

Management of Gunshot Injuries

Introduction

In war and troubled times, physicians and surgeons come to treat extensive injuries and mass casualties. The deal with gunshots and war injuries has its merits and considerations. The surgeons have to operate in less optimum conditions and less available equipments, and have to deal with patients who suffer from various sorts of wounds all over their bodies and patients who lost considerable amounts of their blood and body fluids to the extent that puts their lives at high risk. During under- and post-graduate training, very few surgeons worldwide have been exposed or dealt with gunshots or war injuries. However, the basic principles of wound management and care remain more or less the same regardless to the etiological variables. Lessons from the past should be documented and learned and the experience should be passed among surgeons who deal with these cases.



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Since October 2000, large number of Palestinians in the West Bank and Gaza suffered from various injuries due to different guns and weapons. The head and neck region, like other parts of the body, received considerable amount of different sorts of trauma, including gunshots with different calibers and from all sorts of ranges, rubber bullets and all sorts of bombs, missiles and explosives. The type of injuries caused by gunshots vary according to the type of gun; pistols, rifles, missiles, explosives ... etc. The type of injury also varies according to the bullet caliber; range of shot, and to the powder used in guns and bullets.

Palestinian Statistics

According to the Palestinian Ministry of Health statistics in 7 years period from October 2000 till October 2007, 1934 people were killed in the West Bank, 95% of which were males and

5% were females. 72.7% of mortalities were due to live bullets, 17.4% were due to explosions, 2.2% were due to shrapnel. 19.3% of the cases died due to injury to the head and neck region. 43 children (2.2% of all cases) were below the age of 9 years when they were killed. During the same period, 33528 people were injured 91% of them were males and 9% were females. 25.3% of the injuries were due to beating, 18.9% were due to live bullets, 17.3% were due to rubber bullets, 8.8% were due to shrapnel, 6% were due to gas and the rest of cases were due to other causes falls, stones ...etc. 16.6% of the cases were injured in the head and neck region. 434 of the injured patients (1.3%) were below the age of 5 years, 1107 patients (3.3%) were between 5-9 years old, 8740 (26.1%) were between 10 – 17 years old and 38.6% of the cases were between 19-29 years old at the time of injury. Injuries in the head and neck area comprise 16.6% of all injuries recorded in the same period (tables: 1-6).



▲ (Figure 1) Live bullet



▲ (Figure 2) Shrapnel



▲ (Figure 3) Rubber bullet

Type of Injury	Cases	Percent
Live Bullet	1406	72.7
Rubber	0.3	0.2
Shrapnels	42	2.2
Gas	16	0.8
Beating	8	0.4
Falling	1	0.1
Stone	1	0.1
Others	46	2.4
Torture	2	0.1
Crash	29	17.4
Explosion	336	2.3
Unknown	44	100
Total	1934	

▲ (Table 1) Type of injury causing death

Site	Cases	Percent
Head	333	17.2
Eye	3	0.2
Neck	37	1.9

▲ (Table 2) Site of injury causing death

Age group	Cases	Percent
Below	14	0.7
5-9	29	1.5
10-17	269	13.9
18	75	3.9
19-29	961	49.7
30-49	363	18.8
50+	99	5.1
Unknown	124	604
Total	1934	100

▲ (Table 3) Age Group of killed people

Type of Injury	Cases	Percent
Live Bullet	6344	18.9
Capsulated Metallic	16	0
Rubber	5808	17.3
Shrapnel	2965	8.8
Gas	2006	6
Beating	8499	25.3
Multiple	21	1
Falling	3430	10.2
Stone	300	9
Others	2821	8.4
Torture	2	0
Crash	233	7
Explosion	398	1.2
Unknown	683	2
15	1	0
Total	33527	100
Missing System	1	0
Total	33528	100

▲ (Table 4) Type of injuries

Site	Cases	Percent
Head	4408	13.3
Eye	814	2.4
Neck	384	1.1

▲ (Table 5) Site of injuries

Age Group	Cases	Percent
Below 5	434	1.3
5-9	1107	3.3
10-17	8740	26.1
18	2164	6.5
19-29	12944	38.6
30-49	6091	18.2
50+	1491	4.4
Unknown	557	1.7
Total	33528	100

▲ (Table 6) Age Group of injured people

Bullet wound and entrance hole

In most cases, bullet entrance hole is small and the size of it is not related to the size of bullet. Entrance holes usually have an abrasion collar or contusion ring around them. The ring is an area of epidermis free margin around the entrance of the gunshot and is caused as the bullet penetrates the skin it mechanically indents and abrades or scrapes the epidermis of the skin leaving the collar or ring (fig.4).



◀ (Figure 4) Bullet entrance hole

However, Sellier in 1967 showed in his work on gunshots using high-speed camera, that the circular loss of epidermis around the entrance wound was caused by superficial tissue particles being thrown back against the direction of fire.

Bullet exit hole is usually larger than the entrance hole and more tissue loss and laceration.

Considerations of gunshots in the head and neck region

Injuries in the head and neck region have their own considerations due to the local anatomy. The head and neck region includes many vital organs and structure and contains the air and food entrance to the body.

Death due to gunshot injuries in the head and neck region can prevail due to many different causes, including direct brain trauma, bleeding from major blood vessels like carotid arteries or jugular veins, airway obstruction by blood clots, foreign bodies or laryngeal or tracheal damage.

Impairment of function can be due to loss of eyes, damage to ears, larynx or esophagus. Loss of teeth, part of jaw bones or tongue can also cause severe functional involvement to the affected patient. Neurological impairment results from nerve damage in the region, like facial nerve, trigeminal nerve, hypoglossal nerve, optic nerve, vagus nerve or due to brain damage. Serious and permanent disability can happen due to cervical spine damage; one case we treated in 2002, where 16 years old male who received live bullet to his neck which went through his larynx and external carotid artery. After working several hours in theatre and giving him more than 6 units of blood, bleeding was controlled, his larynx was repaired, but he ended with quadriplegia, because the bullet damaged part of his spinal cord.

Aesthetic disfigurement is an important factor that should be considered in treating facial injuries due to its psychological impact on the affected patients.

Treatment of gunshots in the head and neck

Initial or immediate management: at this stage the **A, B, C, D, E**, principles of **Advanced Trauma Life Support (ATLS)** should be applied. These include; **A:** securing Airway and stabilizing the cervical spine, **B:** Breathing, **C:** Circulation, **D:** neurological Deficit and **E:** Exposure.

The second stage, which is the definite treatment stage, should be carried out, once the initial management has been satisfactorily achieved and the patient is stable and secure, all the investigations needed to estimate the extent of injuries, reach full diagnosis, and put extensive treatment plan, has been done including plain X rays and CT scans. In our experience, this stage should be performed at the earliest possible time. It has been noticed, that the earlier the bone fixation and the soft tissue wounds closed are performed, the better the achieved outcome in aspects of bone and soft tissue healing and the incidence of postoperative infection. Sometimes, this stage is performed on the same day of injury if the circumstances allow.

At the **second stage**, wound debridement is done; all necrotic soft tissues are excised, necrotic and doubtful bone pieces and are also removed from the wound site. All shrapnel and bullet fragments dusts and other dirt and foreign debris that could be seen and removed without risking vital structures must be cleaned from the injury site to reduce the risk of infections. The area is washed with copious amounts of normal saline to make sure all necrotic free particles are have been completely cleaned from the wound. All viable bone pieces must be put back together and fixed with as rigid fixation as possible. It has been found from our practice, that the more rigid the fixation is, the better the bone healing and the fewer the incidence of infection. Therefore, non-rigid fixation like osseous wires is not recommended and should be avoided. In case of comminuted mandibular fracture, where the fragments are held strongly enough together by the periosteum, IMF for a period of 6 weeks can a satisfactory measure of treatment after closing all soft tissue wounds.

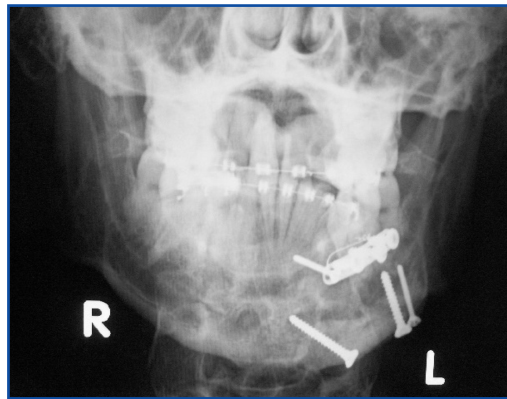
During and after all treatment stages, prevention of infection and its control when it happens are as important as the surgical procedures. The first step in prevention of infection is to remove all possible causes during surgery including bullets, shrapnel, and necrotic soft and hard tissues. Proper broad spectrum antibiotic cover should be given intravenously and then orally for a long enough period to prevent infection. In our protocol, the patients are usually given amoxicillin with clavulanic acid and metronidazole. If infection is encountered during the course of treatment, swab is taken for culture and sensitivity and antibiotic is prescribed accordingly. Needless to say the importance of local wound hygiene and good oral hygiene using regular mouthwashes and tooth brushing in prevention of secondary infections.

Third stage (Reconstruction Stage): this stage usually starts after the second stage is completed. The patient is fully assessed regarding the secondary defects. The treatment includes reconstruction of hard and soft tissues using different types of bone grafts and soft tissue flaps including local, distant and free vascular flaps.

Fourth stage (Rehabilitation): it includes functional and psychological rehabilitation of patients. At this stage replacement of missing teeth and supporting hard and soft tissues is done using maxillofacial and dental prosthesis and dental implants.

Conclusion

treatment of gunshot injuries should be planned and carried out carefully. It takes different stages and procedures to achieve the targeted treatment plan, Bone fixation and wound closure should be done at the earliest possible chance. Prevention and control of infection are important in the success of the treatment.



(Figure 5)
Rigid fixation of
gunshot in the
mandible

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