



A case report: Management of neglected distal radius and ulna open fractures gustilo-anderson grade II accompanied with compartment syndrome

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ABSTRACT

Introduction: Compartment syndrome and infection of neglected distal radius ulna open fracture is not quite common. Therefore, writers would like to present such unique case, its challenging management and outcome.

Case Report: 65-years old woman came with left arm open injury since seven days ago. Inadequately treated by traditional bone setter, there was an infection, compartment syndrome, and tingling sensation over the medial side of elbow to the tip of the finger. Standard open fracture initial management was done, followed by volar-incision-approach fasciotomy, and ORIF using K-wire technique.

Discussion: Delay initial management and patients' predisposing factor contributed to the development of this condition. To manage such complicated case, orthopedic surgeons combine such medications as Cefoperazone, Gentamicin, high dose vitamin C, along with the operative management. ICF model by doing proper positioning, exercise, stretching, splinting, and early mobilization were done. Without leaving aside the standard operative and post-operative management that were done, she suffered from left forearm contracture.

Conclusion: The management of neglected and infected open fracture remains challenging. However, maximum effort to save the infected limb has to be done such as using the K-Wire Technique.

KEYWORDS: open fracture, compartment syndrome, ORIF with K-wire technique, fasciotomy, contracture.

1. Introduction

Distal radius fractures are one of the most common orthopedic injury. It has bimodal distribution, in young patients it is caused by high energy trauma whereas in older patients it is caused by low energy trauma¹. They make up 8%-15% of all bony injuries in adults. Most of the fractures are caused by a fall on the outstretched hand with the wrist in dorsiflexion.

However, the presence of such simultaneous complicated case as radius ulna comminutive fracture, skin abscess, and compartment syndrome is relatively rare. Therefore, writers would like to present such unique case, its challenging management, and outcome.

2. Case Report

A 65-years old woman, presented to our hospital with chief complaint of pain on the left forearm since seven days before admission. Seven days before, she fell on the outstretched hand with the wrist in dorsiflexion. Noted there was an open injury, she directly seek a traditional bone setter (in Java, Indonesia, it is called *Sangkal Putung*). She was treated with traditional ointment medication, was bandaged, and was given a traditional oral medication (in Java, Indonesia, it is called *Jamu*).

On the day of admission, in addition to painful sensation and open injury of the left forearm, profuse pus was draining out from the injury. The patient explained that the foul smelling pus was continuously drain from the wound. In addition to this, patient also complained swollen

forearm and tingling sensation from elbow to the tip of fingers.

In emergency department, the vital sign was as followed: blood pressure 110/50 mmHg, heart rate 102 x/min, temperature 37,5° C, respiratory rate 20 x/min, and numeric pain rating scale 3. The result of general head to toe physical examination was normal. However, in local examination of the left forearm (Figure 1) there was redness and bruishes over the wounded area, swelling, and pus draining from the wound area during inspection.



Figure 1. Photograph of the Case

As illustrated in figure 1, in palpation, the left forearm was warm, swollen, had crepitation and subcutaneous emphysema sensation, and weak pulse. In range of motion (ROM) examination, there was pain sensation on both passive and active movement, limitation of the joint range, and tingling sensation starting from elbow to tip of the finger.

On Plain X-Ray (Figure 2), comminutive fracture of the distal left radius and ulna with posterior fragment displacement and subcutaneous emphysema were found. The results of laboratory examination were WBC 4.71 (Diff. Count Neu 90,8, Lym 5,7, Mono 2,0, Eos 0,2, Baso 0); RBC 3,67; Hb 10, 5; Hct 29,1; MCV 79,3; MCH 28,6; MCHC 36.0; Thrombocyte 221.000; GDS 274; Na 130; K 4,1; Cl 100; Ca 1,05; and high ureum and creatinine level. After initial trauma survey and resuscitation, the patient was given some medication for the initial management including abscess drainage and wound care, cefotaxime injection 1 g/12 hours and gentamycin injection 80 mg/12 hours (initial antibiotics), ketorolac injection

30 mg/8 hours, tetanus vaccine and immunoglobulin. In the ward, the patient had hypovolemic shock. Loading dose 0.9% NaCl and insulin sliding scale per 4 hours were given.



Figure 2: Plain X-Ray of The Case (Pre-Operative)

The patient was then referred to intensive care unit (ICU) because of the unstable condition. The next day, patient undergone hemodialysis (HD) for the acute kidney injury (AKI). Some medications were reconsidered after HD: cefotaxime and gentamicin were replaced by cefoperazone injection 1 g/12 hours because of its nephrotoxicity and ketorolac was replaced by tramadol 200 mg within 500 ml NaCl 0.9%. The next day, pantoprazole 1 A/12 hours was given pre-operatively and the patient was scheduled to have Open Reduction Internal Fixation (ORIF).

The patient was treated by orthopedic surgeon, internist, anesthesiologist, and medical rehabilitation specialist. This patient was diagnosed to have grade II open fracture of distal radius and ulna comminutive type displaced, compartment syndrome of the left forearm, skin abscess of the left forearm and other additional diagnosis including acute kidney injury, anemia, hyperglycemia, hyponatremia, and hypocalcemia.

2.1. Surgical Technique

At the beginning of operation, surgeon performed aseptic procedure sterilizing the wound area and

also performed irrigation using 6 L of normal saline.

The surgeon followed a standardized K-wiring technique presented by Gibbs, J. et al. (2006) with some modification. The surgeon cross K-wire to fixate radial fracture and also ulna fracture. The patient is placed supine on the operating table with a tourniquet placed on the arm (Figure 3). The surgeon abducted the patient's shoulder at 90° and the elbow flexed to approximately 70°. Longitudinal traction was applied across the wrist when a vertical bolster was fixed to the table so as to hold the arm in this position. An arm table was then attached to the table caudal to the bolster. After that, the tourniquet was inflated and the arm painted and draped in standard fashion. An upturned kidney dish was placed under the forearm and longitudinal traction applied to the thumb and fingers by the assistant.

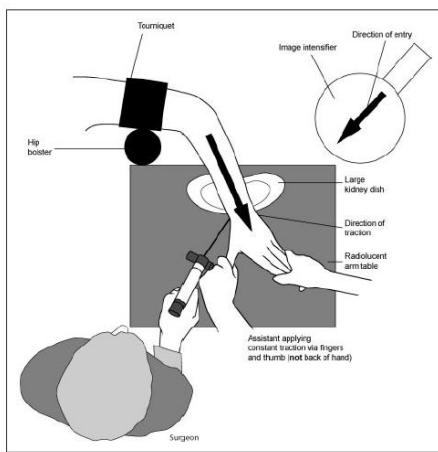


Figure 3: K-Wire Technique

Once adequate reduction was achieved, surgeon used anatomical landmark to insert the K-Wire instead of using C-arm. To internally fixate the radial fracture, the surgeon palpated the lateral styloid process of radius and moved the point medially at around 3 mm. The wire was inserted just posterior and medial to cephalic vein, in between the abductor pollicis longus and extensor pollicis brevis (Compartment 1). To fixate the ulnar fracture, the surgeon palpated the styloid process of ulna, moved the point laterally at around 3 mm.

The wire was inserted just in between the extensor carpi ulnaris (Compartment 6) and extensor digiti minimi (Compartment 5).

Intra operation, the infection seemed worse than before. Pus drained out from the open wound and increased the compartment pressure. Volar-incision-approach fasciotomy (Figure 4) was performed after installing the K-wire.



Figure 4: Fasciotomy Volar Incision Approach

As illustrated in figure 4, incision started radial to flexor carpi ulnaris at wrist and extends proximally to medial epicondyle. The surgeon opened lacertus fibrosus and fascia over flexor carpi ulnaris (FCU). Later, surgeon retracted the FCU ulnary and flexor digitorum superficialis (FDS) radially. The fascia was opened over the deep muscles of forearm. There was profuse pus that surgeon needed to massage the volar part of forearm. Fasciotomy was left unsuture and fixation dressing (adhesive skin closure) was applied until the wound heal by themselves.

3. Results

The patient tolerated the procedure well. After the operation, the patient was treated in Intensive Care Unit (ICU) for 3 days. The medications included cefoperazone injection 1 A/12 hours, metronidazole 500 mg/8 hours, pantoprazole 1 A/12 hours, ranitidin 1 A/12 hours, sliding scale insulin/ 4 hours, fentanyl 100 mcg/50 ml Normal Saline, vitamin C 500 mg/12 hours were given. The

patient was infused with NaCl 0.9% and Ringer Lactate (RL) and also received 1 kolf of packed red cell (PRC) with Dexamethasone and Dipenhydramin as premedication. With all management, patient was stable and had no medical complaint. The patient was then referred to the ward. Same medications were given. Additional management include insulin 8 U/ 24 hours and collaboration with physiotherapy and medical rehabilitation were provided at second day post-operation.

The rehabilitation principle for this patient was early mobilization. The rehabilitation goals including pain management and maintenance of muscle function (strengthening isometric exercise and ROM exercise). The strengthening isometric exercise included grip strengthening exercise: twice a day (twelve hours interval), ten seconds each set for grasp-and-release-movement, and was done for six to twelve sets with less then two minutes interval between each set. The ROM exercise included wrist flexion and extension, radial and ulnar deviation, metacarpal and phalanx flexion and extension, and elbow flexion and extension.

After the patient condition was stable, patient was permitted to go home. Was asked to do the program individually at home, the patient had to evaluate the rehabilitation program at first and second month post-operation.

At the first follow up session (Figure 5), patient had a complaint of movement difficulty at the wrist joint and fingers. The patient suffered from forearm contracture. Later, the orthopedic surgeon managed to do manipulation underanesthesia (MUA). Cefotaxime injection 1 g/12 hours, gentamicin injection 80 mg/12 hours, ketorolac injectin 30 mg/ 8 hours, vitamin C injection 500 mg/ 12 hours were given to support the MUA. In addition to it, the rehabilitation programs to restore forearm function include positioning, ROM exercise, stretching elbow and wrist, and isometric exercise to the forearm muscles.



Figure 5. Comparison between Right and Left Forearm

At the second follow up session (Figure 6), patient complaint was assessed with The Disabilities of The Arm, Shoulder, and Hand Score (Quick Dash) and goniometer assessment.



Figure 6. Comparison between Right and Left Forearm



Figure 7. Condition of Left Forearm

The Quick Dash score of this patient was 70.5 (Unable to work). In addition to it, goniometer assesment was done. The patient neutral condition was 20° wrist flexion and 10° phalanx flexion. The

maximum active ROM included 30° wrist flexion, 0° wrist extension, 0° radial deviation, 0° ulnar deviation, 10° metacarpal flexion, 0° metacarpal extension, 20° phalanx flexion, and 0° phalanx extension. In conclusion, ROM was limited because of the forearm contracture.

4. Discussion

Fracture of the distal radius and ulna is one of the most orthopedic injury with bimodal distribution due to either high or low energy trauma¹. The most common cause of distal radius fracture, as the mechanism of injury in this case, is a fall onto an outstretched arm². The patient condition was severe enough to cause an open fracture. Open fracture is a fracture with direct communication to the external environment.

In developing countries, for example in Indonesia, many patients prefer to go to traditional practice than to medical doctor. There were some reasons, according to the patient, behind this condition. First, there is still a perception about the expensive cost of going to the hospital. Second, the distance between the house and the hospital was too far. Third, the decision was relied on the extended family decision. Because not all traditional practician knows when to refer the patient to the doctor, this may cause a problem such as the one reported in this case report.

In this case, the seven days neglected open fracture causes deep infection. There are some factors influencing infection rates after open fractures of the radius and/or ulna²: the greater the grade of open fracture by Gustilo-Anderson the more likely patient to get a deep infection. According to some references, the delayed time of antibiotic administration contributed to the development of infection. In this case, the less barrier from outside body, absence of antibiotic administration at the first attempt, and the hyperglycemic condition of this patient contributed to the development of infection. This is supported by the evidence of increase infection in delay antibiotic initial treatment less than 3 hours^{4,7}. In addition this, in this case, there was a development of clostridial myonecrosis (gas

gangrene) due to anaerobic condition caused by retainment of non-viable tissue. The condition would likely have been prevented if early closure was done.

In managing patients with an acute open fracture, there are some basic principles in emergency room³ such as initial antibiotics and tetanus prophylaxis, control bleeding, assess soft-tissue damage and neurovascular examination, debridement, and stabilization. The more advanced management in operating room³ includes aggressive debridement and irrigation with saline, fracture stabilization, staged debridement and irrigation, wound closure, and antibiotic bead-pouch in open dirty wounds.

Due to the neglected fracture, late management of open fracture with infection need to be done as fast and careful as possible. Until recently, there are no references that clearly explain the exact management of neglected open fracture case with infection. One of the references stated that two important things to treat infections after fracture are early initial antibiotic and debridement and irrigation. Therefore, operation was done very carefully to do initial debridement and internal fixation. According to AAOS (2011), there are several techniques to treat forearm fractures such as open reduction and internal fixation (ORIF) with plate and screws, ORIF with rods, and external fixation. In this case, with irregular fracture line, the ideal procedure was to use external fixation at first attempt. However, the orthopedic surgeon used K-wire technique. The reason behind this condition was the insurance platform. It becomes one of the barrier especially in developing countries because the platform is not enough to imply the ideal procedure, in this case external fixation. In addition to it, the limitation of equipments also become one of the problem in developing countries. There was no complication during the installment of ORIF.

According to Orthobullet (2017)³, the antibiotic recommendation for grade II open fracture is first generation of Cephalosporin. In this case, medical team used third generation

Cephalosporin (Cefoperazone) in combination with Aminoglycoside (Gentamicin). The reason of combining Cefoperazone and Gentamicin was because of its synergistic effect combating broad-spectrum gram negative bacteria¹². To improve patient condition, fasciotomy was performed. The surgeon used standardized method according to Orthobullet (2017)¹¹ included ulnar volar incision, deep dissection, radial incision, and fascial released. The cause of the increase of intracompartment pressure was pus within the fascia. Fortunately, no intraoperative complication was found.

Some medications were used to improve patient condition and prevent complications. The antibiotic used in this case is explained in the previous paragraph. As explained in surgerysupplement.com (2012)¹³, the post-operative vitamin C administration was essential for the formation of new connective tissue in a healing wound. The important component in healing is collagen. It is consist of the amino acids lysine, proline, and glycine. Collagen forms the structure of the connective tissue. The enzymes critical to forming collagen cannot function without their co-factor, which is vitamin C. Beside that vitamin C is a powerful antioxidant and immune system modulator (enhance neutrophil migration and lymphocyte transformation)¹⁴. One study recommends 1-2 grams (1,000-2,000 mg) daily vitamin C supplementation¹⁴.

However, until the last of post-operative follow up, the patient suffered from contracture and sometimes had tingling sensation over the distribution of lateral cutaneous nerve of forearm and radial nerve of superficial branch. The complication happened eventhough rehabilitation program was conducted based on International Classification of Functioning, Disability, and Health (ICF) Model. The principles of contracture prevention are proper positioning, exercise, stretching, splinting/bracing, and early mobilization¹⁵. However, the program was patient-dependent. Therefore, reasons for the development of contracture include inadequate rehabilitation process because of the patient

dependency, uncontrolled program because the patient controlled in primary health center (PHC) that was lack of medical rehabilitation speciality, and the most important factor was severe wound condition at the time of admission.

In conclusion, there are some points that orthopedic surgeons can learn from this case. First, the cultural aspect of the patient may be take into consideration. Surgeons have to collaborate with any other health care providers including traditional bone setter. Basic training and regulation about different competencies must be provided by the Ministry of Health. Second, in this severely infected neglected open fracture, writer would like to give an idea that instead of amputating the forerarm, orthopedic surgeons are encourage to preserve it. It is because most of developing country patients, especially Indonesian people, never ready to be amputated. Third, in relation to choose the medical procedure, orthopedic surgeons need to be so creative that the most appropriate procedure not necessarily the most ideal one. The best procedure can be used among the other as long as it causes no harm to the patient. Fourth, in treating such complicated condition, orthopedic surgeons have to be aware about the complexity of the condition and have to prevent any further possible complications. It includes collaboration with other medical specilities. Fifth, the rehabilitation program becomes the most important yet the most difficult thing to do in such case. Therefore, rehabilitation program protocol need to be well-established and well-distributed even to PHC.

5. General Message

The management of neglected and infected open fracture remains challenging. However, maximum effort to save the infected limb has to be done. The K-wire technique is one treatment of choice and encouraging surgical option that can be used. However, the treatment and prevention of further complications become one of the most challenging part of this case.

Limitation

There are some limitations of this case report including lack of physical examination and score assessment standardization (pre and post operative) and lack of documentations (photo and video pre, intra, and post operative).

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