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Emergency Room Treatment of the Hand

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Abtract: This article presents summary treatment of common hand problems seen in the emergency room. It is intended as an introduction for those new to the field, and as a review to practicing clinicians. It is not intended as a comprehensive guide to treatment of hand injuries and problems, but rather a brief review of their initial management in the emergency room. Topics include general treatment, lacerations, infections, compartment syndromes, crush injuries, fractures, dislocations, amputations, and replantation indications.

Introduction

Injuries to the hand are common. Approximately 30% of all emergency room injuries are to the upper extremity, amounting to 16 million hand injuries per year seen in the United States [1]. Fractures in the hand and wrist are the most common bony injuries seen in medical practice.

General

Appropriate treatment of any hand injury begins with a good history and physical examination. It is important to know the nature of the injury and other medical problems. Allergies and medicines must be concisely recorded. The treating orthopedic physician should obtain history of why the patient sustained the injury and ask careful questions about the patient's overall medical status. (Initial emergency room management of orthopedic problems can sometimes overlook major medical issues such as syncope, diabetic ketoacidosis, or other underlying medical problems which may take precedence over the orthopedic injury itself).

For hand injuries in particular, the type of device that created the injury, such as a clean or dirty knife, and the location of the injury, such as a clean kitchen cutting board versus a barnyard, are vitally important. The position of the hand at the time of the injury should be obtained if this is known; it can provide important information about damage to the underlying structures.

Examination of the involved limb must look for bony deformity, examine range of motion and tendon excursion for each of the digits, observe tenderness, and frequently a drawing of the injury is helpful for future reference in hand cases.

A good neurovascular exam is vital when looking at any extremity. Capillary refill and pulses need to be assessed. Sensibility of the fingertips can be determined by static and moving two-point discrimination. A simple paperclip can be used for this test, with 5 mm of static two-point discrimination as baseline normal. Subjective paresthesias should be documented, and active motor examination performed.

X-ray examination is usually required for significant hand injuries. Sufficient views to determine bony injury, air in the soft tissues, and of foreign bodies are important.

Glass generally shows on plain x-rays. This is true for all glass fragments, and not just those which are "leaded". The Annals of Emergency Medicine noted that with two views, 2-mm fragments of glass are seen 99% of the time, 1-mm fragments 80% of the time, and 0.5-mm fragments 65% of the time. These numbers were not significantly improved by four x-ray views [2].

Basic emergency room procedure requires that a tetanus injection be performed. Generally, tetanus toxoid is good for 10 years on a clean wound, and for five years on a dirty wound. Tetanus immune globulen should be given for dirty wounds greater than 24 hours old, and in patients who have had 0--1 previous immunizations [3].

Anesthesia

Anesthetic block is often required for emergency room treatment of hand injuries. Use plain Lidocaine without Epinephrine; one or two percent is appropriate. It is important in an emergency room setting for the physician administering the anesthesia block to check the actual anesthetic bottle so that no confusion with Epinephrine occurs.

There are three types of blocks generally used for hand problems: field blocks, digital blocks, and wrist blocks. Field blocks are simply injections into the area of a local wound to provide anesthesia for local cleansing and suture. Digital blocks are applied at the area of the web space and proximal phalanx to provide anesthesia for a specific finger. These are the most commonly used blocks for finger problems. There are several ways for applying digitals. The most common and useful method is through the web space from a dorsal to volar direction to administer anesthetic to each of the digital nerves, and then application of a dorsal injection. With these three needle sticks and approximately 5--10 cc of plain Lidocaine, a finger can be well anesthetized for 30--90 minutes.

Wrist blocks in the area of the ulnar nerve, median nerve, and radial sensory nerve can provide good anesthesia for the whole hand. These should generally be given by those familiar with the anatomy who have had some practice in the technique. It is unusual that anesthesia of the entire hand is necessary or warranted in the emergency room setting.

Splinting

The most common splinting technique for hand and wrist problems involves putting the hand in the safe or "beer can" position. This is useful, particularly for emergency personnel, and many patients with late night hand injuries will be immediately familiar with this position.

The intrinsic plus position is somewhat better, however, with the MP joints flexed to 90° and the IP joints of the fingers at 0°. This is usually accompanied with the wrist in 20°--30° of extension. This position is useful because it allows the metacarpal collateral ligaments to remain in a stretched position and the intrinsic small muscles of the hand in a contracted position, which will aid later therapy.

Beer can or Intrinsic Plus splinting is used for many hand problems such as lacerations, fractures, and dislocations. When extensor tendons are splinted, however, the 90° MP flexion is best adjusted to approximately 30°, and the wrist extension increased to approximately 40°.

A thumb spica splint is often useful for radial sided thumb and hand problems. Ulnar gutter splints are used for those issues on the ulnar side of the hand such as fractures of the ulnar metacarpals.

Tourniquets

Tourniquets are sometimes needed in emergency room settings for hand problems which involve significant bleeding. As with any general emergency bleeding case, pressure on the wound for an extended period of time is usually sufficient to stop even major arterial bleeding. In some instances, however, if the patient has a partially lacerated artery or is on anti-coagulants, this may not be the case. Blood pressure cuffs make good upper arm tourniquets, however, it must be noted that most patients can only tolerate up to 20 minutes of non-anesthetized tourniquet time. 250 mm. of mercury is the upper arm pressure necessary for most patients.

Finger tourniquets such as a tied Penrose drain can be very useful in dealing with digital problems, however, it is vitally important to remember to remove these tourniquets after a procedure has been completed. This author prefers to use a hemastat on a Penrose drain, if possible, which automatically facilitates tourniquet removal at the end of the procedure.

Exploration and Cultures

It is often tempting to hunt for glass fragments in the emergency room. This should generally be avoided, and only aspects of the wound which can be seen should be probed. Vessels should rarely be clamped in an emergency room setting, as this often leads to concomitant nerve injury.

Cultures in the emergency room must be done with care and precision. If a

deep wound is properly cultured, valuable information can be obtained, however, too often emergency cultures of hand problems result in skin culture rather than wound culture. Unless a culture can be taken under precise circumstances, it generally does not add valuable information to the treatment decision process.

Lacerations

Skin

Simple skin lacerations which are clean in nature and a few hours old can generally be treated with local field block cleaning, appropriate saline irrigation, and closure. Most open wounds should not be tightly closed in the emergency room, but rather closed loosely to allow egress of bleeding and sanguinous drainage. Old or dirty wounds are generally left open. Wounds which are contaminated or greater than 6--12 hours old are generally best left open. In situations such as this, skin should be tacked to cover nerves and tendons.

Extensor tendon

Extensor tendon lacerations which are simple in nature and involve a clean wound can be repaired in the emergency room. In general, one extensor tendon can be repaired in the ER, however, if the laceration is more complex, or involves multiple tendons, this is best done in the operating room. Extensor tendons can be repaired with simple or figure-8 sutures. Non-absorbable sutures such as Ethabond or absorbable suture (Vycril) can be utilized.

It is important to differentiate extensor tendon lacerations of the dorsum of the hand from lacerations of the juncturae Tendinum. Extensor hood lacerations at the MP joint can be complicated in nature, and may require intervention in the operating room. Clean extensor tendon lacerations can have the wound irrigated and the skin closed in the emergency room for operation in approximately 1--2 weeks.

It is important to question the patient thoroughly concerning any laceration around the MP joints of the fingers, and to have a high index of suspicion for a human bite wound even if this is not divulged in the history.

Open injuries to the dorsal PIP joint require special attention to the central slip. Extension splinting of the PIP joint with or without direct repair of the central slip is the best initial treatment.

Flexor tendon

Lacerations of the flexor tendons are generally repaired in the operating room. This can be achieved as a primary repair within approximately two weeks of an injury. Emergency treatment of flexor injuries involves a thorough examination to determine which tendons are lacerated and

assessment for concomitant injuries to digital nerves and vessels. The zone of injury should be recorded, as this has implications for the nature of operative intervention and prognosis. Flexor lacerations are cleaned, and the skin can be tacked closed with a local field block if required. Splinting is best done in the intrinsic plus-type position [4].

Nerve

Nerve lacerations are also usually repaired in the operating room. They do not need to be done urgently, but are best performed within two weeks of the injury. It is important to beware of concomitant vascular injuries to digital vessels [5].

Vessel

Pressure is used to stop bleeding in the hand and forearm, as well as in other areas of the body. True vascular compromise of a digit or limb beyond the area of vascular injury is a surgical emergency, and should be dealt with as such. Lacerations to large vessels are best explored in the operating room if this is needed. The deep and superficial palmar arches will often obviate the need for immediate emergency surgical repair of one of the single large forearm vessels. The nature of these arches can be variable within the population, however, and they cannot be taken for granted. Allen's testing for patency may be helpful in some circumstances to help with this determination.

Joint

Lacerations which penetrate a joint are treated with irrigation and appropriate closure on an urgent basis in the hand as they are elsewhere in the body. Again, one must have a high index of suspicion for human bite wounds around the MP joints. Small joint lacerations can often be irrigated in the emergency room and initially treated with IV/IM antibiotics, followed up with PO's. Splinting is usually required.

Bite Wounds

Bite wounds are commonly seen in the emergency room setting. Bite wounds should almost never be closed primarily, and are initially treated with irrigation and IV/IM antibiotics. Human bite wounds can be particularly challenging, and the pathogen often cited by authors is Eichanella. This is best covered by Penicillin, as is Pasteurella, which can be seen in cat and dog bites [6]. Fresh bite wounds may require hospital admission, depending on their severity. However, long standing bite wounds which have become infected generally require admission. Infected bite wounds are treated by splinting, IV antibiotics, and local wound care in the emergency room. Incision and drainage of deep infected bite wounds is usually best

accomplished in the operating room, but can occasionally be done in well equipped emergency room settings.

Infections

Minor infections

Infections of the nail area, termed paronychia, and pulp of the finger, which are called felons, are very common. These can generally be treated in the emergency room with local drainage and PO antibiotics. Felons are best approached from the lateral aspect of the pulp of the finger after appropriate digital block, and paronychia can be drained from a small incision around the nail bed. Oral antibiotics such as a broad spectrum cephalosporin should be prescribed for a short course.

It is important not to confuse herpetic whitlow with bacterial infections. Whitlow generally presents with multiple small lesions and can involve several digits. A history of employment in a field where exposure to human herpetic lesions around the mouth can be very helpful. Workers in dentistry, respiratory therapy, and food service are particularly prone to this type of problem. It is best treated with observation and supportive care as needed. Incision and drainage is contraindicated [7].

Cellulitis

Generalized soft tissue infection of the hand is a common problem. It presents as a generalized tender erythema and swelling of the fingers, hand, and wrist area. It is usually the sequelae of some type of open injury, though this insult is not always remembered by the patient. Cellulitis is best treated with admission, splinting, IV antibiotics, and elevation. It is important to differentiate between cellulitis and deeper infections in the hand, such as deep space abscess or purulent tenosynovitis. Cellulitic infections tend to be dorsal in nature, and they are not fluctulent. The choice of IV antibiotics can include cephalosporins or various Penicillin derivatives. Ancef and Penicillin-G used in combination can be very effective for most infections of the hand involving cellulitis or deeper structures.

Flexor tenosynovitis

Deep infection of the tendon sheath is a serious hand problem. It can involve one or multiple digits. Kanavel's four signs are still used as the hallmarks for flexor tendon infection. These include:

1. Finger held in slight flexion (no AROM).
2. Swelling along the tendon sheath.
3. Tenderness along the sheath.
4. Pain with passive stretch [8].

Infectious tenosynovitis generally has a history of penetrating trauma, and

staph aureus is the most common infectious agent. If infectious tenosynovitis is treated within 24--48 hours of its occurrence, admission, splinting, and IV antibiotics can be effective treatment. Beyond this time frame, urgent incision and drainage is recommended [9].

The index, long, and ring fingers are most commonly involved in flexor tenosynovitis. The thumb and little finger, however, can communicate when they are involved, and create a "horseshoe swelling" in the hand [10]. Rupture of tenosynovitis into Parona's space of the distal forearm is also possible. Special care should be taken with evaluation of immuno-compromised patients, because the external manifestations of deep purulent infection are not always present.

Deep space infections

Deep space infection of the hand involving the thenar (radial space) or the midpalmar (ulnar space) are becoming less common, but may occasionally be seen in the emergency room. The patient will usually present a history of deep puncture wound and significant swelling, along with erythema and deep pain. Deep space infection of the hand was regarded as a life threatening problem prior to the advent of antibiotics. It still requires admission, splinting, IV antibiotics, and urgent operative drainage [11].

Other

Established joint infections in the hand require urgent incision and drainage, as they do elsewhere in the body. This can sometimes be accomplished in the emergency room rather than the main operating room, if it is well equipped, and appropriate assistance, anesthesia, and sterile technique can be rendered.

Gangrenous infections occur in the hand occasionally and need emergent incision and drainage. A special type of strep infection called Meleney's digital infection presents as a rapidly advancing necrotizing fasciitis of the finger, and often requires amputation. Clostridia is often the causative organism for gas gangrene, and can be life threatening. Clinical examination and x-ray examination to look for gas in the soft tissues is, therefore, important [11].

Fungal infections are more indolent than those described above. Sporotrichosis, which can result from rosebush thorns, evolves over several days and often presents in the area of the PIP joint with reduced motion, swelling, and mild pain. Blastomycosis and many other types of fungus can infect the hand, and are regional in nature. Nonpurulent hand problems are treated with splinting, anti-inflammatory medication, and close office follow-up [12].

Tuberculosis infections of the hand, termed dactylitis, have been rare in the past, but are increasing, particularly in some inner-city populations. Other microbacterial infections, including microbacterial marennin and microbacterial lepri are also occasionally seen. In the case of the former, there is usually some exposure to a marine environment such as injury from

a fish bone or a sharp shell [13]. Microbacterial infection is definitively treated in the operating room; emergency care involves splinting and position of function with close office follow-up.

Nail Bed Injuries

Injury to the nail bed occurs with great frequency in both children and adults. A common nail bed injury involves subungual hematoma without destruction of the nail plate. Many authors recommend removal of the nail and exploration of the nail bed injury with repair if the hematoma exceeds 25% of the nail plate. Care must be taken in removal of the nail plate from the nail bed, however, and this should only be done if appropriate equipment such as a Freer elevator, sterile field, and fine chromic suture with small instruments are available [14].

Nail bed lacerations which are open in nature often involve fracture of the distal phalanx, which must also be treated. In adults, irrigation after digital block, reduction of the fracture and fine 6.0 chromic repair of the nail bed injury with replacement of the nail plate or substitute petroleum gauze is appropriate.

It is important to inform the patient about the possible consequences of nail bed injury. They should know that deformity can occur as a result of nail bed injury, even with anatomic repair.

Nail bed injuries in small children less than three years of age are common. This often results from a door being closed on the child's hand. These injuries must be treated carefully, because neurovascular compromise of small fingertips can occur with overly vigorous handling. Irrigation should be gentle, and these injuries should usually be treated in a summary fashion with crossed steri-strips after applying Benzocaine proximally. Gross reduction of the fingertip is performed, and the hand is then placed in sterile dressings and a long arm mitten cast. The mitten cast is allowed to remain in place for 1--2 weeks before removal and inspection of the patient's wound [15]. Small children have great capacity to remodel and heal soft tissue injuries, and even greater capacity to remove short arm dressings.

Burns

First degree burns involving reddening of the skin can generally be treated symptomatically with anti-inflam-matory medication and topical ointments. Second degree burns which involve blistering are best emergently treated with splinting and application of Silvadene cream. Anti-inflammatory medication can be helpful [16]. Third degree burns in the hand are often localized in nature and can be treated with cleansing of the wound and splinting in the position of function. If the burn involves a large area, admission to the hospital after cleaning and splinting may be appropriate. Compartment syndrome can occur within the hand or forearm, thus frequent neurovascular examinations are required evaluation of other injuries [17]. Fourth degree burns to the level of bone generally require operative intervention on an urgent basis. These type of injuries often require amputation and late operative reconstruction. With these, and all burn

wounds, tetanus should be administered as appropriate and antibiotics should be a useful early adjunct.

Chemical burns

These injuries usually result from industrial exposures. Initial treatment of acid or lye injuries involves irrigation with copious amounts of water. Hydrofluoric acid burns can be treated with calcium gluconate paste or 10% calcium gluconate injection. White phosphorous burns are treated with 1% copper sulfate [6].

Electrical burns

Electrical injury is proportional to the current applied. Most patients will present both entrance and exit wounds. Patients with significant electrical shock must be treated by a multi-disciplinary team of physicians because of the potential cardiac arrhythmias and rabdomyalysis with resultant renal damage. Orthopedically, one must be aware of compartment syndromes which may develop over time. Most significant electrical shock patients, therefore, need admission to the hospital. Electrical burns should be treated with initial wound care, splinting, and compartment measurements if needed. Compartment syndromes can develop in these patients over time, requiring hospital admission [18].

High Pressure Injection Injuries

Injection injuries at greater than 7,000 lbs. per square inch have been shown to result in 100% amputations in studies by Gelberman. Paint injection frequently results in necrosis of tissue. Grease injection can result in fibrosis. Injection injuries are usually present with a small entrance wound, and require urgent debridement. Despite the initial benign appearance of these injuries, they must be taken very seriously, and often result in amputation [19].

Frostbite

Frostbite in the hand is often accompanied by overall patient hypothermia. Initial management must involve restoring the core temperature of the individual involved. Thawing of the hand in a 40° water bath is recommended [20]. Frostbite is then treated with analgesics and loose dressings. Administration of a tetanus shot must be remembered. Anticoagulation and sympathectomy are not currently recommended in frostbite injury. The extent of frostbite necrosis is not often known at the time of injury, and should be deferred until the patient's fingers or hand area declares itself.

Compartment Syndromes

Compartment syndromes can occur in the forearm, hand, and in the fingers. They are often a result of blunt trauma such as a crush injury, but can be caused by sharp wounds. Etiologies include fracture, compression, burning, and post ischemic swelling. Compartment syndromes are diagnosed clinically. They involve tense compartments, pain with passive stretch, pain at rest, and little or no active range of motion. Other neurovascular symptoms, such as numbness or pallor distally, are unreliable. Compartment pressure measurements should be made if the clinical diagnosis is suspected.

Different authors have cited different pressure measurements for absolute pressure in the compartment [21--23], and recently work done at the University of Pennsylvania has focused on the difference in pressure between mean arterial blood pressure [(2× diastolic + systolic)/2], and compartment pressure. As a general rule of thumb, this author considers 40 mm of mercury as a good figure to remember either for absolute compartment measurement or DeltaP as described above. In other words, an absolute compartment pressure measurement of 40 mm of mercury or greater, should be considered for fasciotomy and a DeltaP of 40 mm of mercury or less should be considered for compartment release. It is important to remember that compartment syndromes can occur in the hand, and although they are uncommon, they can also occur in the digits when there has been significant crush injury. Because of the potential major sequelae involved, this type of injury should always be treated with suspicion and error on the side of caution.

Crush Injuries

Crush injuries as noted above can result in compartment syndrome, and can be major or minor in nature. Even without significant fractures, major crush injuries should be treated with great care, and error again should be on the side of admission and observation with neurovascular checks.

Closed Tendon Ruptures

Closed tendon ruptures are generally the result of trauma or attrition. They often present to the surgeon first in the office, but are sometimes seen first in the emergency room. This is true of injuries such as mallet finger (extensor tendon rupture at the DIP joint of the fingers). This type of injury is generally best treated with extension splinting of the DIP joint and close clinical follow-up in the office, particularly if there are bony avulsion fragments.

Jersey finger (FDP avulsion distally) is best treated with initial emergency room splinting and early return to the office for flexor tendon repair within two weeks.

Rupture of the central slip at the PIP joint is of particular importance in emergency room care. This injury is often missed, and can result in late boutonniere deformity, with severe restriction in finger motion and function.

Any PIP joint injury should be tested thoroughly for discomfort dorsally and splinted in extension at the PIP joint only if a central slip rupture is suspected.

Patients with rheumatoid arthritis sustain closed rupture of tendons frequently and sometimes present to the emergency room with this problem. It is best initially splinted in a position of function with instructions to follow-up for appropriate operative reconstruction.

Gunshot Wounds

The energy of a gunshot wound is proportional to mass of the projectile × velocity squared. This means that velocity is the primary factor which determines damage by a given projectile. Fortunately, most civilian gunshot injuries are by pistols of low velocity nature. These injuries can be treated directly, similar to a closed fracture, with appropriate treatment for nerve, tendon, and vascular injury per the direct trauma to these structures. In the hand because there is relatively less soft tissue than in the more proximal aspect of the limbs, gunshot wounds more often require immediate debridement and treatment. The hand also has a greater number of small joints which can be involved in these type of injuries. A low velocity gunshot wound to the humerus, for example, can often be treated as a closed injury; however, a gunshot wound to the metacarpals or phalanges often leaves exposed bone and tendon which require more immediate attention.

High velocity gunshot wounds are the result of rifle injuries or close range shotgun blasts. This type of injury causes a wound shock cavity, with damage well beyond the direct path of the bullet. In most cases, high velocity gunshot wounds require immediate operative debridement and often result in amputation [24].

Fractures

Hand fractures can be open or closed. Open fractures in the hand require adequate irrigation, as they do anywhere else in the body. However, this can often be accomplished in the emergency room, depending on the quality of the emergency room staff and the nature of the wound. Distal tuft fractures are often open, and require adequate irrigation; loose skin closure is appropriate.

Fractures of the distal phalanx should be considered separate from simple tuft fractures. This injury often involves laceration to the nail bed, which should be repaired, and at times reduction of distal phalanx fracture is necessary. If the fracture is open, it should be thoroughly irrigated, though care must be taken that this is not over-vigorous in situations where vascular compromise can occur. These fractures should be splinted and return for appropriate care within a few days.

Phalanx fractures in the fingers and thumb require appropriate splinting and reduction if necessary. Digital block is useful. These fractures are often unstable, or can involve the articular surface. After splinting in the emergency room, these patients should be instructed to follow-up closely

within a few days for possible surgical intervention, if necessary.

Distal metacarpal fractures such as the so-called boxer's fracture of the 5th metacarpal, are commonly seen in the emergency room. As with phalanx fractures, the most important component of reduction is rotational, and this should usually be done in the emergency room. Angulation of distal 5th metacarpal fractures is somewhat controversial, but most authors now recommend that angulation is not of great importance, whereas early range of motion is. Therefore, emergency attempts at anatomic reduction of distal 5th metacarpal fracture are probably unwarranted, and these should be splinted in situ with early office follow-up. Note that displaced metacarpal fractures in the index and long fingers will often require reduction and fixation.

Fractures of the shaft of the metacarpal bones tend to have significant dorsal hand swelling and tenderness. Fractures of the long and ring metacarpals are usually stable, as they are tethered by adjacent bones. In general, metacarpal fractures should be splinted in intrinsic plus position, with instructions to return for office follow-up. Rotation is also a factor in metacarpal shaft fractures [25].

Fractures of the carpal bones can be difficult to see on x-ray, and a good physical examination is the best indication of problems in the carpus. Some fractures, such as those of the scaphoid, are classically seen with snuff box tenderness, however, not all carpal bone fractures are immediately apparent. If examination shows significant tenderness in the wrist, a splint should be applied, with instructions to follow-up for further examination.

Fractures of the thumb can involve avulsions or intra-articular injuries. Most thumb fractures are serious injuries, and patients should be treated with a thumb spica splint and instructed to follow-up for appropriate definitive care within a few days of the injury. Articular injuries such as Bennett's fractures or ulnar collateral ligament avulsions require particularly close follow-up.

Fractures of the distal radius are one of the most common injuries seen in the emergency room. If this type of fracture is minimally displaced, a simple splint in situ is often sufficient initial management. When the fracture is displaced, however, a closed reduction should be considered with the use of finger traps and placement of a coaptation splint on both sides of the wrist. Hematoma block is often successfully used for this type of injury. As with other fractures requiring reduction, close follow-up is necessary to check on the state of the fracture.

Dislocations

Dislocations of the distal phalangeal joint and the thumb IP joint are rare as an isolated injury. They are usually associated with tendon avulsions and open wounds, and their treatments are incidental to the wound issues. When these are isolated injuries, closed reduction and splinting for 10--12 days is appropriate. Note the volar plate or flexor tendon can be trapped in this type of dislocation, requiring operative intervention [26].

Proximal interphalangeal joint dislocations are very common. They mainly occur in a distal dorsal direction, and require initial appropriate x-rays and neurovascular examination. A digital block can be used for reduction, though

this author prefers direct reduction without anesthesia using longitudinal traction in a rapid, but controlled, manner. Splinting in 20°--30° of flexion is then appropriate.

Rotary dislocations of the PIP joint can occur. This often involves inner position of the lateral band, making this difficult or impossible to reduce in a closed fashion. This type of injury often requires operative intervention, but can have a good result if recognized early and appropriately treated. When a fracture is present with PIP joint dislocation, the injury often requires operative intervention, or at least ex-tension block splinting, and follow-up should be as soon as possible after the emergency room visit [27,28].

Buddy taping adjacent fingers can be performed after PIP joint dislocations as a form of a moving splint. If the PIP joint is grossly stable status post reduction, this can be a very useful method for regaining early motion.

Metacarpal phalangeal dislocations can occur in a simple fashion, or be complex. Simple dislocations often look worse, but can be reduced by hyperextension and treated with splinting in approximately 60° of flexion. Complex dislocations sometimes appear less deformed, but often involve inter-position of the volar plate. A dimple in the volar skin or interposed sesamoid bones on the x-rays are indications that this type of dislocation has occurred. Initial management of complex dislocation can involve a straightforward attempt at reduction, however, if this does not succeed, this type of injury is best brought to the operating room for open reduction [29].

A special type of dislocation seen at the metacarpal phalangeal joint occurs at the thumb. This so-called gamekeeper's or skier's thumb involves rupture of the ulnar collateral ligament as a result of distal stress in a radial direction. This injury is commonly seen in the emergency room setting. It should be treated with a thumb spica splint and instructions for early follow-up. This type of injury may require surgical intervention in the face of significant instability or a "Stener lesion", which involves displacement of the ruptured ulnar collateral ligament over the aponeurosis of the adductor [30].

Carpal metacarpal joint dislocations are uncommon alone, and usually occur with significant fractures. Oblique x-rays are useful in evaluating this problem. This type of injury is usually unstable, and requires operative intervention for reduction and internal fixation. Closed reduction in the emergency room could be attempted with hematoma block and placement in intrinsic plus volar splint, however, the chances of achieving or maintaining reduction are limited in the opinion of this author.

Small dislocation of the carpal bones is not uncommon, but is often missed in the emergency room setting. Scapholunate dissociation is one of the more common carpal dislocations which can be subtle on initial x-rays and require multiple or special views. A clenched fist view in radial or ulnar deviation and comparison views are often helpful. In general, if a carpal dissociation is suspected, the patient should be placed in an appropriate splint and return for early follow-up.

More serious dislocations in the carpus are generally seen around the lunate bone. So called peri-lunate dislocations involve dislocation of the carpal bones in a dorsal direction while the lunate remains with the radius. By the time this injury is seen in the emergency room, the carpus has often relocated, pushing the lunate down in a volar direction, with the appearance that the lunate itself has dislocated initially. This type of injury can be

associated with various fractures of the carpal bone, such as scaphoid fracture or fracture of the triquetrum or capitate. These are very serious injuries, and this needs to be expressed to the patient so that they understand the nature of the problem. Closed reduction of peri-lunate fracture dislocation can be performed using finger trap traction and appropriate reduction technique. However, this is an extremely difficult prospect, and this type of injury usually requires operative intervention as well as internal fixation. Neurovascular status should be checked carefully at the time of emergency room presentation, and a low threshold for hospital admission should be maintained [31].

Radiocarpal dislocations and dislocations of the radial ulnar joint are often part of a greater injury complex, and the result of major forced impact. These type of injuries will almost always be treated operatively, though closed reduction in the initial trauma setting may be helpful to maintain neurovascular status.

Open Wounds

Open wounds can be classified generally as being tidy or untidy. Tidy wounds involve sharp clean edges which can often be cleaned and closed primarily. Untidy wounds are those that involve crushed, avulsed, burned or mangled parts. These wounds are often dirty and contaminated. In general, large untidy wounds require operative debridement and hospital admission. Many tidy wounds, on the other hand, can be dealt with in the emergency room, and discharged with instruction for follow-up [32].

Mutilating Injuries

The role of the emergency room in very severe injuries to the hand is to prepare the patient for the operating room. Despite the appearance of a patient's wounds and the usual difficult emotional state, the basics of emergency care must be remembered. A good general history and examination is important. Allergies and medications must be recorded, and tetanus and initial IV antibiotics can be started. The history of previous injury to the involved extremity or disease process such as diabetes or vascular disease and smoking history, are vitally important to obtain prior to operative intervention

Amputations

Amputation of the fingertip is a common occurrence. As many opinions regarding this subject exist as there are authors to discuss it. The recent trend has been toward allowing fingertip amputations to granulate and heal primarily versus skin grafting or complex procedures.

Most authors agree that wounds less than 1 cm in area should be allowed to granulate primarily. Larger wounds can be treated with full thickness skin grafting, primary closure or local flaps. In the opinion of this author, primary

closure is usually possible in the emergency room setting, though any bone which is prominent in the area of the fingertip should be cut back with a small ronguer. The decision to apply skin graft or local flaps to a fingertip amputation depends on the nature of the wound itself. These should usually be done in the operating room procedures

In small children, and occasionally adults, a composite graft technique can be used. This involves cleaning the wound and amputated tip, and then simply re-attaching the tip to the finger stump with skin sutures. Although this may appear unlikely at first glance, this author has seen remarkable "take" with this type of procedure, even in selected adults.

Large oblique amputations of the fingertip will often require flap surgery from adjacent digits or the thenar eminence. In these instances, emergency room management would involve appropriate cleaning, dressing and splinting a wound in preparation for eventual definitive surgery.

Amputations of the thumb tip can be treated with any of the preceding techniques. In the case of the thumb, however, preservation of length is vitally important so that it can act as an appropriate post in prehensile grip. Most thumb flap surgery is best done in the operating room [33].

Avulsion Injuries

Avulsion injuries are a special type of amputation involving de-gloving of skin and soft tissues away from the bony structures. These type of injuries can be difficult to assess, but should not be taken lightly. This is particularly true of ring avulsions, which can present to the untrained eye as minor injuries, but result in very significant loss.

Ring avulsions are separated into three categories. Class 1 has the circulation intact. Class 2 has inadequate circulation, but is a candidate for microvascular surgery and Class 3 involves complete de-gloving, which is best treated with revision of amputation in the operating room. The distinction between these three classes of injuries is sometimes difficult to make initially, and like crush injuries, should be treated with caution.

Replantation

Replantation of amputated parts is not an emergency room procedure, however, the initial patient contact is made in the emergency room. Assessment for replantation, handling of amputated parts, and discussion of patient expectations often is done in the emergency room.

It is the opinion of this author that for the vast majority of the population in the vast majority of cases, a simple amputation is, by far, the best treatment. Selection for replantation is vitally important if a reasonable functional result is to be obtained. At tertiary care medical centers, patients with amputated parts are often sent for potential replantation. It is important for the accepting physician to clearly define the situation for both the referring doctor, as well as the patient and family. No commitment should be made to replantation until the patient and parts are actually seen

by the accepting replant service. The patient and family should be advised of non-replant options, the possibility for failure, the need for vein graft or nerve graft, prolonged hospital stay, and the possibility of subsequent procedures. In the case of micro-replantation such as fingers with little muscle bulk in the parts, the speed of replantation is of relatively less significance, and the microsurgical skill of the replant team is of greater importance. When replantation involves larger parts, at the level of the hand or above with significant muscle bulk in the amputated part, speed is more important, and because of the increasing caliber of vessel size, microsurgical skill becomes relatively less important. Warm and cold ischemia time which an amputated part can tolerate prior to replantation depends on these issues. A finger, for example, which is properly stored in a cool clean environment, can sometimes be replanted 24 hours or more after it has been amputated. Larger parts such as hands and forearms are another matter. Warm ischemic time for larger parts cannot be greater than 6 hours, and cold ischemic time should not exceed 12 hours. This is both because of tissue necrosis in the amputated part and the affect this necrosis can have on the body if the replantation is completed [6].

Indications for replantation include any part in a child, thumb amputation, multiple digit amputations, single digits amputated distal to the FDS tendon, and amputations at the level of the hand or higher [6]. Strong contraindications for replantation include significant other injuries, patients with severe underlying diseases, multiple level amputations, and mentally unstable patients [6,34]. Relative contraindications for replantation include amputation of a single digit, amputations proximal to the FDS tendon insertion, any avulsion or de-gloving injury, and extreme contamination. Other relative contraindications are age beyond 60 years, severely crushed parts, or previous injury or surgery to the amputated part [6,34,35].

Amputated parts must be handled appropriately to facilitate possible re-implantation. They should be wrapped in saline gauze and placed in a plastic bag or container, which should then be placed on top of a bed of ice. Amputated parts should not be immersed directly into iced water or iced saline [6,7].

Summary

The preceding article is intended as an initial summary guide to hand problems commonly seen in the emergency room. It is not a comprehensive review of hand injuries, and is intended mainly for those who are new to the field as a quick overview. As with any aspect of medicine, the emergency care of hand injuries is an evolving process which can only be viewed from the art of medical practice. Addressing patient's fears and questions concerning their emergency hand issues in a straightforward but compassionate manner is at least as important as the technical details discussed above.

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