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Case report

Mangled right hand: A case report

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ABSTRACT

Introduction: The mangled hand is a complex and uncommon injury of the upper extremity. It involves injury to multiple structures i.e., bone, soft tissue, and neurovascular bundles of the hand leading to loss of function and viability. These injuries are usually caused due to trauma from high-energy equipment.
Presentation of case: A 32-year female presented with a crush injury to her right hand by a grass-cutting machine. The right hand was de-vascularised with injury to both radial and ulnar arteries. She had multiple lacerations, fractures of the distal radius and ulna, and multiple fractures of the metacarpals and phalanges. An initial revascularization procedure with a vein graft was done in the ulnar artery, joints were stabilized, and planned for reconstructive surgery at a later date.
Discussion: Initial evaluation includes a decision to salvage or amputate the limb. Early intervention to restore vascularity is key to salvaging a mangled hand. This should be followed by a multidisciplinary team approach. Preference is given to reconstruction procedures rather than amputation and prosthesis procedures.
Conclusion: Early intervention, a multispecialty approach, and staged procedures are required for the successful management of a mangled hand. Eventually, physiotherapy has a key role in the restoration of function.

1. Introduction

Hand and wrist injuries are one of the major causes of functional disability worldwide. Among hand and wrist injuries, a mangled hand is a relatively uncommon emergency presentation. A mangled hand indicates an injury to multiple structures of the hand, jeopardizing its function and viability. It may include bone, soft tissue, and neurovascular injury [1]. It is usually due to high-energy trauma such as agricultural, mechanical, blast injury, or road traffic accidents.

Early management of hand injury is necessary as the extent of tissue damage is progressive and often greater than the initial injury if the management is not instituted in time. The duration of injury, mechanism of injury, and patient's co-morbidities help in formulating the management plan. Every mangled hand case is different and management plans should be individualized. The goals of treatment include: thorough debridement, restoration of vascularity, bone stabilization, soft tissue reconstruction (tendons and nerves), and coverage with well-vascularized tissue [2]. This case has been reported in line with the SCARE 2020 criteria [3].

2. Presentation of case

A 32-year female presented to the Emergency department with an alleged history of an accidental crush injury to her right hand by a grass-cutting machine. She had a dominant right hand, didn't smoke or consume alcohol, and had no co-morbidities. She arrived at nine hours of injury without any first-aid treatment. The primary survey revealed a patent airway with a respiratory rate of 22 breaths per minutes and oxygen saturation maintained in room air. Blood pressure was 90/50 mm Hg; pulse rate was 118 beats per minute. Her Glasgow Coma Scale (GCS) was 15/15; with round, regular, reactive pupils.

On local examination, there was a 5 cm × 3 cm lacerated wound over the volar aspect of the right distal wrist, an open fracture of the right distal radius and ulna, and multiple segmental lacerations of the right palm and digits. The proximal-most injury was 1 cm proximal to the proximal wrist crease. Intervening tissue bridges did not demonstrate any capillary refill. Flexor tendons were transected at multiple levels. Thumb was floating and there were multiple fractures of metatarsals and phalanges. Active bleeding from ulnar artery was present at the level of proximal wrist crease. The right upper extremity was de-vascularized distal to injury site with loss motor and sensory functions (Fig. 1).

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Fig. 1. Patients' hand on arrival at emergency.

The patient was resuscitated with normal saline and pain medications. The bleeding from the ulnar artery was controlled with compression dressing at the Emergency department. A standard X-ray showed a fracture of the distal radius and ulna, with dislocation of the carpometacarpal joint of the thumb (Fig. 2). The patient was immediately shifted to the operating room. The per-operative findings were open fracture of distal radius and ulna, radio-ulnar and carpometacarpal joint dislocation of thumb, and transection of all six flexor tendons. Ulnar and radial arteries were both transected, and median and ulnar nerves were also transected.

Debridement was done and the patient underwent a revascularization procedure. About a four-centimeter segment of the ulnar artery was absent for which interpositional vein graft was done (using a cephalic vein). The wrist joint was stabilized with three percutaneous k wires. The radial artery was transected and the remaining stump was sutured. Post-procedure capillary refill was established in all fingers including the thumb.

On the eighth post-operative day, the orthopedic team did the fixation of the carpo-metacarpal joint, distal radio-ulnar joint, and wrist immobilization with external fixation. The patient was discharged on the post-operative day 12 of initial surgery, with the aim of performing soft tissue reconstruction on a later date. She presented one month later, with pus discharge from her wound along with loss of skin over dorsal aspect of base of thumb. She was admitted, the wound was debrided and the defect was resurfaced with thoracoabdominal flap (Fig. 3). The thoracoabdominal flap was detached after three weeks.

The patient underwent physiotherapy for one year. During the latest visit she had intrinsic minus hand position. Protective sensation of hand was present. Patient was able to make use of hand for some gross activity like carrying a bag by hooking it. There was some dorsiflexion of fingers. Surgical plan involved claw correction, restoration of flexion cascade of fingers using Zancolli lasso procedure so that a more functional position of hand could be achieved. Subsequently, the procedure was performed and the patient was discharged (Fig. 4). The initial emergency surgery was performed by experienced consultant plastic surgeon; the subsequent procedures were performed by head of plastic surgery department and assisted by the consultant plastic surgeons.

3. Discussion

A Mangled hand is defined as a complex injury of the hand that involves multiple structures including muscle, bone, skin, and neurovascular structures. These injuries are usually caused by high-energy forces that result in avulsion, crushing, or laceration [1]. A thorough history taking is important. It should include the mechanism of injury, time of injury, and circumstances. The mechanism of injury helps to determine the extent of destruction and hence the determination of management plans. The injuries that are clean cut and distally located have good prognosis than those located proximally and involve crushing, torsion or traction [4].

The management of mangled hands requires a multidisciplinary approach. The aim of emergency management is to control the bleeding while preventing the ischemia of the affected part. This can be done with limb elevation or by directly pressing the bleeding site. Application of a tourniquet should be a last resort to control the bleeding and if applied, it should be removed as soon as possible [1]. It is difficult to quantify the extent of injuries immediately after the trauma which makes it hard for decision-making. Undertreatment leads to functional disability and overzealous surgeries may lead to increase morbidity and dysfunction of the hand. Hence it is very important to optimize the treatment.

At the time of initial evaluation, it is difficult to identify salvageable limbs from unsalvageable ones. There has been the use of scoring systems to aid in decision-making. Mangled extremity severity score (MESS) has been designed to decide on amputation of the lower limb for severe injuries; with the score being seven or higher as an indication for

Fig. 2. initial X-ray of the patients' hand.

Fig. 3. After thoracoabdominal flap closure of base of thumb defect.

Fig. 4. Lasso procedure.

amputation. Unlike the lower limb, the upper limb does not have a scoring system to choose between amputation or repair procedures. However, MESS is used in upper extremity cases without proper validation [5]. Due to recent advances in the treatment, the diagnostic accuracy of MESS for the need of amputation has decreased [6]. Furthermore, the management of such injuries should not be solely based on these scoring systems as they provide only general guidelines for treatment.

The goal of the index surgery includes removal of the dead tissues and debris, identification of structures, bony stabilization, and restoration of vascularity. Unlike in lower limb trauma where prosthesis can sometimes give a superior result when compared to limb salvage, we believe that utmost effort should be given to salvage an upper extremity. Certain priorities need to be set during the mangled hand reconstruction. The surgeons should try to preserve the thumb preferably up to the interphalangeal joint and at least one or two fingers needed for pinch with the thumb. The reconstructed hand should have good and durable soft tissue coverage along with preserved sensation [7].

The outcome of the reconstruction depends on various factors. Early or immediate reconstruction tends to give better results compared to late reconstruction [2]. There is a role of early and planned rehabilitation in gaining better results. With an increased understanding of human physiology, new fixation devices, and microsurgical techniques the outcome of the reconstruction has improved [4]. The results comparing the replantation versus amputation and prosthesis show that the replantation produces a superior functional result [8]. Overall, the patients': age, comorbidities, motivation and psychological makeup, and adherence to the treatment are key factors that determine the outcome [7].

4. Conclusion

We present a successful management of a mangled hand with a delayed presentation. Early intervention with restoration of vascular anastomosis has key role to prevent the damage. Further management with staged reconstruction and early rehabilitation can restore the structure and the function of the hand. We believe that a salvaged upper extremity provides better cosmesis and function on most occasions than a prosthesis unlike in lower limb where prosthesis can sometimes give a superior result.

Abbreviations

MESS	mangled extremity scoring
GCS	Glasgow coma scale
POD	post-operative day

Ethical approval

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Author contribution

Dr. Pratima Gautam: Data collection, Drafting of manuscript, Review & editing.

Dr. Sagar Gyawali: Conception and design, data collection, drafting of manuscript, and final approval of the version to be published.

Dr. Prakash Mainali: Involved in drafting of manuscript, Writing - Review & editing.

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Consent

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

Guarantor

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N/A.

Declaration of competing interest

The authors state that there is no conflict of interest.

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