

VOLKMANN'S CONTRACTURE AS A COMPLICATION OF SUPRACONDYLAR FRACTURE OF HUMERUS IN CHILDREN — CASE REPORT

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Abstract: The patient T. K, 7 years old, had sustained a supracondylar fracture of the left elbow after the fall on the left hand with elbow extended. She was admitted in local hospital where the clinical examination and X ray were made and they confirmed the diagnosis of supracondylar fracture of the left elbow (Gartland Type III). She was treated with closed reduction (without anaesthesia) and cast immobilization for four weeks. With poor to no function of the left hand she was send to physical therapy for duration of 10 days, but she did not gain her functions of the left hand, almost all active movements of the left hand were impossible and the muscles of the left underarm were hypotonic. Due to loss of left hand function, EMG was made and the EMG result showed acute lesion of the nerves of left forearm caused by possible nerve compression (n. medianus, n. radialis and n. ulnaris). After four months she was admitted in University Clinic for Orthopaedic Surgery in Skopje where we perform operation of the left elbow, with removing callus formation in which we find entrapped median and ulnar nerves. We also have done osteotomy of the humerus for correction of the angular deformity and fixation with K wire. The patient was put in cast immobilisation after the surgery for four weeks. After the removal of the cast and K wire she was sent to intensive rehabilitation. One year after surgery she regains almost all of hand and elbow functions with satisfying range of motion. She is now able to fulfil every day function without any help or support.

Keywords: supracondylar fracture, ORIF, Volkmann's contracture, Gartland classification.

INTRODUCTION

A supracondylar fracture of the distal humerus is one of the most common fractures in children with up

to 60% of paediatric elbow fractures and it is often associated with the development of serious complications (1). It requires appropriate assessment and prompt orthopaedic care in order to prevent serious and long-term complications.

This fracture occurs most frequently in children between 5 and 10 years of age, which is the period of maximum ligamentous laxity (2). The boys have a higher incidence of this fracture than girls with left or no dominant side predomination. The mechanism of injury is a fall from a height with an outstretched arm in 70% of all the fractures. Strong action of the triceps muscle produces proximal displacement of the distal fragment. If patient falls on an outstretched supinated arm, the posteromedial periosteum is disrupted first and the fragment is displaced poster-laterally. If patient falls on pronated arm, the distal fragment is displaced posteromedial (3).

Medial displacement of the distal fragment places the radial nerve at risk (4, 5). Lateral displacement of the distal fragment places the median nerve and brachial artery at risk. Nerve injury occurs in at least 7-15% and significant vascular injury in 2% to 12% of cases. The median nerve with 52% and radial nerve with 32% are most frequently injured in the course of the injury (6). Most of injuries are neuropraxias (a contusion or stretch of the nerve) and spontaneously recover function in 2–3 months (7, 8).

Depending upon the displacement of the distal fragment of bone the supracondylar fractures are classified as an extension type (9), which is most common type (95%) of all supracondylar fractures with distal fragment displaced posteriorly and flexion type (5%) with distal fragment displaced anteriorly, relatively to the proximal segment. The most used classification in

practice is Gartland classification system (10), based upon the degree of displacement of the distal fragment (on the lateral x-ray). The Gartland type I is undisplaced fracture, Gartland type II is angulated fracture with intact posterior cortex and Gartland type III is displaced distal fragment posteriorly, no cortical contact divided into posteromedial or poster-lateral.

The most common clinical features are:

- Pain and inability to use the upper extremity after the fall

- Swelling around the elbow within a few hours

- Point tenderness over medial and lateral columns

- Anterior pucker sign or anterior bruising may be present, which occurs when brachialis has been penetrated by proximal fragment and it is a sign of considerable soft tissue damage.

Diagnostic protocol include: clinical examination, neurologic examination and vascular assessment which is essential and radiological examination. Baumann's angle which is formed by a line perpendicular to the axis of the humerus (11), and a line that goes through the physis of the capitellum must be measured. There is a wide range of normal for this value, and it can vary with rotation of the radiograph, but normal range is in between 64 and 81 degrees. Decreased angle is a sign of varus angulation which it is not obscured by elbow flexion or pronation. It is important to notice that the Baumann angle is not equal to the carrying angle of the elbow and any change in 5 degree will result in 2 degree change of clinical carrying angle.

The general management of the supracondylar fractures include:

- Closed reduction

- Traction method

- Surgery

- * CRPP (closed reduction and percutaneous pinning)

- * ORIF (open reduction and internal fixation)

Complication following this type of fixation include: immediate complications such as a neurological or vascular complications, early as compartment syndrome and Volkmann's ischemia and late as non-union or mal union (cubitus varus/cubitus valgus) (12), Volkmann's ischemic contracture, myositis ossificans, elbow stiffness, pin track infection.

So understanding the anatomy, radiographic findings, management options, and complications associated with this fracture, allow physicians to limit the morbidity associated with this relatively common paediatric injury.

CASE REPORT

The patient T. K, 7 years old, had sustained a supracondylar fracture of the left elbow after the fall on

the left hand with elbow extended. She was submitted in local hospital where the clinical examination and X-ray were made and they confirmed the diagnosis of supracondylar fracture of the left elbow (Gartland Type III) (Figure 1). She was treated with closed reduction (without anaesthesia) and cast immobilization (Figure 2). The 3rd day after immobilization she complained of swelling of the arm and the plaster was remodelled. Plaster was removed after 18 days. With poor to no function of the left hand she was sent to physical therapy for duration of 10 days, but she did not gain her functions of the left hand, almost all active movements of the left hand were impossible and the muscles of the left underarm were hypotonic. She also had angular deformity of the left elbow because of mal-union of the fracture. Due to loss of left hand function, EMG was made and the EMG result showed acute lesion of the nerves of left forearm caused by possible nerve compression (n. medianus, n. radialis and n. ulnaris). Extensor muscles of the left forearm were active only with electrical stimulation. In that condition, she was sub-



Figure 1. X-ray of supracondylar fracture-Gartland type III



Figure 2. X-ray after closed reposition and cast immobilisation

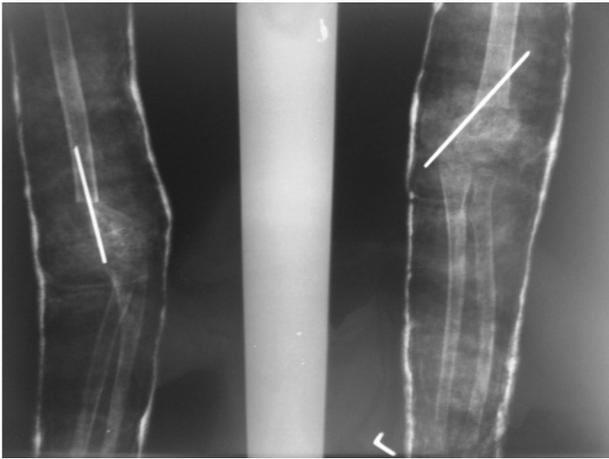


Figure 3. X ray after ORIF of the supracondylar fracture

mitted in University clinic for orthopaedic surgery in Skopje, four months after the fracture and previous treatment. Although with clinical presentation of a lot of complications, very bad EMG results and statistically poor chances of recovery due to poor results in clinical examination we perform operation. With anterior approach of cubital fossa, we removed callus formation in which we find entrapped median and ulnar nerves. We make a transposition of the nerves on more suitable position within safety muscle cover. The brachial artery was decompressed. We also have done osteotomy of the humerus for correction of the angular deformity and fixated it with K wire (Figure 3). After the operation a plaster cast was applied for four weeks. After cast removal, she was continued with intense physical therapy and exercise. One year after surgery she regains almost all of hand and elbow functions with satisfying range of motion. EMG result showed complete recovery of the median, radial and ulnar nerve. Range of motion of the elbow was 100 degree flexion, full extension, pronation 70 degree and supination 50 degree. Also function of the hand (pinch and grasp, opposition of the thumb with other fingers) completely recovered. She is now able to fulfil every day function without any help or support.

DISCUSSION AND CONCLUSION

Supracondylar fractures are one of the classical paediatric injuries with very high incidence. They should be treated with high vigilance mostly because they are associated with development of serious complication. For this reason detailed examination and diagnostic protocol should be always followed so exact and proper diagnose can be made. Also the treatment plan must be carefully made according to official recommendations and protocols so we can avoid development of iatrogenic complication and bad outcomes.

According to the X-rays our patient T. K., 7 years old girl, had Gartland type III fracture.

The AAOS recommendations about various type of fracture include: nonsurgical immobilization of the injured limb for patients with acute Gartland Type I or non-displaced paediatric supracondylar fractures of the humerus or posterior fat pad sign and closed reduction with pin fixation for patients with displaced Gartland Type II and III, and displaced flexion paediatric supracondylar fractures of the humerus.

After clinical assessment and diagnosis, the elbow should be splinted in a position of comfort (approximately 20°–30° of flexion) to provisionally stabilize the limb. Splinting in full elbow extension is contraindicated because it stretches the neurovascular bundle over the fracture site in displaced or unstable fractures. The application of a comfortable, well padded, and appropriately applied splint is a critical part of the initial management of these injuries, regardless of their definitive treatment.

Historically, a majority of these fractures were treated with closed reduction and long arm casting with the elbow in a position of greater than 100° of flexion. This flexed posture helped maintain the fracture reduction, but lead to problems with vascular complication and subsequent Volkmann's contracture. An injury of the brachial artery as the cause of the ischemia is leading to the flexion contracture of the hand at the wrist, resulting in a claw-like deformity of the hand and fingers. The most affected are flexor group of muscles of the forearm, especially m. flexor digitorum profundus and m. flexor pollicis longus which becomes fibrotic and short. After a closed reduction, percutaneous pinning maintains fracture reduction without the need for immobilizing the elbow in significant flexion and thus prevents obstructing the circulation of brachial artery (13).

Supracondylar fractures of the distal humerus that creates significant displacement, classified as Gartland Type III are particularly prone to neurovascular compromise so determining the integrity of the neurovascular structures should be a vital component of the physical exam. Vascular examination for presence of the radial and ulnar pulses must be performed at the wrist with palpation. If no pulse is present, then other signs of perfusion must be checked, as the colour of the hand, the warmth, and good capillary refill.

The radial, median, and ulnar nerves should each be tested for both motor and sensory function. Discrete sensory areas of the radial nerve should be checked -dorsal first web space, for median nerve -palmar index finger, for ulnar nerve -palmar little finger.

Finger, wrist, and thumb extension problems usually correlate with radial nerve injury, index, distal interphalangeal flexion and thumb interphalangeal flexion with anterior interosseus nerve and thenar strength

with median nerve injury. Also, passive finger extension and flexion should be tested and the findings should be accurately recorded. Entire limb should be evaluated for associated forearm fractures. Fractures with displacement treated by closed reduction and casting have a higher incidence of residual deformity than those managed with operative reduction and pinning (14). So after a careful clinical evaluation that finds no neurovascular injury, an operative fracture may be splinted and managed safely in a delayed fashion (within 24 h) while awaiting operative fracture reduction. An open reduction and internal fixation is indicated in cases where the fracture is irreducible by closed methods or if the brachial artery has been compromised and requires exploration. Also ORIF is indicated in open fractures. The should be performed emergently (< 8 hours) or urgently (< 24 h hours), or after swelling has decreased, but not later than 5 days after injury because the possibility of myositis ossificans apparently increases after that time (15, 16). Preoperative arterial insufficiency may be improved by operative reduction and pinning, in that a kinked brachial artery, draped over the distal end of the proximal fragment, may become patent after manipulative reduction of the fracture. Open supracondylar fractures warrant a surgical debridement of the fracture followed by stabilization.

While postoperative protocols vary from surgeon to surgeon, a typical regimen calls for a long arm, ulnar gut-

ter-type splint or a split long arm cast to control elbow motion and forearm rotation for 4 weeks, followed by pin removal and early range of motion or continued splinting for additional 1–2 weeks. If a stable closed reduction and pinning of the fracture is achieved by an experienced paediatric orthopaedic surgeon, follow-up may safely be delayed until the day of pin removal. However, if there is any uncertainty about fracture reduction or stability after pinning, the first follow-up visit should be within 7 days of surgery (17, 18). This early follow-up for unstable fractures allows for a repeat closed manipulation and pinning if there has been a loss of reduction.

The children with these fractures can have easy recovery and good prognosis only if we provide them with proper treatment and rehabilitation protocol, so they can quickly return to their normal activities.

Conflict of interest

The authors declare are no conflict of interest.

Abbreviations

EMG — Electromyography

CRPP — closed reduction and percutaneous pinning

ORIF — open reduction and internal fixation

AAOS — American Association of Orthopaedic Surgeon

Sažetak

VOLKMANOVA KONTRAKTURA KAO KOMPLIKACIJA SUPRAKONDILARNE FRAKTURE KOD DECE — PRIKAZ SLUČAJA

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Pacijentkinja T. K., stara sedam godina, zadobila je suprakondilarnu frakturu levog lakta posle pada na levu ruku, sa laktom u ekstenziji. Primljena je u lokalnu bolnicu gde su urađeni klinički pregled i radiografija leve ruke, i potvrđena je suprakondilarna fraktura levog lakta (Gartland Type III). Izvedena je zatvorena repozicija (bez anestezije) i imobilizacija gipsom u toku četiri nedelje. Posle toga, pacijentkinja je, gotovo bez ikakve funkcije leve šake, upućena na fizikalnu terapiju u trajanju od 10 dana, ali nije vraćena funkcija leve šake. Gotovo svi aktivni pokreti leve šake su bili nemogući i mišići leve podlaktice su bili hipotonični. Zbog gubitka funkcije leve ruke urađen je EMG koji je pokazao akutnu leziju nerava leve podlaktice nastalu najverovatnije zbog kompresije nerava (n. medianus, n. ul-

naris i n. radialis). Posle četiri meseca pacijentkinja je upućena na Univerzitetsku Kliniku za Ortopedsku hirurgiju u Skoplju gde je izvedena operacija levog lakta sa uklanjanjem kalusa u kojem su nađeni uklješteni n. medianus i n. ulnaris. Izvedena je i osteotomija humerusa radi korekcije angularnog deformiteta i fiksacija K žicom. Ruka je nakon hirurškog tretmana imobilisana gipsom tokom četiri nedelje. Nakon sklanjanja gipsa i K žice, pacijentkinja je upućena na intenzivnu fizikalnu rehabilitaciju. Nakon godinu dana povratila je gotovo u potpunosti funkciju lakta i leve ruke sa zadovoljavajućim opsegom pokreta. Danas je u mogućnosti da obavlja svakodnevne aktivnosti bez ikakve pomoći.

Cljučne reči: suprakondilarna fraktura, ORIF, Volkmanova kontraktura, Gartlandova klasifikacija.

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