Blast Injuries of Mandible: A Protocol for Primary Management

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Abstract

Objective Purpose of this study is to introduce a new protocol for primary management of blast injuries of mandible with the aim of preserving maximum tissues at the same time achieving excellent aesthetics and function in the long term.

Method All cases were managed primarily using this protocol. Secondary reconstruction was carried out at least six months later.

Results Excellent results were achieved in all cases.

Conclusion Management of blast injuries requires special consideration to achieve good aesthetics and function. The above protocol will give good results in the long term.

Keyword Blast injuries · Mandible · Protocol for management

Introduction

“In these troubled times no one knows when our physicians will be called upon to treat war wounds in mass casualties on short notice and without time for any more extensive training than they have already received in medical school and internship...” These words, written in 1965 by Lieutenant General Leonard D. Heaton, Surgeon General to the American Army are still relevant today [1].

Gunshot wounds and blast injuries are increasingly becoming common in every location due to the current scenario of emerging terrorism. Terrorism has spread to such an extent that no place can be considered safe. In this context, it is necessary for all health care personnel to be well versed in the management of such cases. Due to the protection afforded by the bullet proof jacket, the face and extremities are more commonly involved in such incidents. In the facial skeleton, mandible is more commonly involved being the most prominent.

Gunshot wound and blast injuries of maxillofacial region, although gruesome in their presentation is rarely life threatening. The major cause of death in such cases is due to the airway obstruction. Hence the most important aspect to be considered in such cases is the management of airway. This is especially important in cases where there is disruption of continuity of mandibular symphysis. Other problems associated with such injuries include loss of soft and hard tissues (Fig. 1) which, leads to cosmetic deformity and loss of function like speech, mastication etc. Careful handling of the soft and hard tissue in the initial stage is critical in achieving good esthetics and function in the long term.

Protocol for Primary Management

The aim of primary management is to establish airway, maintain breathing, stabilize circulation and to preserve tissues as far as possible.

Airway

Management of the airway includes manual clearing of the airway by removing broken teeth, bone fragments and

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Fig. 1 Blast injury showing severe avulsion of soft and hard tissue

foreign bodies if any; control of hemorrhage and maintaining patency of the airway. Today, special nasal packs—Merozel Doyle's nasal dressing for anterior pack and Epistat II nasal catheters are readily available which are very useful in the management of hemorrhage due to trauma. Whenever the patient is conscious and reflexes are intact, the patient should be allowed to take a position that he/she is most comfortable. At the same time patient should be constantly monitored for any change in level of consciousness. If the patient is not able to maintain airway voluntarily, the next best option is the passage of an endotracheal tube at the earliest. The endotracheal tube can be first passed orally for quick results and then changed to nasal once patient stabilizes and investigations are complete. If facilities for endotracheal intubation are not available, then an oropharyngeal airway can be used as a first aid and patient kept in the tonsillar position till expert care is available. Intermittent suction is very important for maintaining the patency of the airway. In cases with extensive loss of hard and soft tissues involving the symphyseal region, it may be best to do a planned tracheostomy because recovery from such an injury may take few months or years and tracheostomy will aid in airway management during the many sequential surgeries required in such cases. Recently, "Combitube" another device has been introduced which is very useful in such cases where intubation at the earliest can save the life of the patient but there is poor visibility or access.

Breathing

Once airway is established, breathing should be monitored. If the patient is not conscious, respiratory rate is maintained either using a ventilator if available or using an

ambu bag which should be available at all treatment centre as part of first aid equipment. Mouth to mouth or mouth to nose respiration may not be possible because of the nature of injuries in the region.

Circulation

Stabilizing the circulation involves establishing IV lines, restoration of blood volume and maintaining blood pressure and other vital parameters. IV access should be obtained with a 16 G IV cannula so that adequate fluids can be transfused in a short period of time. Baseline records of all vital parameters and GCS scale should be taken next and monitored every half hour for the first 2 h and then second hourly. Patient is given suitable analgesics and antibiotics at this point of time.

Investigations

Once patient's general condition stabilizes, CT scan is done to assess the extent and severity of the injury. In many cases of blast injuries, it may not be advisable to waste time in getting a CT scan done as control of hemorrhage requires urgent surgery and the bony injuries are usually visible through the wound.

Primary Surgery

The nature of primary surgery depends on the nature and extent of the injury. Several sequential surgeries may be required to get an acceptable result. In severe injuries involving considerable amount of hard and soft tissue loss, the primary surgery involves arresting hemorrhage and suture of mucosa to skin where possible. In mild to moderate cases, bony apposition is achieved to the extent possible taking care to preserve as much of soft and hard tissue during debridement. Reconstruction plate is the best method of stabilization of bony skeleton where the mandible is comminuted as is the norm in such injuries (Fig. 2). However, precise adaptation of the reconstruction plate is very difficult but important to prevent post operative complications and to achieve reasonable esthetics. If the plate is not adapted precisely, during the post operative period, the screws may come out of bone due to muscle pull. A tension band using a cast metallic splint connecting the remaining teeth will also help to prevent torsion of the fragments due to muscle pull. Where it is not possible, intermaxillary fixation should be resorted to. Due to the shock effect, some of the tissues that look vital at the time of primary surgery later give way (Fig. 3). However, attempt must be made to leave any bone fragment that is attached to periosteum in situ. These bone fragments may act as a good recipient site at the time of secondary

reconstruction. During debridement, it is not a must to remove all foreign bodies from the wound, especially metallic pieces. It may be wiser to leave these fragments in situ to conserve soft tissues. However, profuse irrigation of the wound with dilute hydrogen peroxide and saline alternately must be done at the outset to remove any loose debris. Once the bony framework is stabilized, then soft tissue closure is started at the most recognizable borders and critical junctions like vermillion border. Care should be taken in identifying and preserving important soft tissue structures like parotid duct, branches of facial nerve etc. A gastrostomy should also be carried out in cases of moderate to severe loss of soft and hard tissue for feeding purposes as recovery will take few months to years and involve multiple surgeries.

Post Operative Care

Routine post operative care is provided. Oral hygiene is to be meticulously maintained to prevent dehiscence and infection. Even then, there is a high risk of dehiscence. Hence, in most of the cases it is advisable to keep the patient nil orally during the post operative period. Gastrostomy and tracheostomy in moderate to severe injury cases helps in the management. Usually some of the tissues at the injury site becomes non vital which requires debridement and secondary reconstruction at a later stage. Antibiotics to be continued for 7–10 days depending on the nature of patient's response.

Fig. 2 Intra operative photograph showing temporary stabilization with reconstruction plate

Fig. 3 Necrosis of bone and soft tissue in the post operative period

Discussion

Even though head and neck region comprises of only 12% of the human body, there has been an increase in the incidence of maxillofacial injuries in the 21st century warfare. Maxillofacial injuries represented 7% of injuries evacuated to the UK in 2005, 9% in 2006 and 18% in 2007[2]. Among the US troops, 29% of the injured had craniomaxillofacial injuries [3]. Of these, 58% had soft tissue injuries while 27% had fractures of which 76% were open. Fracture mandible comprised 36% followed by maxilla/zygoma 19%, nasal 14%. Orbit was involved in 11% of cases. The main cause of injury was explosive device 84%. Wade et al. reported an incidence of 39% craniomaxillofacial injuries of 1130 wounded in Operation Iraqi Freedom from March to September 2004[4]. In the Indian scenario, there were 324 injuries in a 2½ year period [5]. Of these there were 137 mandibular fractures, 86 maxillary fractures, 98 zygomatic complex fractures and 19 nasoethmoid complex fractures. Soft tissue injury without involving the bony skeleton was seen in 102 cases.

As can be seen from the literature, mandible is most commonly involved in such injuries. The management of mandibular injuries require special attention. As the mandible is a curved tubular bone which contributes to a great extent to the width, height and projection of face, the biggest challenge is to reconstruct the width, height and projection of the face when there is considerable loss of hard and soft tissue.

Most of the blast injuries present with multiple soft tissue penetrating lesions along with one or more fractures. They are also characterised by heavy contamination and the presence of multiple splinters. In many cases they

Fig. 4 Post operative photo after mandibular reconstruction

present with avulsive wounds which require meticulous soft tissue closure for good long term results. The primary goals of primary management are control of haemorrhage; stabilisation of the bony support base, thorough wound debridement and primary closure wherever possible. The face has very good blood supply and hence an attempt should be made to preserve as much tissue as possible. Any bony piece with attachment should be preserved unless it is too small to survive. During the primary management, care must be taken to avoid periosteal stripping as far as possible to maintain remaining blood supply. Fracture fragments are then mobilised and stabilised with mini plates/micro plates and screws. In severely comminuted mandible and in cases with loss of hard tissue, a properly adapted reconstruction plate will restore contour for optimal soft tissue healing. Secondary bone grafting should always be carried out at a later stage. In our experience, management of blast injuries with bone plate and screws has yielded excellent results in contrast to the findings of Gokel T and Gibbons et al. [6, 7]. Proper stabilisation of the facial skeleton is very important to prevent collapse of soft tissues and fibrosis which is difficult to correct at a later stage. The actual extent of tissue damage is well beyond the

apparent. An experimental study by Tan and colleagues on the extent of tissue damage in ballistic injuries of the maxillofacial skeleton in dogs found that necrosis extended 30 mm from the apparent wound margin together with micro thrombus formation and vascular endothelial loss [8].

Conclusion

Improvised explosive devices produce unique injury patterns the management of which are different from routine maxillofacial trauma care. They result in devastating facial injuries with significant immediate and delayed loss of tissue. Early and skilled management of these injuries at the primary stage is critical in achieving good aesthetics and long term function (Figs. 3, 4).

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