Case report

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Penetrating injury to cervical spine from a nail gun

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Abstract: Though modern civilian neurosurgical practice frequently encounters unusual penetrating injuries of cranium and spine; penetrating nail injuries to neck are very rarely described. We describe the case of a 24 year old male who suffered such an injury from a nail gun. The history, radiological studies and treatment are presented. Mechanism of injury seems to share characteristics of low velocity projectiles. We discuss the management of this unusual case reviewing the current literature on penetrating neck injuries caused by similar objects.

Keywords: nail, nail gun, penetrating neck injury

INTRODUCTION

Since its introduction in early nineties, nail gun has become an instant hit due to ease of use and significantly reduced stress injuries[1]. However, the growing popularity of these tools has been accompanied by a rise in the incidence of nail gun injuries, which are primarily accidental[1,2]. Although nail gun injuries to various parts of body have been described, there are only few reports available regarding head and neck region. Mechanism of injury share characteristics of low-velocity projectiles, causing a limited amount of tissue injury. We report a case of penetrating trauma to neck from a nail gun along with discussion of relevant wound ballistics.

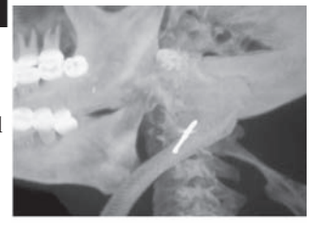
CASE REPORT

A 24-year-old man was referred to Sawai Man Singh Medical College, Jaipur (SMSMC) after he had been stuck in the left side of neck by a nail 2.5 inches in length. The man had been working as a carpenter at a construction site and had accidentally fired a nail while reloading a nail gun. Immediately thereafter, he felt severe pain and noticed drops of blood oozing out from a wound on his left upper neck. He did not experience any loss of consciousness, headache, radicular pain, numbness or any other focal neurological deficit. The man was taken to emergency department, where plain radiography revealed presence of nail in spinal canal (Fig 1). The patient was transferred to SMSMC in a stable condition.

Physical examination detected a 2 mm entrance wound in left side of neck. Findings on neurological examination were within normal limits except for mild nuchal rigidity and restricted neck movements. Non-contrast CT (axial and coronal cuts with 3D reconstruction) showed that nail had penetrated the spinal canal at the level of second cervical vertebra, well behind the airway and major vascular structures (Figs 2, 3 & 4).

Fig 1: X ray cervical spine lateral view showing nail in upper cervical canal.

2, 3 & 4



Figs: 2, 3 & 4
NCCT Neck axial and coronal cuts with 3D reconstruction showing penetration of upper cervical canal by nail.

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Patient was taken into the operating room for neck exploration through posterior midline cervical incision under fluoroscopic guidance. Nail was entering into spinal canal through the space between lamina of C2 and C3. C2 hemilaminectomy was done and nail was carefully removed (Fig 5). Dural rent was repaired and anatomical closure of wound was done over drain. His postoperative course was uncomplicated. Drain was removed on third postoperative day, and he was discharged seven days later.

Fig. 5: Nail after removal.

DISCUSSION

The growing popularity of nail guns over the past decade has been linked to an increase in injury[1,2]. Nearly 75% of all nail gun injuries occurred to the finger, hand, and foot with eye injuries accounting for 1.4% of the total[1]. Search of literature did not reveal injuries specific to head and neck region.

Several authors have described the details of wound ballistics of conventional firearms pertaining to head and neck region[3,4,5]. Understanding these principles provides an insight into how patients survive this type of penetrating trauma.

Law of physics states that KE = ½ MV^2 , where KE is kinetic energy, and is major determinant of wounding potential, M is the mass & V is the velocity of missile.

The missile velocities of conventional firearms range from 300 ft/sec (0.22- and 0.25-caliber pistols) to 2,200 ft/sec (0.27-caliber hunting rifles) [3]. A missile speed of 1,000 ft/sec or less is considered to be low velocity[6]. The standard AK-47 or AKM used by Indian army and most of mercenaries world around fires a projectile weighing 8 grams (120 gr), with a muzzle velocity of 710 metres per second (2,300 ft/s). Muzzle energy is 2,010 joules (1,480 ft-lbs). High-velocity missiles create a temporary (pulsating) cavity as they pass through living tissue[4]. This phenomenon explains the significant damage that is sustained by neural and vascular tissues that are not directly in the path of a bullet. A bullet entry can also create a permanent cavity, which can be three to four times larger than the diameter of the bullet itself[3]. In experimental conditions, a standard nail gun fires a 3 inch nail (weighing 66.7 grain) with an average velocity of 105.5 ft/sec[7]. The average KE is 1.64 ft-lbs, much less than 1,480 ft-lbs of an AK-47 round. Instability of trajectory is another factor which significantly reduces the wounding potential of nails[7].

In our case, patient was hit at a close range by a nail, which penetrated deeply into neck and spinal cord. Lack of neurological deficit is consistent with injury pattern of low velocity missiles. Cord parenchyma is spared of cavitation effect as energy imparted is very low (only 1.64 ft-lbs). Another Alma factor is that low-velocity missiles are deflected by structures such as vessels, nerves, and facial planes, which limits damage to the tissues[4].

The neck can be divided into three zones to help guide evaluation of penetrating injuries: Zone I, as defined as the area between the clavicle and cricoid cartilage, injuries have highest mortality. Zone II is the area between the cricoid cartilage and angle of the jaw. Up to 80% penetrating injuries included in Zone II but mortality is low with these injuries because of ease of exposure and ability to control bleeding. Zone III consists of the area between the angle of the jaw and the base of the skull. This is the least common area of injury but has high morbidity secondary due to the difficulty of obtaining exposure of the involved structures[8]. Angiography is recommended in injuries of zone I (below the level of cricoid cartilage) and zone III for evaluation of the vital vessels and evaluation of relationship between foreign bodies and vessels[9]. For zone II injury either exploration or angiography could be done[10]. Studies have shown that there is no significant difference between clinical examination and angiography for detection of vascular injury in zone II penetrating neck injuries. It is also seen that findings on physical examination are good predictors of arterial injury in patients with penetrating neck wounds and can exclude injury in over 99% of patients[11]. Our case is of zone II injury and had no physical signs of major vessels injury; so extensive investigations were not done apart from the CT scan to get some information on the anatomical relationship of the penetrating object with other structures in the neck.

Such foreign bodies should always be removed by exploration in a proper setup. Exploration of is considered mandatory by many surgeons but a selective approach is considered appropriate by others considering the morbidity and mortality associated with surgical exploration especially for zone I and zone III injuries.

Our case was operated under the assumption that penetrating object is in continuity with cerebrospinal fluid space, spinal cord parenchyma and outside environment where delay in treatment can cause potential life threatening complications in form of meningitis and intramedullary abscess.

CONCLUSION

Penetrating neck traumas can pose significant diagnostic and therapeutic challenges for emergency physicians and though, physical examination is a significant factor that aid in the management of penetrating neck trauma to the surgeon, prudent use of CT and catheter angiography when necessary might reduce morbidity in these peculiar injuries. Early exploration and removal reduces the chances of wound infection resulting in a favorable outcome.

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