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Management of compound fracture of the radius and ulna using pop and splints in a Nigerian Indigenous breed of dog: A case report

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Abstract

A case of compound fracture of both radius and ulnar which occurs from trauma as a result of a rodent's trap was presented to the small animal unit of the Veterinary Teaching Hospital, the University of Maiduguri with the chief complaint of trauma and severe bleeding which was haphazardly managed before the presentation. It was then referred to the Surgery and Radiology unit of the hospital, where it was managed using external fixatives consisting of Plaster of Paris and splints around the unaffected area, where the affected area was sutured and treated as an open wound until it healed. Conventionally, such fractures are managed using either external fixatives such as Ilizarov apparatus, Octopod external fixator, and Taylor spatial frame or internal fixatives such as intramedullary pin, bone plates, and cerclage wires. However, we couldn't get any of this within our reach, we had to use POP and splint which is more affordable since the client complained of not having money to go for expensive procedures. The dog was discharged home, and twelve weeks after, there was no sign of wound dehiscence, mal union, or non-union, hence the fracture healed completely.

Keywords: Fracture, internal fixatives, radius and ulna, Plaster of Paris (POP), splints

Introduction

Fracture healing is a complex biological process that follows specific regenerative patterns involving the interplay of physiological, cellular and molecular/genetic factors as well as extracellular matrix (Granero-Molto *et al.*, 2009) ^[1]. The overall pathways of both the anatomical and biochemical events have been thoroughly investigated and knowledge of physiological processes of the sequence of events that occur following a fracture has become clearer (Marsell and Einhorn 2009) ^[2]. Generally, fracture repair commences following the initial trauma, thereafter bone heals by either direct intramembranous or indirect fracture healing, which consists of both intramembranous and endochondral bone formation. The most common pathway is indirect healing, since direct bone healing requires an anatomical reduction and rigidly stable conditions, usually only obtained by open reduction and internal fixation (Claes *et al.*, 2002) ^[3]. However, when such conditions are achieved, the direct healing cascade allows the bone structure to immediately regenerate anatomical lamellar bone and the Haversian systems without any remodeling steps necessary (Granero-Molto *et al.*, 2009; Song *et al.*, 2011) ^[1, 4]. In all other non-stable conditions, bone healing follows a specific biological pathway. It involves an acute inflammatory response including the production and release of several important molecules, and the recruitment of mesenchymal stem cells in order to generate a primary cartilaginous callus (Nauta and Fibbe 2007) ^[5]. This primary callus later undergoes vascularization and calcification and is finally remodeled to fully restore a normal bone structure. Indirect (secondary) fracture healing is the most common form of fracture healing and consists of both endochondral and intramembranous bone healing (Gerstenfeld *et al.*, 2006) ^[6]. It does not require anatomical reduction or rigidly stable conditions. On the contrary, it is enhanced by micro-motion and weight-bearing (Green *et al.*, 2005) ^[5]. Indirect bone healing typically occurs in non-operative fracture treatment and in certain operative treatments in which some motion occurs at the fracture site such as intramedullary nailing

external fixation, or internal fixation of complicated comminuted fractures (Pape *et al.*, 2002) [8]. Bone repair is driven by complex events at both cellular and tissue proliferation and differentiation levels (Schindeler *et al.*, 2008) [9] culminating in the formation of new bones. These include osteogenic growth factors, inflammatory cytokines, antioxidants, osteoclast, osteoblast, hormones and some essential amino acids (Lee *et al.*, 2013) [10]. The repair cells originate from the inner osteogenic layer of the periosteum osteoprogenitor cells associated with the blood vessels of the Haversian systems within the cortical bone, the endosteum inner cortex, undifferentiated mesenchymal cells of the bone marrow, and possibly from the undifferentiated cells of the surrounding muscle and connective tissue based on their ability to differentiate as needed.

Case Presentation

A Nigerian indigenous breed (NIB) dog was presented to the small animal unit of the Veterinary Teaching Hospital, the University of Maiduguri with a case of compound fracture of both the radius and ulna resulting from a locally made rodent trap. There was severe bleeding which was haphazardly managed using a tourniquet before it was presented. It was then referred to the Surgery and Radiology unit of the hospital where the clinical assessment and management plan of the patient were ascertained.

Signalmen

The dog weighed 15 kg, the temperature was 38.5 °C, respiratory rate was 40 cycles per minute while the pulse was 120 beats per minute.

Physical Examination of the Patient

Upon physical examination of the affected limb, the skin covering the radius and ulna was torn in three different regions, the fractured bones were visible, and they were communicating with the surrounding muscles and external environment. The Pronator quadratus and the deep digital flexor muscles were torn as a result of the trauma. Radial nerves were exposed yet they remain intact. The radial vein together with some of its bifurcations was transected, resulting in severe bleeding at the fracture site. There was dyspnea and tachycardia.



Fig 1: The dog upon presentation, torn skin, muscles, multiple fracture and damaged blood vessels (yellow circle).

Vaccination History

The vaccination history of the dog was traced, it revealed that the dog's vaccination was up to date for all the canine viral infections including the highly infectious rabies.

Case management plan

The contaminated wound was drained with 0.3% chlorhexidine gluconate. The fractured bones were assessed to

see the possibility of using an improvised splint and POP on both proximal and distal part of the aligned bone to so as to make a window on the wounds, for it to be treated as open wound.



Fig 2: Close Examination and appraisal of the fractured tibia and fibular.

Differential diagnosis

Automobile Accident, trauma arising from a trap, hit from neighbours, etc. this particular case was identified as Trauma from Rodents/Feline trap based on histology and clinical examination.

Results

Surgical intervention

The surgical procedure was performed under sedation and general anesthesia using a combination of 2% xylazine (VMD, Belgium) at 1mg/kg and 5% ketamine HCl (Rotex) at 5 mg/kg body weight respectively. The surgical site was cleaned and irrigated with 0.3% chlorhexidine gluconate and povidone-iodine, the bleeders were individually ligated while 0.1% adrenaline (Par sterile products, USA) was infiltrated on the wound surface to cauterize minor bleeders and capillaries. The fracture was reduced using manual traction, where a bandage was applied on the affected limb distally on the digits, then pulled backward to allow the fractured bones align at the same time extending the relaxed muscles that surround the bones. Furthermore, the wound edges were sutured using polyglactone size 2.0 while povidone-iodine was applied judiciously to the sutured wound. The limb was padded using an orthopedic pad, then splints were applied on the limbs, avoiding the injured portion and secured. The splints were secured with bandage. POP was applied on both the proximal and distal portion of the affected limbs avoiding the sutured site which will be treated as an open wound until it healed completely.



Fig 3: Surgical Management of the affected limb, a window was created around the open wound for daily dressings.

Post-surgical medication

Immediately after the procedure, we applied the following medications; Oxytetracycline (Oxypharma®) spray (Topically) (topical antibiotics) Inj. Amoxicillin (1 ml) Intramuscular x 5/7 (antibiotics); Ketoprofen 0.2 mg/kg; (4 mg total dose), Intramuscular x 3/7 (analgesics).



Fig 4: Patient upon follow-up, showing an application of Oxytet spray on the open wound

Follow up

The patient was admitted to the kennel and was monitored closely for 6 weeks in the hospital, whereas the wound healed smoothly, we didn't notice any post-surgical complications such as osteomyelitis, mal union, non-union, etc., hence, it was discharged to its owner.



Fig 5: Arrow showing point of fracture completely healed, patient bearing weight on the affected 6 weeks after Surgery.



Fig 6: Patient, 16 weeks after Surgery, no any post-surgical complication, the fracture healed completely.

Discussion

Tibial fractures are the most common type of fracture usually encountered in canines. This is due to the fact that the tibia is covered with minimal muscles, which predisposes it to various degrees of fracture. Fractured bone comminution in various degrees has been particularly difficult to control

during fracture healing (Ghiassi *et al.*, 2017)^[12]. The degree of fracture comminution can affect the formation of callus. The inadequate stability of internal or external fixation leads to variable degrees of displacement and repeated movements of the bone fragments during the healing period (Glatt *et al.*, 2017)^[13]. Fracture repair progression usually constitutes the initial hematoma/inflammation phase characterized by clot formation, leucocyte infiltration, and the presence of megakaryocytes. This is followed by fibrocartilage formation and angiogenesis and which leads to the stage of the calcification of the cartilage and bone formation known as the hard callus phase during which osteoblasts populate the fracture sites. The fourth and final phase is ultimately bone remodeling typified by the presence of osteoclasts and reduction in the volume of the callus. In this case, the dog was unable to bear weight on the affected limb on days 14, 21 and 28, however, the dog started bearing weight on the affected limb at six weeks, this agrees with Oryan *et al.* (2015)^[14] and Handool *et al.* (2018)^[15] who states that callus index was lower at week 2 and reached a maximum level at weeks 3 and 4 before decreasing at week 6. This implies that remodeling usually occurs after 6 weeks in dogs.

Conclusion and Recommendation

Closed reduction and external fixation in a compound fracture are usually done with external fixators such as Ilizarov apparatus, Octopod external fixator, and Taylor spatial frame. However, we couldn't get any of this within our reach, we had to use POP and splint which is more affordable. The main advantage of close reduction is that blood supply to the fracture site is not disrupted by an open surgical procedure and less trauma to the already injured limb.

We, therefore, recommend that compound fractures of the radius and ulnar can be managed with external fixators such as splints and POP provided that windows are created to allow the injury to be treated as an open wound until it healed completely.

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