Management of blowout fracture with iliac bone graft

Cokorda Agung Dalem Pemayun1, Putu Yuliawati2, Ni Made Laksmi Utari2, AAA Sukartini Djelantik2, Agus Roy Rusly Hariantana Hamid3

ABSTRACT

Introduction: Blowout fracture is a traumatic deformity of the orbital wall and the repair is indicated when enophthalmos is troublesome to the patient, or when diplopia interferes patient’s activities. Iliac bone has been reported in the immediate and secondary repair of orbital wall deformities following blowout fracture. This case is to report blowout fracture management using iliac bone graft.

Case Illustration: A 35 years old man complains pain on his left eye when moving his eye and diplopia in upgazed since 4 months after fell down from stairs. Eye position is orthophoria, visual acuity 6/6 on both eye, anterior and posterior segments are normal, restricted movement to superior on left eye, Hertel exophthalmometry examination on right eye 15 mm and left eye 10 mm (base 90). On CT-scan examination, it was found that an orbital floor fracture was characterized by herniation of the orbital tissue. The patient was diagnosed with left eye enophthalmos, suspect inferior rectus muscle and adnexal entrapment and neglected blow out fracture. LE Repair Orbital Floor Fracture, Release Muscle Rectus Inferior, Exploration (join op with Plastic Reconstructive and Aesthetic Surgery Department) is done to this patient.

Conclusion: Iliac bone graft can be used as an alternative in orbital floor reconstruction, since it easy to harvest, low risk to rejected or extruded and can be used in large defect. Optimal outcome of blowout fracture repair can be achieved if the surgical management is done before two weeks after the incidence.

Keywords: Blowout fracture, ocular manifestations, iliac bone graft.


INTRODUCTION

Blowout fracture is a fracture of the orbital floor caused by sudden increase of intraorbital pressure without involvement of the orbital rim. Most of the blowout fractures occurs on the floor of the orbit and others occurs on medial wall with or without fracture of the orbital floor. Severity level varies from small and minimal fracture i.e. misplaced one orbital wall that does not require surgery, or damaged severe orbital wall causing bony deformity and positioning eyeball.1

Diagnosis of blowout fractures established based on anamnesis, physical examination and supporting examinations. There is a history of blunt trauma to the face extracted from anamnesis. Gold standard to establish the diagnosis of blowout fractures is a head CT scan which shows a fracture in the orbital floor and or on the medial wall of the orbit. Differential diagnosis of blowout fractures is zygomaticomaxillary complex fracture and naso-orbito-ethmoidal fracture.2

Case of blowout fractures most are just observed to see hematoma absorption. Recommended indications for surgery are the presence of diplopia, enophthalmas, extensive fractures and CT scan shows presence of a pinched muscle and no clinical improvement within 1-2 weeks. Complications can occur as a result of the initial trauma or surgical therapy. Prognosis generally good, if proper management is carried out.3

Blowout fractures caused by indirect blunt trauma to the orbit which is a protective mechanism to reduce the sudden increase of intraorbital pressure with decompression through the weakest part of the orbital walls, which are the floor of the orbit and the medial wall of the orbit.4

To overcome this problem, a reconstruction of orbital floor is needed. The goal of surgery is to repair the anatomical defects and functional. Several materials have been used in the reconstruction of orbital floor, among others: synthetic materials, silicone plate, hydroxypatite, titanium mesh, porouse polyethylene implants; and autogenous material, such as the cranial cortex, ribs, iliac bone, conchal auricular cartilage. In addition, the recent extraordinary advances recent research has provided biocompatible, gentle, strong, and easy to handle. Biocompatible materials absorbable, and which materials unabsorbable has the potential for severe late complications such as infection,
foreign body rejection and extrusion.\(^4\) Reconstruction with synthetic and autogenous materials has advantages and lack. The use of synthetic materials is not carried out for retrieval surgery grafting, trimming and shaping to fit the defect; on the other hand, infection and rejection rates of synthetic materials are higher compared to autogenous material. Autogenous material, especially cortical bone such as cranial bone and iliac bones may be used. Although the cortical bone is quite strong, processes it is not easy to take because of the lack of strength and flexibility to conform to the contours of the orbital floor. Because of the cortical bone contains fewer cells such as osteoblasts and osteoprogenitor cells compared to the periosteum and medulla. Cortical bone provides poor remodeling and sometimes absorbable.\(^5\)

Autogenous materials have advantages over synthetic materials, namely bone iliac cancellus which, although only 1 mm thick, has strong strength simply because it has beam structure (like beams). Further, because of the cancellus bones contain many hematopoietic stem cells and osteoprogenitor cells, as well has aspects of generative medicine.\(^3\)

**CASE REPORT**

A 35 years old male patient came for the first time to the eye outpatient, Plastic, Reconstruction and Oncology (ROO) division in Prof. Dr.I.G.N.G Ngoerah Hospital on January 20, 2020 with complaints of pain in the left eye since 4 months ago due to a fall from the stairs with his eyes hitting the potted plant. Pain in left eye felt when the patient moves the eye. Complaints are accompanied by double vision in the upper area. Other complaints such as red, watery eyes, eye discharge and headaches were denied by the patient. The patient had time to check himself after incident to the Singaraja Hospital and a head CT scan was done and it was said there was fracture of the wall of the left orbit, then the patient was referred to Prof. Dr.I.G.N.G Ngoerah Hospital. History of using Lyteers eye drops and oral paracetamol. Disease history such as hypertension and diabetes mellitus are denied. Denied history of allergies, history wearing glasses is also denied.

*Figure 1. Photo of both eyes of the patient (Courtesy of Cokorda, 2020)*

*Figure 2. Movement of 9 gaze (Courtesy of Cokorda, 2020)*

*Figure 3. Head CT-Scan orbital focus (Courtesy of Cokorda, 2020)*
Ophthalmological examination of the right eye revealed UCVA in both eyes 6/6. Examination of the anterior segment from lid to lens was within normal limits. Examination of the posterior segment was within normal limits. Obtained enophthalmos on left eye by Hertel exophthalmometry examination with base 90°, which are 15 mm on right eye and 10 mm on left eye. Examination of eyeball movement in the eye right within normal limits and in the left eye found a restriction superiorly in the presence of pain, Forced Duction Test (FDT) examination was found to exist restriction to superior and WFDT got diplopia.

Examination with an orbital CT scan found a fracture of orbital floor in the left eye, which is characterized by herniation of the orbital tissue. Patient diagnosed with Left Eye (LE) Enophthalmos + Suspect Inferior Muscle Entrapment ec Neglected Blowout Fracture. Patient planned with LE Pro Repair Orbital Floor Fracture + Release Inferior Rectus Muscle + Exploration join op with Plastic Reconstruction and Esthetic Surgery Department. Patient was diagnosed with Neglected Rima Orbita Fracture Sinistra + Neglected Fractur Orbital Floor Sinistra + Suspect Muscle Entrapment and planned with Pro Reconstructive Osteotomy + Iliac Bone Graft Implantation.

The operation was carried out on February 7, 2020. During the operation the patient was in supine position with the GA-OTT anesthetic technique. Operating field disinfection performed with povidone iodine and sterile towels. Durante surgery is also performed FDT inspection to ensure there are no obstacles/entrainment of Inferior Rectus Muscle. Subciliary incision was made and tumescence was injected. Incision done layer by layer from the skin incision, orbicularis muscle, to perios until fracture was visible. Rima Orbita Sinistra fracture was found, Orbital Floor Sinistra fracture with Inferior Rectus Muscle Entrapment. Then the release of inferior rectus muscle was done. Harvesting bones graft from the anterior superior iliac spine (ASIS). Next is pasting bone grafts on Left Orbital Floor Fracture. The sewing layer by layer starting from perios, muscles, skin was done. The donor area is sutured with thread absorbable monofilament 6-0 and 4-0 in the subcutis.

Figure 4. Left Orbital Floor Fracture (Courtesy of Cokorda, 2020)

Figure 5. Iliac bone used as bone grafts (Courtesy of Cokorda, 2020)

Figure 6. Bone grafts attachment (Courtesy of Cokorda, 2020)
On the second day post-operative, the patient complained of postoperative pain. From the examination results, the right eye (RE) was within normal limits: visual acuity 6/6, palpebral within normal limits, calm conjunctiva, clear cornea, deep anterior chamber, iris regular, pupil reflex (+), clear lens, fundus reflex (+), IOP 15. LE: vision 6/6, palpebral edema (+), spasm (+), hematoma (+), hектing (+); SCB (+), chemosis (+) reduced; clear cornea; deep anterior chamber; regular iris; reflex pupils (+); clear lens; fundus reflex (+); IOP 12; obstructed eyeball movement superolateral direction. The patient is diagnosed with LE post repair orbital floor + release inferior muscle entrapment bone-graft. The patient received Ketorolac 3x1 ampoule and Paracetamol 4x500mg orally, Gentamicin ointment 3x1 LE, Tranexamic Acid 3x500 mg orally (D3), Statrol eye drops 4x1 LE, Ceftriaxone 2x1 gram intravenously, IVFD Lactate Ringer 20 drops per minute, oral hygiene every 4 hours, and on a liquid diet for 3 weeks.

The patient performs control on the seventh day post-operative and still complained of postoperative pain, but it has lessened. From the results examination found RE within normal limits: visual acuity 6/6, palpebral within limits normal, calm conjunctiva, clear cornea, deep anterior chamber, regular iris, pupil reflex (+), clear lens, fundus reflex (+), IOP 15. LE: vision 6/6, palpebral edema (+), spastic (+) minimal, hematoma (+), hектing (+); SCB (+); clear cornea; deep anterior chamber; regular iris; pupil reflex (+); clear lens; fundus reflex (+); IOP 15; good eyeball movement in all directions. Patient diagnosed with LE post repair orbital floor + release inferior muscles bone graft entrapment D-7. Aff hектing is done and the patient gets Tranexamic Acid 3x500 mg orally, Statrol eye drops 4x1 LE, Lyteers eye drops 6x1 LE, and Paracetamol 3x500 mg orally.

Control patient 1-month post-operative with complaints like something propping when looking at the top left, pain is denied. From the inspection obtained orthophoric eye position, RE within normal limits: visual acuity 6/6, anterior and posterior segment within normal limits, good eye movement in all directions, IOP 15. LE: enophthalmos (+), visual acuity 6/6, normal lids, anterior...
and posterior segment within normal limits, IOP 18, movement of the eyeball is inhibited in the direction superolateral. Hertel with 90 mm base: RE 15; LE 10. FDT restriction (-); FGT paresis (-). The patient is diagnosed with LE post repair orbital floor + release inferior muscle entrapment bone-grafts (1 month). The patient received Lyteers 6x1 LE eye drops and was asked for control if there is a complaint.

DISCUSSION

The orbital cavity is limited by orbital roof, lateral and medial walls, as well as orbital floor. Most of the thin (<0.5 mm thickness) portion of the orbit is present on medial infraorbital groove and the infraorbital canal, which is the roof of the sinus maxillary and floor of the orbit. The lateral portion of the ethmoid sinus, is called the lamina papyracea, is the medial wall of the orbit which is also thin. All these bones can involve in orbital fractures. However, floor (base) and the medial wall of the orbit is more frequently for fractures because of these anatomical characteristics (Fig. 15). Orbital floor composed of the palatine bones, maxillae, and the orbital plate of zygomatic bone. The orbital floor is also the origin for the inferior oblique muscle (plays a role in extortion, elevation and abduction of the eyeball). The inferior arch of the orbital floor is passed by the infraorbital nerve (part of the maxillary branch of the trigeminal nerve) which innervates the face through the infraorbital foramen.

Blowout fractures can occur due to a collision or impact of an object which is larger than the diameter of the orbital rim. Impact towards this orbit can increase intraorbital pressure, resulting in pressure...
in all directions of internal organs causing fracture of the fragile part of the orbital wall (medial and orbital floor) accompanied by herniation of the intraorbital organs. Blowout fractures are more common in males adults and teenagers. Research by Reyes et al (2013) found that blowout fractures occur in males (80% of cases), the mean age is 31 years with the most common cause was a fall (32%). Research by Khojastepour et al (2020) also found that male (86.2%) experienced the most blowout fractures with a mean age of 36 years and the most common cause found is a traffic accident (69% of cases). Research by Seifert et al (2021) also supports that blowout fractures occurs most frequently in ranges aged 16-35 years and 72% of cases experienced by men. In this case it is found that the patient was male, aged 35 years, and had a history of fell from the stairs with his eyes hitting a potted plant 4 months ago.

Blowout fractures leading to inferior herniation of the intraorbital organs characterized by enophthalmos accompanied by signs of periorbital trauma such as ecchymosis and subconjunctival hemorrhage. Another disorder that can arise is diplopia when looking up as well as movement disorders of extortion, elevation, depression, and abduction of eyeball caused by hematoma and orbital edema, or because mechanical entrapment of inferior rectus and inferior oblique muscles. Hypoesthesia to anesthesia of the facial area innervated by the branches of the trigeminal nerve, infraorbital maxillary, can also be found on blowout fractures because involvement of the infraorbital canal and obstruction of the infraorbital maxillary branch of the trigeminal nerve. Physical examination may show signs of organ herniation such as enophthalmos, impaired movement of the eyeball to the superior, and hypoesthesia to anesthesia of the trigeminal nerve innervation area maxillary infraorbital. Another physical examination may show signs of orbital trauma such as subconjunctival hemorrhage and infraorbital hematoma. In this case the patient complained of pain in the eye left on moving the eyes and accompanied by double vision in the upper region. On ophthalmological examination, enophthalmos was found in the left eye with Hertel exophthalmometry examination with base 90° on right eye 15 mm and 10 mm on left eye. Examination of the movement of the left eyeball found a restriction to the direction superior in the presence of pain, FDT examination found a restriction to superior and WFDT found diplopia.

Supporting examination is necessary to confirm clinical findings and radiological classification. Head CT scan of orbit with axial, sagittal and coronal examination is the standard examination for diagnosing orbital fractures. CT scans can evaluate the location, size of the fracture and involvement of deep extraocular muscles to predicts the likelihood of enophthalmus and muscle clamping. Not only the size and shape of the fracture be seen determine the clinical diagnosis but also determine the surgical plan. Tissue herniation from the orbit to the maxillary sinus on a CT scan can provide a typical overview “teardrop sign”. CT scan can detect the pinched of rectus muscle by looking at the displacement of the muscle to the fracture area with or without displacement of the bones. The results of supporting examinations on this case was the CT scan found an orbital floor fracture on the left eyes with herniation of the orbital tissue.

Management of blowout fractures divided into initial management and further management. Evaluation of airway, breathing, and circulation (ABC) always performed in every case of trauma especially facial trauma. Observations made as initial treatment by giving cold compresses to see absorption of the hematoma, oral antibiotics, steroids to relieve signs of inflammatory, and neuroprotective in the presence of peripheral neuropathy. Patient with blowouts fractures with minimal bone displacement, without diplopia, and without clamping of the supporting structures of the orbit can be observed during the first 1 week. If sinus involvement is suspected, prophylactic antibiotics can be given asked not to blow from the nose. Some studies mention steroids 1 mg/kg/day for the first week may help reduce edema of tissues and reduces the risk of persistent diplopia.

Further management in the form of surgery can be considered after observation period. Indication for surgery
for blowout fractures are the diplopia persists for up to 2 weeks after confirmed trauma radiologically, enophthalmos >2 mm, and defects of orbital floor more than half of orbitals floor.13 In this patient, the indication criteria were obtained in the form of: enophthalmos in left eye and orbital floor fracture with inferior rectus muscle entrapment. Surgery, especially in adults, should be done within the first 1-2 weeks after the accident so expected that resolution of bleeding already happened and tissue edema and scar tissue has not yet formed which inhibits maximum correction. Another case for blowout fractures in child which generally trapdoor type, and recommended for surgery has been carried out within the first 24-48 hours.14

Patients fall into the category neglected blowout fracture because of the trauma has been going on since 4 months before finally getting treatment. Action surgery should preferably be performed within 2 weeks post trauma to minimize processes of necrosis and fibrosis as a result of pinched muscles simply do not get blood supply.15 This delayed handling is at risk of occurrence permanent dysfunction of the extraocular muscles.8 In contrast to the results obtained by Clavero et al namely surgery performed before 48 hours clinically improves fractures healing and clamps in the muscles but the results were not significantly different when compared with surgery performed after 48 hours.16

Operation as treatment for blowout fractures aimed at reconstruction of orbital floor, repositioning the intraorbital organs, and eliminating diplopia with improve eyeball movement. This goal is achieved by implant placement expected to replace structure and function of orbital floor which has damaged. The implant used can be an autograft from the cranium, iliac plate of the anterior iliac crest, cartilage of the conchae, part of the ostium of ribs, and mandible.17 In this patient the autograft used were from ASIS. Iliac bone graft is the most bone graft commonly used because of its regenerative properties. It is associated with existence osteoblasts (bone-forming cells) in trabecular bone. Surgical technique for retrieval of the bone graft involves the extraction of material from the iliac crest bone anterior or posterior. Harvesting iliac bone graft provide benefits with large amounts of autogenous bone for a variety of procedures, ranging from bone fusion back to bone reconstruction.2 The main steps of this procedure includes (1) starting with a surgical incision, (2) paying attention to the crista iliaca while avoiding neurological structures, (3) identify the location and perform iliac crest corticotomy, (4) retrieval bone graft cancelous using a curette, (5) performing hemostasis, and (6) performing closure layered.18

The surgical technique used for harvesting iliac bone graft has underwent some modifications. A variety of surgical techniques are used currently evolving to facilitate species selection bone grafts appropriate (eg cortical, cancellous or corticocancellous) and approach techniques. Despite the diversity of surgical techniques for harvesting iliac bone graft, this taking can generally be classified into trapdoor techniques, splitting techniques, window techniques, and trephine extraction. Trapdoor method made by making a bone flap on the iliac crest which is subcortical bone moved to find cortical anatomy. This method is like “open flaps” because it leaves the cortex open to access cancellous bone. On window technique by moving the iliac crest segments including cortex part. This method can maintain aesthetic symmetry. Extraction bone grafts with trephine extraction can make that hole penetrate the cortex so that this method is said to be minimally invasive.19

The advantages of autograft are stimulation of osteogenesis and revascularization, has good stability, does not cause rejection reactions, which resistance good against infection and in terms of lower costs. On the other hand there is also the weakness, which was autograft requires a longer operating time donor retrieval, additional trauma to the patient, limited number and implant size, tissue death at the removed donor site and, resorption process unpredictable bone formation which can lead to enophthalmos or hypoglobus later in life.17,20,21

The operation begins with the achievement towards orbital floor through the incision subcutaneously or subconjunctivally. The subcutaneous incision consists of an infraorbital incision, subtarsalis, or subciliaris. Infraorbital incision is the simplest method but there is a high risk of scarring. Subtarsal incision can be done in the elderly who have folds under the lower eyelid, and is not recommended performed in young patients because of the risk of scarring. Subciliary incision provides better visualization of the inferior orbit and carries a risk of cicatrical smaller so that a subciliary incision was performed in this patient. Next step after successfully achieving orbital floor is the liberation of the organs intraorbital and repositioned with great care. The implant is attached for fixation intraorbital organs to keep them in their proper positions. Final stage of operation are implant fixation and suturing of surgical incisions.1

Complications of blowout fractures both as a result of trauma and post reconstruction which can occur include orbital hematoma, orbital emphysema, infection, latent infection of implants, neuropathy of the optic and inferior orbital nerves, diplopia, enophthalmos, naso-orbital fistula, subconjunctival hemorrhage and displacement implant. Routine control during the observation period and after surgery necessary to monitor complications that may arise.22 The complications found in this patient are orbital hematoma, enophthalmos, and subconjunctival hemorrhage. Enophthalmos is the most common complication of this type of fracture. Enophthalmos which is often covered by edema and a hematoma occurs due to expansion of the cavity orbit, atrophy of fat, cicatrical contractures, and backward traction by trapped.23 The complications in these patients have been managed successfully medical administration for treatment.

The prognosis is generally good if proper management is carried out. Surgical repair of orbital floor fractures usually results with the good prognosis although persistent problems may occur. Visual acuity is generally good after surgery unless there are complications when surgery such as exposure to the optic nerve.24 Neuralgia fits distribution of intraorbital nerves that can appear after surgery, can be more intense and
the improvement can reach 6 months or more. When it happens persistent diplopia especially when isolated in extreme positions and interferes with the function of vision, then it is better to do correction through surgery. Enophthalmos can get worse over time even though fracture repair was performed because atrophy of orbital fat may also occur and produce enophthalmos. Accompanied by carefully executed actions good understanding of the anatomical structure will give good results.3

CONCLUSION

Blowout fractures is a fracture of the orbital floor caused by sudden increase in intraorbital pressure without involvement of the orbital rim. Diagnosis of blowout fractures based on anamnesis, physical examination and supporting examinations. Gold standard to establish the diagnosis of blowouts fractures is a CT-scan of the head where a fracture in the orbital floor is seen and/or on the medial wall of the orbit. Suggested indications for surgery is the presence of diplopia, enophthalmos, extensive fractures and CT-scan shows a pinched muscle and no clinical improvement in 1-2 weeks. Surgery are performed with use of bone grafts on Fractures on Left Orbital Floor. Complications can occur as a result of the initial trauma or surgery. Surgery should be done within 2 weeks after the trauma to minimize the process of necrosis and fibrosis due to pinched muscles. Delayed treatment risks permanent dysfunction of the extraocular muscles. Prognosis is generally good, when management was appropriate.

CONFLICT OF INTEREST

The author states that he has no conflict of interest.

ETHICS APPROVAL

Inform consent has been obtained regarding the usage of patient’s medical record

FUNDING

No third-party funding was involved in this study

AUTHOR CONTRIBUTION

All authors contributed equally in this study

REFERENCE