices just for the penetration of the bullet into the bone with no shock waves and spreading of the damage.

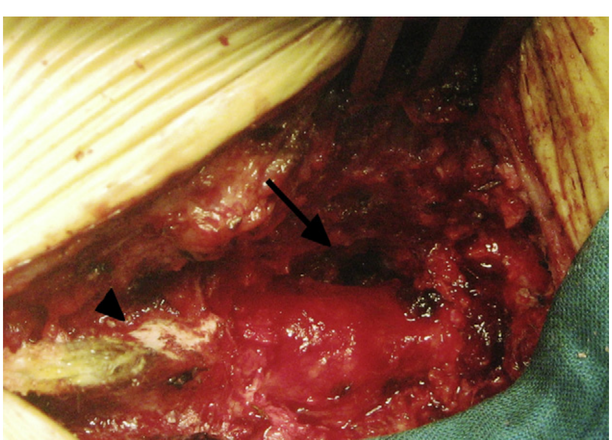

Fig. 5 – Operative photograph: site of the bullet after its removal, arrow, spinous process, arrowhead.

The ammunition used in the military service include the M-16, 223 Remington bullet with 55 grains (3,56 g) in weight, caliber 5.56 mm, muzzle velocity of 3250 ft/sec (990 m/s) and energy 1287 ft/lb (1745 J), and the 7.62 mm AK-47 with bullet weight 123 grains (8 g), velocity of 2362 ft/sec (720 m/s) and energy of about 1530 ft/lb (2074 J).[7]

Such injury caused by the bullet with high-speed velocity and energy deposit on impact produce conqasation not only on the path of the bullet but also remote from the impact area making surgical debridement a significant challenge. The energy amount of those bullets is almost 20 or 23 times greater than the energy of a bullet fired, from 6, 35 mm handgun, which is 50 grains in weight and energy of 85 J (62, 7 ft/lb). This difference make direct hit to the spine with no neurological loss as possible outcome for the projectile fired from the 6, 35 mm handgun. Patients usually present with neurological deficit immediately after injury. However, there are reports on cases where a patient is neurologically intact after initial injury but develops deficit several months or years later. Delayed neurological deficit resulted from the bullet migration.[10–12]

Retained intraspinal bullets can present with delayed neurological findings secondary to reactive changes around the bullet.[12] Spontaneous expulsion of the bullet initially lodged in the body of C2 vertebra was noted after 40 days of injury. Because of the risk of bullet migration that might result in delayed neurological loss it is advised that the bullet should surgically be removed early if it is lodged in the body of the vertebra.[13]

3. Conclusion

The bullet lodged in the vertebral body protruding to the spinal canal can be safely removed from the posterior approach employing laminectomy.

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