Missile injuries in head – neck and maxillo-facial region – an experience in eastern nepal

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Abstract Ballistic injuries to head-neck and maxillofacial region is quite common problem nowadays. Most of the time the injuries seem to be dreadful but the mechanism of the injuries caused by ballistics and the anatomical conditions of maxillofacial and head-neck region mitigate the severity of the injuries. Proper primary management followed by reconstruction and management of associated injuries decreases the mortality and morbidity of missile injuries in head-neck and maxillofacial region. Eleven cases of missile injuries in head-neck and maxillofacial region are included in the present study. The mechanism of the injury and the ideal management strategy for the ballistics injuries in the region has been discussed in the article.

Keywords Missile injury · Head-neck · Maxillofacial · Eastern Nepal

Introduction

As a result of increasing number of weapons and increasing activities of terrorism ballistic injury is frequently encountered in emergency department. In US 500,000 missile wounds occur annually, resulting in 50,000 deaths. Among the total missile wounds about 20% involve the head-neck and maxillofacial region [1, 2].

Wounds in head-neck and maxillofacial region often present with frightful deformity. But proper emergency management, homodynamic resuscitation, airway management followed by proper evaluation of primary and concomitant injuries with its management may improve the outcome.

Nepal has seen insurgency for last thirteen years & has faced the problem of missile injuries significantly. In Guerilla war tactics injuries to head & neck region and maxillofacial region are more common.

Materials and methods

Medical records of patients presented with ballistic injury in head-neck and maxillofacial region in B.P. Koirala Institute of Health Sciences, Dharan, Nepal during last 2 years (2005 & 2006) were reviewed. In all cases primary management was done in emergency. After proper evaluation and investigations the patients were shifted to the ward or emergency operation theater as necessary. Demographic variations, type of the missile injuries, entry and exit wounds with associated injuries, position of the bullet and overall outcome of the patient was considered in the study.

Results

Among the eleven cases, 10 (91%) were male and 1(9%) was female. In 6 cases hand gun was the weapon used. In

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4 cases the accidental explosive injury has occurred when they were preparing the hand bomb or filling the cartridge. In one case rifle was the weapon. In 7 (64%) cases definite entry wound was found and only in 2 cases exit wound was detected. In 7 cases bullet or pellets were found on wound exploration in Operation Theater. Common associated injuries in adjacent organs included mandible #, vertebral fracture. Other injuries includes facial nerve palsy (Fig. 2), tympanic membrane perforation, and fracture of maxillary sinus walls. (Table 1) & (Fig. 3) Mean hospital stay was 14.2 days. There was no postoperative complication or mortality in our cases.

Fig. 1 x-ray soft tissue neck(lateral view) showing multiple fragments of pellets

Fig. 2 Left facial nerve palsy caused by bullet injury

Fig. 3 Bullet in Lt. infratemporal fossa

Discussion

When projectiles penetrate living tissue, the injury is directly related to the amount of energy transferred to the target. This is expressed by the equation: $E = mv^2 / 2$ where E = energy transferred, m = mass of the missile, v = velocity of the missile. Thus, wounding capacity is most directly related to the energy imparted by the missile's velocity as it violates tissue. The bullet passes through the tissue crushing and shredding the tissue in its direct path while radially flinging the surrounding tissue away from its path. This action produces a temporary cavity with a diameter far greater from the bullet itself. The amount of tissue injury in the final wound is not only a function of the actual bullet path but also the effects of the temporary cavity.

Several factors affect the location, size and shape of the temporary cavity: the amount of kinetic energy lost by the bullet as it passes through the tissue, the rapidity of the loss of kinetic energy and the elasticity and cohesiveness of the tissue itself. The maximum volume and diameter of the temporary cavity may be many times the volume and diameter of the bullet. The temporary cavity oscillates for 5–10 msec before coming to rest as the permanent wound path. Because of the alternating negative and positive pressures, foreign materials and bacteria can be drawn in to the wound at both entry and exit sites [3]. Infection is more likely to occur when a prolonged period occurred between the time of injury and the initial treatment. The infection of the wound can be prevented with early wound care and appropriate antibiotics. In our cases there is no postoperative wound infection. But there was a case of retropharyngeal abscess which was treated with drainage and broad spectrum antibiotics. 1.8 % of wound infection was observed by Ordog in minor gunshot injuries [4].

Damage can occur in tissues distant to the actual bullet path because of the temporary cavity. Thus the temporary

Table 1

S.N	Age/Sex	Type of the weapon	Entry wound	Exit wound	Associated injury	Operation	Position of the bullet	Hospital stay
1	30/M	Hand gun	Lt side of chin	-	-	Neck Exploration	Medial to the carotid artery	4 days
2	20/M	Explosion of the home made bomb	-	-	Fracture of incisors and canine teeth.	Wound debridement and Removal of broken teeth pieces from wound.	-	8 days
3	36/M	Hand gun	Posterior to Rt angle of mandible	-	-	Exploration of the neck	In between Rt suboccipital muscles	9 days
4	28/M	Hand gun	Rt suboccipital region	Posterior to Rt angle of mandible	C ₅ Fracture	Wound debridement with dressing and cervical collar	-	12 days
5	39/M	Hand gun	Rt side of cheek	-	Fracture of anterolateral wall of Rt maxillary sinus and Rt orbital floor	Bullet removed from Rt infratemporal fossa through Weber-Ferguson approach	Rt infratemporal fossa	16 days
6	30/M	Explosion of cartridge	-	-	Laryngeal edema	Tracheostomy with Neck exploration and wound debridement	Multiple pellets in neck	27 days
7	31/M	Explosion of the cartridge	-	-	-	Wound debridement and dressing	-	10 days
8	35/M	Explosion of home made bomb	-	-	Retropharyngeal abscess with surgical emphysema	Incision & drainage of retropharyngeal abscess, wound debridement and dressing	Multiple pellets in neck	15 days
9	37/M	Rifle	Lt side of cheek	Lt preauricular region	Lt parotid injury with Lt facial nerve palsy, Mandible Fracture, perforation Rt TM	Superficial parotidectomy, wound debridement and dressing	-	28 days
10	30/M	Hand gun	Lt side of angle of mandible	-	Fracture of transverse process of C ₂	Neck exploration	In between vertebral muscles	9 days
11	15/F	Hand gun	Lt side of angle of mandible	-	Fracture mandible	Neck exploration	Posterior to Lt SCM muscle	8 days

cavity phenomenon is potentially the most important factor in determining the extent of wound.

Ballistic injuries can be divided into two categories: low energy transfer wounds and high energy transfer wounds.

Low energy transfer wounds are caused by bullets striking the body at velocities below that of sound in air (340m sec^{-1}). Bullets from the hand guns cause such type of injuries. Such bullets produce a direct path through the tissue with little extension into the surrounding tissue. Small temporary cavitation occurs without significant damage to the surrounding tissue. High energy transfer wounds are caused by high velocity bullets. Such bullets are capable of creating a large temporary cavity. The maximum diameter of the cavity occurs when there is maximum loss of kinetic energy by the bullet. This occurs when the bullet offers most resistant to passage through the tissue by turning sideways, a condition known as maximum yaw. Military rifle bullets have a much higher available energy, up to 3000 joules.

In present study one case had high energy transfer wound by military rifle. In this case the maximum associated injury was observed including facial nerve palsy, mandible fracture and tympanic membrane perforation. In other 6 cases where the weapon was hand gun the associated injuries were minimal. It can be explained by the fact that, hand gun bullets causes low energy transfer wounds with minimal associated injuries in head & neck region.

Another factor on which, damage caused by cavitation depends is the elasticity and cohesiveness of organs and tissues. Elasticity and cohesiveness of tissue and organs prevents huge cavitation and associated damage. A high velocity bullet will cause massive damage if it strikes the bone, which retards it completely, causing it to give up all its energy. In order for cavitation to occur, a wound track of some length is required. In the maxillofacial region air cavities interrupt bone and soft tissue and to some extent mitigate the effect of cavitation.

In 4 cases the explosion was the cause of injuries. Most of the time, these injuries occurred accidentally, when the person was making the home made bomb or filling the cartridge.

An explosive blast has pressure, fragmentation and incendiary effects. All explosions generate an expansive shock wave that radiates out from the explosive source. This 'blast wave' has two components: an initial high pressure shock wave, caused by a rapid escape of gases and then a negative pressure phase or 'blast wind', due to air being drawn back toward the point of detonation. The amount of damage from the pressure shoke wave depends on the peak pressure, duration, medium in which the explosion occurs (open air, confined space, or water), and distance from the explosion.

Injuries due to blast are classified into primary blast, fragmentation, displacement or miscellaneous injuries [5].

Primary blast injury refers to the effects of direct pressure, that is, barotrauma, due to either under pressurization or over pressurization relative to atmospheric pressure. Gas-enclosing organs, such as the lung, tympanic mem-

brane and bowel are the most vulnerable as a consequence of dynamic pressure changes occurring at the air–liquid interfaces. In head-neck region the most common injury is rupture of the tympanic membranes. In our study there was no tympanic membrane perforation and middle ear damage in explosive wounds. This may be due to the fact that the weapons were home made and the energy produced by them were minimal.

Fragmentation injury refers to the effects of blast projectiles, such as metal shards and broken glass. These projectiles may come from the explosive device per se, or from debris propelled by the shock wave. In 2 cases multiple small pieces of fragments were removed, in 1 case from tongue and in another from the neck (Fig. 1).

Displacement injury results from persons or objects falling or being thrown because of the blast wave, causing acceleration and deceleration injury and soft-tissue destruction. One of our cases suffered from the fracture of incisor teeth when he felled down due to displacement by the blast wave.

Miscellaneous injury is not directly attributable to the blast per se and includes asphyxia, burns and inhalation injuries. Burns are most commonly superficial 'flash' burns. In this study all the cases of explosive injuries suffered superficial burns. Among them one was in respiratory distress requiring tracheostomy.

There are four main steps in the management of patients with missile injury of maxillofacial and head-neck region:

- i) securing an airway
- ii) controlling hemorrhage
- iii) identifying other injuries and
- iv) removal of the bullets or fragments along with definitive repair of the traumatic deformities [6].

All the four steps were carefully performed in our cases. In only one case tracheostomy was needed for securing the air way. In all cases hemorrhage was controlled by ligation of the blood vessels and pressure bandage where applicable. Associated other injuries were evaluated in all of our cases. Two cases suffered from the cervical vertebral fracture and two with mandible fracture. They were treated with the help of orthopedician and maxillofacial surgeons. Other associated injuries include undisplaced orbital floor fracture, facial nerve injury and tympanic membrane perforation. They were all treated conservatively consulting ophthalmologist and neurologist. Only one patient suffered from permanent injury of facial nerve, otherwise all patients are without any permanent deformity. There was no mortality in this study.

Though the missile injuries of maxillofacial region and head-neck region appear ghastly and dangerous, the overall outcome may not be lethal. Presence of air containing sinuses in maxillofacial area and small muscle mass mitigates the cavity problems. Abundant blood supply of the region permits excellent reconstruction of the wound. And in neck region, elasticity of great vessels protects them from missile injuries, most of the time.

Conclusion

Maxillofacial and head-neck missile injuries are increasing with unrest in society. Though injuries of the region appear ghastly, with proper evaluation and careful management results can be acceptable.

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