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Case Report

Le Fort III fractures: An approach to resuscitation and management

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ABSTRACT

Introduction: Le Fort fractures occur in approximately 20% of facial fractures and result from a high velocity/force mechanism of injury. In those rare 20% occurrences, the Le Fort III fractures are the least common and are highly associated with injuries of the cervical spine, intracranial, and internal neck structures.
Importance: This makes them difficult to manage and requiring a definitive sequence of resuscitation and thorough secondary and tertiary surveys thereafter. The morbidity and mortality of these severe fractures is high but with appropriate resuscitation and adequate stabilization of the fracture, this may be improved on and lowered.
Case presentation: A male sustaining multiple stabs to the face presents to a level one trauma emergency unit haemodynamically unstable/abnormal with a threatened airway and stridor. *Discussion:* This case report walks through step-by-step the management approaches at each stage thereby assessing and managing the outcomes of each diagnosis.
Conclusion: Le Fort III fractures are rare but critical injuries that require intensive resuscitation and a multidisciplinary approach to achieve wholistic and appropriate management of these patients. Adequate initial resuscitation and stabilization of fractures may improve the morbidity and mortality of these sever injuries.

1. Introduction

This case report has been reported in line with the SCARE Criteria [Agha RA, Franchi T, Sohrabi C, Mathew G, for the SCARE Group. The SCARE 2020 Guideline: Updating Consensus Surgical CAse REport (SCARE) Guidelines, International Journal of Surgery 2020; 84:226–230] [11].

Le Fort III factures are uncommon and may also be referred to as craniofacial dys-junction/dissociation, which involve disruption of the midface and involve nasofrontal junction, bilateral frontozygomatic suture and arch fractures. To result in separation from the skull base, the pterygoid plates of the sphenoid bone are involved as these dorsally connect the midface to the sphenoid bone [1]. Le Fort fractures may be associated with other facial fractures, neuromuscular injury and dental avulsions, and Le Fort III fractures have the highest cerebrospinal fluid (CSF) leak rate [2]. These fractures account for approximately 10–20% of all facial fractures with the Le Fort III category being the least common, and there is a high association of intracranial head injuries and cervical spine injuries in patients that have sustained Le Fort fractures [3].

Le Fort III fractures typically present with bilateral periorbital swelling and ecchymosis, oedematous face, enophthalmos, bilateral mastoid ecchymosis, haemo-tympanum, and possibly rhinorrhoea and otorrhoea (CSF and/or blood leakage) [4]. Examination according to Advanced Trauma Life Support (ATLS) principles of primary survey to secure a definitive airway and immobilize the cervical spine (C-spine), breathing with ventilatory support, circulation support with haemorrhage control, assess disability, and lastly expose the patient in their entirety with environment control is necessary [1]. The airway obstruction in such cases results from the multiple facial fractures with compromised anatomy and multiple sources of bleeding into the upper airway. The secondary survey of such patients would include evaluation of the orbits and globe once the fractures have been stabilized as best as possible with sutures and packing where necessary.

A multidisciplinary team approach is needed in the management of Le Fort III fractures and may include trauma surgeon, maxillo-facial surgeon, Ear-Nose-Throat (ENT) surgeon, ophthalmology, plastic surgeon, and Intensive Care Unit (ICU) physician. Imaging is vital in assessment of the extent of damage and a Computed Tomography (CT) scan with three-dimensional reconstruction is sufficient, along with CT scan of the brain, C-spine and angiogram of neck to exclude any associated injuries [5]. The goal of surgery is to fixate unstable fracture segments to the stable structures once the patient has been adequately resuscitated and stabilized. This fixation involves restoration of the

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facial projection, establish occlusion of teeth, and restore nasal and orbital structure [6]. However, the prognosis is reliant on the mechanism of injury and associated life-threatening injuries, but the mortality rate for Le Fort fractures is higher than other facial fractures. Delayed complications are mainly due to CSF leaks and persistent epistaxis.

This case report delves into the acute management of a patient presenting with a Le Fort III fracture and multiple associated life-threatening injuries according to ATLS principles. Furthermore, reviewing the resuscitation and stabilizing such a patient in order to do a complete secondary survey, investigations, and plan for surgery and ICU management, thereafter.

2. Case study of patient A

2.1. Presentation

A 44year old black African male presented to a level one Trauma Unit brought in by paramedics from a road-side post assault with a panga. Patient arrived without intravenous (IV) access, combative, with extensive facial oedema, active bleeding, and hypothermic. He had no significant medical or surgical history, no relevant family history, and no known drug history or psychological history.

2.2. Clinical examination

Heart rate (HR): 31 beats per minute (bpm), Blood Pressure (BP): 53/32 mmHg, Temperature: 29.1° Celsius, Glasgow Coma Scale (GCS) of 9/15 (motor = 6 verbal = 2 eyes = 1); saturation: 74%.

Extensive active bleeding from multiple extensive and deep lacerations/slash wounds to the face (Fig. 1).

Obvious stridor noted and a definitive airway (endotracheal intubation and surgical airway) was prepared, and simultaneously, facemask oxygen was applied as best as possible in the sitting position (45-degree head of bed angle), bilateral large bore (14gauge) IV access secured and 1 L warmed crystalloid bolus initiated. An arterial blood gas (ABG) (Table 1) was taken along with a massive transfusion protocol activation of 4 packed red cell concentrate, 4 fresh frozen plasma, and one megaunit of platelets with ten units of cryoprecipitate (this equates to a 1:1 transfusion ratio of all products for a balanced transfusion according to the blood bank protocol of this setting.

Fig. 1. Arrival to TEU resus with threatened airway*.

2.3. Resuscitation

2.3.1. Airway

C-spine immobilization with head blocks and head of bed flattened, sedation given and controlled endotracheal intubation was undertaken with a size 7.5 endotracheal tube whilst assistants applied cricoid pressure and stabilized the maxilla and mandible digitally. Once vocal cords seen via laryngoscopy then only the muscle relaxant was administered. 75ml of blood suctioned from airway on intubation.

2.3.2. Breathing

Patient connected to a ventilator on Synchronized Intermittent Mandatory Ventilation (SIMV) with saturation on pulse oximeter improving from 80% to 100% on a fraction of inspired oxygen of one.

2.3.3. Circulation

One litre crystalloid completed, and one unit of packed red cell concentrate, and one unit of fresh frozen plasma initiated. Haemostatic sutures applied to five lacerations on forehead, four lacerations of the maxillary region, nasal packs soaked in 1:10 000 adrenaline and 0.4 μg of Desmopressin inserted into each nostril, exposed fractured maxilla and mandible – pressure dressings applied. This method has no literature-proven benefit and no Thromboelestogram measurement was available (hence the coagulation abnormalities could not be accurately assessed) at the time, however, in order to attain haemorrhage control, all forms of tamponade were considered and used. Inotropic support with Adrenaline initiated at 0.3 μg per kilogram per minute (mcg/kg/min) and increased to 0.8 μg to maintain mean arterial pressure (MAP) of 65 mmHg. HR = 32bpm BP = 98/56 mmHg.

2.3.4. Disability

Right pupil 3mm and reactive, left pupil 5mm and non-reactive. Patient was moving all limbs prior to intubation. No vertebral step deformities noted on logroll palpation. Per rectum exam: no blood, patient paralysed, thus, tone unable to be assessed. Hypertonic Saline was administered due to the suspicion of raised intracranial pressure.

2.3.5. Exposure

Five lacerations (2cm length) on forehead: two deep lacerations communicating with intracranial cavity and brain matter noted in wound.

One right maxillary deep laceration (stellate) communicating with maxillary sinus, three left maxillary lacerations all communicating with various sinuses.

Exposed maxilla with fracture extending dorsally for 5cm and large skin flap.

Exposed mandible with fracture extending 7cm and large lower lip skin flap.

Multiple loose and missing teeth of maxilla and mandible.

All above sutured, packed, plugged, and pressure dressings applied. Patient had all wet clothing removed and a warmer and blankets applied. Temperature of 29.1° Celsius (Fig. 2).

2.4. Adjuncts

Orogastric tube, urine catheter, emergency Focused Abdominal Sonography of Trauma (eFAST) performed (negative), Chest Xray (CXR)

Table 1
Arterial blood gas.

pH	paO_2	$paCO_2$	Saturation	Lactate	Base Excess	Bicarbonate	Haemoglobin (g/dL)	Potassium
7.19	59.4	31.6	82.7	9.1	−13.0	14.1	5.9	2.3

Fig. 2. Post orotracheal Intubation and packing of face*.

ordered, prophylactic dose of broad-spectrum antibiotic given, cyklokapron 1 g given, and anti-tetanus given.

Secondary survey was completed with no other injuries outside of the head and face noted. Patient was taken for a CT scan of the brain, C-spine, and neck angiogram (Fig. 3). CT Brain report: Comminuted fracture of the inner and outer table of the frontal sinuses and frontal bones including the superior orbital rims; comminuted fracture of the ethmoid air cells and bilateral nasal bones (includes bilateral lamina papyraceas with right medial rectus entrapment); bilateral orbital floor fractures extending to inferior orbital rims with right inferior rectus muscle entrapment); lateral wall and rim of right orbit fracture; bilateral anterior, lateral, and medial maxillary wall fractures; fracture of the right temporal bone and extending to base of skull and greater sphenoid wing; medial and lateral plates of bilateral pterygoid plates fractured; right zygomatic arch fracture; horizontal fracture through maxilla with right vertical component between alveolar processes and through coronoid process; comminuted displaced right Para symphyseal mandible fracture; left parietal fracture with underlying acute temporal-parietal acute subdural haemorrhage extending into falx and parietal subarachnoid haemorrhage; bifrontal haemorrhagic contusions and pneumocephalus in bilateral high parietal regions; cerebral oedema with poor grey-white matter differentiation and attenuation of supra-sella cistern; no midline shift or hydrocephalus; large soft tissue defect over right lateral mandible region; extensive facial soft tissue swelling; bilateral extra-conal air locules with intact globes. CT C-spine: no acute C-spine injuries. CT angiogram neck: vessel cut off of proximal right internal carotid artery and external carotid artery – no visualised thrombus or contrast extravasation or blush.

2.5. Pre-operative management

Five hours post presentation the patient was weaned down to 0.4 μg per kilogram per minute (mcg/kg/min) and had completed transfusion of two units of packed red cell concentrate and two units of fresh frozen plasma. Various specialities were consulted: 1) Ophthalmology: viable bilateral globes with left 10% hyphema; 2) ENT: comminuted nasal bone

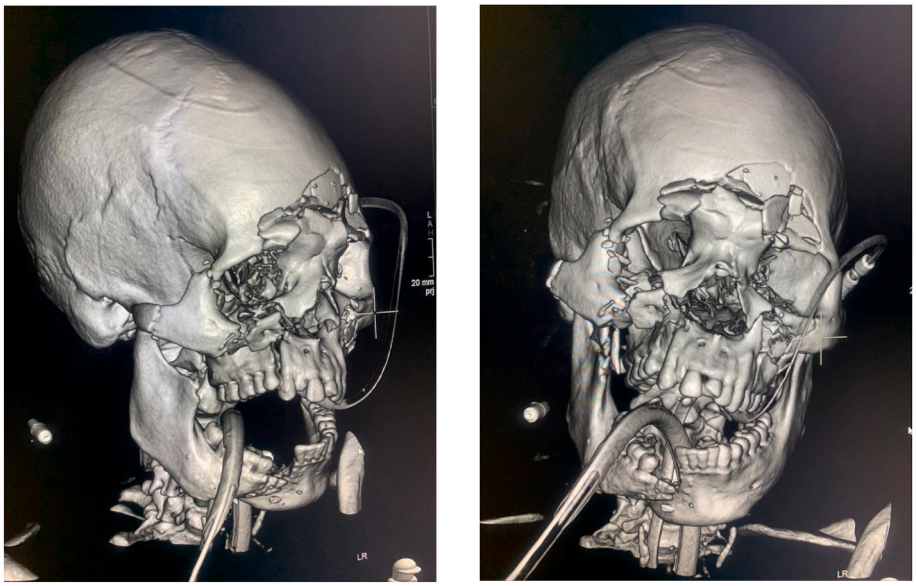

Fig. 3. CT Facial views 3D reconstruction*.

fractures for reconstruction in six weeks, cute plan for tracheostomy; 3) Neurosurgery: small subarachnoid and subdural haemorrhages for non-operative management and neurosurgical ventilatory support, for mannitol/hypertonic saline 8hourly with seizure prophylaxis; 4) Vascular: right external and internal carotid cut off for non-operative management and anti-platelet therapy; 5) Maxillo-facial: for mandibular and maxillary debridement and plating once stable; 6) Plastic surgery: for debridement and skin apposition in theatre.

Ten hours post presentation with completion of a massive transfusion protocol, the patient was completely weaned off inotropic support, GCS was 9/10T, adequate urine passed (1.1 mL/kilogram/hour (ml/kg/hr)), no active bleeding from facial trauma, with a temperature of 36.2° Celsius, HR = 69 BP 144/71 mmHg, and repeat ABG (Table 2):

2.6. Peri-operative management

Intraoperative: A tracheostomy was performed by ENT surgery consultant, followed with debridement of the mandible and maxilla with subsequent plating of the mandible by Maxillo-facial surgery consultant and senior registrar, the neurosurgery senior registrar performed a debridement the frontal bone fractures and sutured the associated laceration, a plastic surgery senior registrar completed the debridement and suturing of all other laceration and apposition of the upper and lower lip skin flaps. These procedures were performed in a tertiary hospital with level one trauma capabilities and a sterile theatre environment. The patient was transferred to ICU on ventilatory support and for neuroprotection for 48 hours thereafter. Day 4 post operative the patient was weaned to tracheostomy mask oxygen of 40%, and day 5 post operative the patient was discharged from ICU to the ward with a GCS of 9/10T with no signs of focal neurology or cerebral vascular incident. The patient is still undergoing rehabilitation, thus, has not been able to give his full perspective.

3. Discussion

This case emphasizes the importance of a systematic approach to the initial management of Le Fort III fractures in an emergency department. The ATLS principles with a thorough primary survey that ensures a secured airway and haemorrhage control are achieved allow for a patient to be fully assessed further in the secondary survey and to be stabilized for imaging [7]. Surgical airway must always be prepared in the case of difficult airway even if it is not often used even in complex facial fractures [10]. The imaging of such patients is important to plan for surgery in order to stabilise the face as a whole [8]. A multidisciplinary team approach that involves the various subspecialities of surgery allows for wholistic and appropriate management as demonstrated in this case study.

The resuscitation and management of the patient above is in accordance with the findings of Vujcich and Gebauer in 2018 [9]. Because an immense velocity or force is required to cause Le Fort III fractures, head and c-spine injuries may be incurred and need to be managed accordingly. Due to the extent of the fractures, there often are no reliable landmarks to initiate reconstruction, and, thus, a sequence of "bottom to top and outside in" is a reasonable approach to use [9]. This includes restoring the mandible and occlusion first (bottom) in order to correct the vertical height, followed by wiring the maxilla, then the zygomatic complex may be repaired (outside) which will address the width of the face, and lastly the central portion of the face (in) [9]. As with this case study, the mandible was addressed first with the plan of doing the maxilla and zygomatic complex in a staged (later) surgery.

4. Conclusion

The complexity of Le Fort III fractures and associated C-spine, neck soft tissue, and intracranial injuries make these rare but fatal injuries crucial to understand their initial resuscitative management and subsequent inter-disciplinary surgical approach. The most important factor in the prognosis hinges on the acute presentation to an emergency department and the ATLS principles applied at this stage. Ensuring a secured airway and haemorrhage control along with a thorough primary, secondary, and tertiary survey may prevent morbidity and mortality associated with these injuries. This case study presented a sequential approach to such a patient and the possibility of a good prognosis for this patient, proving the importance of resuscitation, imaging, and stabilization of these complex facial fractures.

Ethical approval

University of Witwatersrand Human Research Ethics Committee (HREC) approved the case report. Ethics approval was approved by the Ethics Committee.

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Author contribution

All Authors contributed equally to this case report.

Trial register number

1. Name of the registry:National Health Research Database
2. Unique Identifying number or registration ID:GP 202 2070 40
3. Hyperlink to your specific registration (must be publicly accessible and will be checked):https://nhrd.health.gov.za

Guarantor

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Consent

Informed Consent given.

"Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request".

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Consent for publication

Written informed consent was obtained from the patient for publication of this case report and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Table 2
Arterial blood gas.

pH	paO_2	$paCO_2$	Saturation	Lactate	Base Excess	Bicarbonate	Haemoglobin (g/dL)	Potassium
7.44	140	38.8	98.3	3.4	2.8	27	9.4	4.0

Declaration of competing interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Abbreviations

(CSF) Cerebrospinal fluid
(ATLS) Advanced Trauma Life Support
(C-spine) Cervical spine
(ENT) Ear-Nose-Throat
(ICU) Intensive Care Unit
(CT) Computed Tomography
(IV) Intravenous
(HR) Heart rate
(BP) Blood Pressure
(GCS) Glasgow Coma Scale
(ABG) Arterial blood gas
(SIMV) Synchronized Intermittent Mandatory Ventilation
(MAP) Mean Arterial Pressure
(eFAST) emergency Focused Abdominal Sonography of Trauma
(CXR) Chest Xray
(mcg/kg/min) Micrograms per kilogram per minute
(ml/kg/hr) Millilitres/kilogram/hour

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2022.104513.

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