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Case Report

Replantation of an Amputated Hand- A Landmark surgery with Multidisciplinary Team Approach

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Abstract:

An amputation of the hand is a disastrous traumatic injury especially for advanced machinery workers which adversely affects the victim's ability to earn a livelihood, support a family, and carry out daily activities. It also produces great psychological impact. In the following case report, we described a middle-aged male with an amputation at the level of the distal forearm who underwent replantation. The transfer of the amputated hand, operative technique and postoperative status are described. Awareness of the possibility of salvage should be spread among healthcare providers and the need for immediate attention by a multispecialty team is advocated. This report reviews the literature related to the operative technique, contraindications and long-term results.

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Introduction:

Hand plays the most influencing impact on self-perception and self-identity along with professional and social life.[1] Though wrist amputation is not as critical as life-threatening event, it can cause tremendous functional problems and psychological upset which ultimately leads to distortion of personal and professional life.[2] In accordance with significant technological advances in reconstructive techniques and instruments, the first successful hand replantation was performed by Chen in 1964.[3] Many successful replantation of complete and incomplete limb macro-amputations have been reported by numerous authors around the world but this publication is the first in such field from Bangladesh.[4] Replantation is defined as the reattachment of a completely severed body part. Clinical experience, appropriate microsurgical equipment and a well-trained multidisciplinary team are all essential for optimal outcome. The aim of replantation is to retain a reattached part which gives a superior functional outcome compared with prosthesis.

Case Report:

A 36 years old male, Indian citizen working as a crane operator at a power plant in Bangladesh sustained a trauma to his left hand by another crane resulting in amputation of left hand from the distal forearm.

Fig.-1: *Amputated hand.*

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Then he rushed to nearby medical center and cut end of his forearm was bandaged meanwhile his colleagues collected the amputated wrist from the accident site and put into a plastic bag submerged into normal saline and ice cold water (Fig-1). The patient reached to our hospital with his amputated wrist within three hours of incidence. He was fully oriented and conscious, little anxious with stable hemodynamic status.

The amputated hand was brought in a polythene bag placed inside a plastic box filled with ice. The amputated hand was cleaned properly with normal saline, povidone iodine, chlorhexidine gluconate and isopropyl alcohol (Fig 2). A decision to attempt salvage was taken jointly with the orthopedic team and the consent was obtained from the patient after explaining the pros and cons and he was taken up for surgery immediately under GA. A tourniquet was placed over left arm. Then the wrist was meticulously examined. The first attempt was made to restore the vascular continuity between the forearm and wrist. On the amputated part cut end of ulnar and radial artery was identified. Then a mixture containing patient's own blood, heparin, papaverine and normal saline was injected into the left radial artery on the wrist which came out through the ulnar end indicating the clearance of arterial arch of hand and providing some nutrition to the tissue. Though bony fixation was required first, to ensure the viability of amputated wrist and to restore blood supply the radial artery anastomosis was done. Good backflow from the distal ulnar artery was observed. Then bony fixation was done with a plan to complete the rest of vascular restoration after bone stabilization. His left forearm stump showed no evidence of crush injury.

Four 1.8 mm K wire were passed through both the radius and the ulna. Then ulnar artery were freshened and repair was done. Arterial input was established around 4 hours following the injury. After arterial repair an interposition venous graft was put between two cut end of the vein on extensor surface to ensure venous drainage of the hand. All vascular anastomoses were done with 7-0 prolene. All long flexor and extensor tendons were repaired. Median nerve and radial nerve were repaired but ulnar nerve were kept on stay suture for subsequent repair later on. The tourniquet was periodically deflated to stay within the safe time limits. After completion of surgery long arm back slab was applied. The surgery lasted eight hours and the patient recovered from anaesthesia uneventfully. The patient received intravenous heparin of 5000 IU intraoperatively and heparin infusion at the rate of 250 IU hourly for next twenty four hours along with platelet inhibitor clopidogrel and aspirin postoperatively. Antibiotics and analgesic were also given adequately. His vitals, urine output and hand vascularity were monitored closely. Patient's wound healed quite well and looked good after two and half weeks. (Fig: 3 & 4)

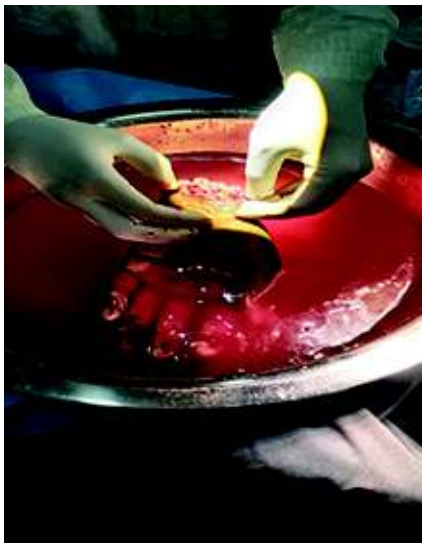

Fig.-2: *Sterile cleaning of amputated hand.*

Fig.-3: *Wound at 16th postoperative day*

Fig.-4: *Wound at 16th postoperative day.*

After two weeks x-ray was done to evaluate bony alignment which revealed near normal continuity. (Fig:5)

Fig.-5: *Postoperative. X-ray*

All wounds healed and the patient was discharged after three weeks after stitch removal (Figs: 6&7).

Fig.-6: *Wound after stitch removal*

Fig.-7: *Wound after stitch removal*

At discharge, there were small extension and flexion movement in all fingers. The patient was advised on the need for regular follow up to assess the bony union, range of motion and nerve recovery.

Discussion:

Wrist replantation are believed to produce the most beneficial outcomes among other macroreplantations.[5] The mechanism of injury is

also very important as it plays an important role on favorable outcome. The factors which usually leads to poor outcome includes severe crush or avulsion injuries, multi-level amputations, complex problems which cause impairment of vascular integrity, immune system and wound healing. The patients with any of these problems are typically poor candidates for replantation.[6] On the contrary amputations caused by sharp cutting injury are ideal because of less involvement of tissue beyond the amputation site.[7] Our patient had amputation at the level of wrist joint level by a sharp object and for this reason he was an ideal candidate for hand replantation than prosthetic rehabilitation.

Amputated must be replanted except absolute life-threatening contraindications like prolonged ischemia time.[8] In general the warm and cold ischemia time for the injury from shoulder to wrist 6 hours and 12 hours respectively.[9] Ischemia time is an important factor that affects the success of limb replantation. [10] Excessive ischemic time may lead to reperfusion injury. The shorter the time interval between blood flow interruption and successful reperfusion, the greater the likelihood of restoration of function.[14]

Replantation involves not only the reconstitution of the separated structures of an injured limb but also anastomosis of the arterial inflow and venous return.[11] Amputations may be classified by the site of injury, type of injury (crush, sharp or avulsion) and degree of contamination and associated local injuries.[12]

Patients who experience traumatic amputation often demand reattachment without appreciation of the implications. The patient should be counselled for a long rehabilitation process which includes long hospital stay and possibility of multiple admissions along with consequences like loss of productivity, lost wages, prolonged time lost from work, family hardships and psychological stress. There is also the potential for a stiff dysfunctional limb.[13] Kleinert *et al.* found that laceration injury had higher chance of replant survival in comparison with crush or avulsion injury.[14] Crush injuries cause more tissue damage with more skin scarring and wider zones of injury in the bone, tendon, muscle, nerve and blood vessels. Complete vascular washout with University of Wisconsin solution at 4p C into the artery has been shown to improve results.

Postoperative care includes adequate fluids and warming the patient's room to prevent hypotension and vasospasm. There are reports recommending the use of aspirin, dextran or heparin, however none are backed by a randomized control trial. During the postoperative period systemic reperfusion problems may present as myoglobinuria, tachypnoea, and signs of acute respiratory distress syndrome. Amputation in such an eventuality may be lifesaving and should be performed as early as possible if the patient shows progressive symptoms of reperfusion syndrome. Development of such systemic problems depends on cold ischemic time, extent and type of tissue defect at the amputation site and total trauma load.[11]

In reviewing the large volume retrospective reports, the limb survival rates range from 82% in North Carolina to 100% in Ogori Daiichi Hospital, Japan. Comorbid illness and personal habits, for example, nicotine, alcohol and medication must also be taken into account. The patients' general physical condition has to be able to withstand both a prolonged operation and to compensate postoperatively for the potential systemic influences of the replanted part. Ischemic time may also be reduced by early referral and en route stabilization.

The success of a functional replantation is closely related to the quality of reconstruction of peripheral nerves. Median and ulnar nerves have an organized fasciculated structure and may be reconstructed with an internal epineural suture. Poor nerve regeneration and poor return of sensory and motor function may cause poor patient satisfaction. Alignment in mixed nerve grafts is required to avoid excess tension. Primary end to end tension free repair is performed whenever possible. Secondary repairs usually require nerve grafting. Postoperatively, physiotherapy plays a key role in terms of regaining function. The functional capacity afforded by replantation may only be realized if physiotherapy is done consistently, adequately and for extended periods. Early motion of joints is encouraged to prevent contractures and facilitate strengthening of musculotendinous units. Zhong-Wei *et al.*

developed a system intended to express functional recovery in terms which are realistic to everyday life. The system analyses the following categories - ability to work, range of joint motion, recovery of sensibility, muscular power. Using the above categories, the four grades described were Grade one—excellent, Grade two—good, Grade three—fair and Grade four—poor. Using return to work statistically as a measure of success has a few problems: performing white collar jobs may not indicate functional return. The ability to gain independence in activities of daily living is considered an acceptable achievement in patients. Interestingly, patients may have suboptimal function but may still be satisfied with the result because of the esthetical aspect of the reconstruction and the extremity. The aims of hand replantation are to restore active flexion and extension of the thumb and fingers and opposition of the thumb, regain sufficient sensation for the performance of normal daily tasks and allow patients to return to their previous employment. Replantation of amputated parts of the hand is not simply a matter of success or failure, but, more importantly, a matter of restoration of function since survival without restoration of function is not success.

Conclusion:

The field of replantation has become sophisticated over the last four decades. Awareness of the possibility of salvage should be spread among healthcare personnel. Timely intervention at every stage will help reduce ischemia time and thus improve the survival rates and the long -term functional outcomes. The management of this kind of patients is not very common in our health care system and no publication regarding wrist replantation was published in our country. The immediate and continuous reeducation helps to recover a useful hand in both social and professional life. Our patient was satisfied with the replanted hand which will enable him to do activities of daily living in future. The patient may need prolonged physiotherapy. With a committed patient and a dedicated team, we are hopeful of a good functional outcome. The success has been a morale booster for the entire team.

Conflict of Interest - None.

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