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Limb Salvage or Amputation in Gustilo Type 3B and 3C Injuries, Report of 2 Cases and Review of Literature

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Abstract: ***Decision making between primary amputation and limb salvation in Gustilo Type 3B and 3C injuries can test the competence of any experienced orthopedic surgeon. Immediately following extremity injury, assessment may be imperfect due to tissue edema, difficulty in deciding in assessing viability of freshly injured tissues (what looks viable may turn out to be non viable later), clinically one may not be able to palpate distal pulsations and doppler studies may not be available at all centres. Large numbers of factors have to be considered objectively as defined by various predictive scores for evaluation. There can be inter-observer variation in scoring systems, thus leaving much on surgeon's experience for making decisions. Involvement of vascular surgeons and plastic surgeons may be of great value. Waiting for 24-48 hours may be of definitive value in deciding amputation versus limb salvage especially in centres where modern technological facilities in terms of investigation and management are not available. Experience of a surgeon rather than scoring systems may be the deciding factor.***

Keywords: Limb salvage, amputation, Gustilo, Type 3B and 3C injuries

1. Introduction

Mangled lower extremity results due to high energy trauma especially due to motor vehicle accidents and is defined as injury to three of the four systems in the extremity i.e soft tissues, bone, vascular and nerve. Open fractures are classified by Gustilo and Anderson's classification in which type 3b is a injury where soft tissue loss and primary closure of the wound is not possible and type 3 c is any open fracture with vascular compromise.

1) Management of these injuries is complex and fraught with complications. Surgeon may consider amputating a limb that has sustained high grade open fracture, severe vascular injury or significant damage to posterior tibial nerve.
2) Until now absolute criteria for amputation are considered to be non reconstructable vascular injury, crush injury with warm ischaemic tissue of more than 6 hours and severe bone and soft tissue loss with tibial nerve transection.
3) Relative criteria are elderly patients in shock with mangled limb, massive soft tissue loss associated with bone loss
4) Mangled Extremity Severity Score (MESS) – more than 7
5) Especially with absent plantar sensation, severe ipsilateral foot trauma, polytrauma and patients that are not expected to tolerate reconstruction.

2. Discussion

Decisions making in clinical situation of Mangled Extremity in complex (6) as number of factors are involved (7). These factors are

(A)Wound Related
1) Fracture grade and type.
2) Compartment syndrome.
3) Possibility of immediate fixation.
4) Duration and severity of ischaemia.
5) Loss of soft tissues of the foot.

(B)Patient related
1) Associated systemic injuries.
2) Shock.
3) Coaugulopathy.
4) Need for vasoconstrictiction.
5) ARDS.
6) Age.
7) Co-morbid conditions.
8) Hospital resources.
9) Transport time.
10) Mass/millitary casualty.
11) Patient Co-operation.

(C) Scoring systems

(D) Expected outcome
- Mandatory weight bearing
- Protective sensations
- Presence of durable skin and soft tissues.

(E)Experience of Surgeon
Availability of vascular and plastic surgeons. All above factors have to be considered individually and collectively to decide on amputation Vs salvage

There are various scoring systems evolved over a period of time to guide the surgeon in decision making.

In 1985, Gregory et al (8) developed Mangled Extremity Syndrome Index (MESI). It considers 10 factors, injury severity score, injury to integument nerve, artery, vein and bone, delay in treatment, age, preexisting disease and presence of shock. They concluded that MESI of 20 is the deciding line below which Functional Limb Salvage can be expected and above which Limb salvage is improbable. The Predictive Salvage Index (PSI) developed by Howe et al (9l in 1987 includes four criteria, extent of arterial injury, degree of bone injury, degree of muscular injury until arriving in operating room. The study was based on retrospective analysis of 21 limbs which analysed the

variable factors that determined amputation or salvage in that group. They reported sensitivity of 78% and specificity of 100% in their cohort group.

In 1990, Johansson et al (10) reported Mangled Extremity Severity Score (MESS) which consisted of 4 factors, skeletal and soft tissue injury, presence of shock, ischaemia and patient's age. They reported that score of 7 or more predicted amputation with 100% accuracy. Russel et al (11) developed Limb Salvage Index (LSI) in 1991 which encompasses 7 factors injurty to artery,nerve, bone,skin muscle and deep vein and warm ischaemia time. Threshold score of 6 was proposed for amputation. This score was found to fair better than MESS,PSI,NISSA and HFS-97 when assessing type 3 Tibial Fractures (11)

Hannover Fracture Scale (HFS) (12) was developed in 1993 wherein 13 characteristics related to the severity of injury were weighted to give HFS. Score is heavily biased towards presence of vascular injuries in orthopedic injuries. Apart from being cumbersome, the need for advanced bacteriological studies and specimens from the initial wound has prevented the wide usage of this score. In 1994 McNamara et al (13) modified previously described MESS to create the NISSA score in which each letter stands for one of the size factors, Nerve injury, ischaemia, soft tissue contamination, skeletal damage, shock and age. This is more accurate than MESS (14). However the idea of placing too much weightage on plantat sensation at presentation or even later has been criticised (15) as initial assesment may be wrong and later recovery may take place or with appropriate footwear problem of complete irrepairable damage to posterior tibial nerve can be addressed.

Finally in 2006 Rajasekran et al (16) proposed score specifically to assess severe grade 3B limb injuries, without vascular injury. The score was developed in 1994 and subsequently modified in the published form after 3 clinincal trial (17). The score is based on well defined objective criteria and has an average inter-observer agreement rate of 98.4% for total score and 97.9% for group allocation.

3. Drawbacks of Scoring Systems

The validity and usage of scores for assessing salvage has been questioned by the Lower Extremity Injury Severity (LEAP) study. LEAP was a prospective longitudnal study of 601 patients with a severely injured lower limb and included in the study with strict inclusion and exclusion criteria (18). Patients were admitted to one of the eight Level 1 Trauma centres in USA for treatment of high energy trauma to lower extremity. As a part of the major study, the clinical utility of five lower extremity severity scoring systems (MESS,LSI,PSI,NISSA and HFS 97)in predicting amputation were analysed. In the final analysis the authors reported that their study could not validate the utility of any of the above mentioned lower extremity injury severity scores. They concluded that the scores were quite useful in predicting limb salvage but the opposite (ie decision to amputate) was not true. All the scores in the series had low sensitivity and could not be accurate predictors of amputation.

To conclude, initial assessment of severely injured lower extremity is difficult due to following factors-

a) Gross oedema, inability to palpate peripheral vessels, naked eye decision of viability of tissues, falacy in testing neural deficit in a painful swollen extremity.

b) In case of ischaemic limb diagnosed clinically and/or with doppler and CT angiography, all attempts should be made to vascularise the limb with the help of a vascular surgeon. This should be done in 6 hours or so.
c) Initial management should include external fixation, wound debridemnet, antibiotics, analgesics, tetanus and gas gangrene prophylaxis.
d) Repeat examination and debridemnet under anaesthesia should be done after 24-48 hours to reassess viability of tissues, presence of infection. Scoring at this stage may be more accurate.
e) Sensate vascular limb should be subject to reconstructive procedures.
f) Economic status of the patient should be considered in case multiple, repeated, expensive bone and soft tissue reconstructions are required. Amputation as done in case no.1 may be a wise decision.
g) Occasionally despite best efforts, gross infection may occur due to lurking infection in reduced comminuted fractures, partially viable tissues, low immunity of the individuals. Strict watch on the general condition of the patient, wound infection, development of sepsis should be kept. Patient may be lost while saving a limb as happened in case no.2.
h) h. Decision making in primary amputation is extremely difficult, despite scoring systems and good clinical judgement. In subsequent days the picture emerges more clearly when decision making is relatively simple.
i) A team approach comprising of orthopedic surgeon, vascular surgeon and plastic surgeon is strongly recommended than individualistic approach.

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A 45 year old male patient was admitted on 28/8/2015 with alleged history of road traffic accidents patient was riding a bicycle when he got hit by a truck from behind at around 7:30 p.m on 28/8/2015. Patient sustained injury to the left leg. On examination skin showed degloving injury over posterior and lateral aspect of left leg and heel, muscles and tendons were exposed and tenderness was present. Distal pulsations were palpable.

Figure 1: Shows initial condition of the wound.

Figure 2: Showing x rays of the patient

Investigations revealed that X-ray left leg was shown for communited fracture distal one third Tibia and Fibula. Doppler study showed absence of dorsalis pedis pulsations. Posterior tibial pulsations equivocally present.

Figure 3: Showing debridement with External Fixation

Angiography revealed all vessels intact except anterior tibial opacification.

Diagnosis: Open Comminuted Fracture Distal One Third Tibia Fibula Left Side. Gustilo Andersen (Grade3c)
Management-

1) Pt was immediately shifted to operation theatre and wound debridement and application of external fixator was done. This was followed by daily dressing.
2) Debridement done again in Sep 2015.
3) Debridement with correction of external fixation was done on Sep 2015.

4) VAC dressing was started on:
1st VAC done on 18/9/15
2nd VAC done on 23/9/15
3rd VAC done on 28/9/15
4th VAC done on 3/10/15

Opinion taken for further management was based upon the opinion of

1) Ilizarov surgeon- In view of gross loss of soft tissue in the leg, heel and foot with exposed tendons anteriorly and posteriorly, amputation was suggested.
2) Plastic surgeon- As multiple operations is required for soft tissue reconstruction with uncertain outcomes and extremely poor socioeconomic status (Labourer), he also recommended below knee amputation.
3) Opinion of vascular surgeon.-No vascular intervention required as anterior tibial artery is opacified.
4) Orthopaedic surgeons-Need for amputation.

Figure 5 Showing before Amputation

Below knee amputation was done on 18/11/15.
Figure 6: Showing after amputation

Figure 7: Showing after amputation X Rays:

Patient readmitted on 2/2/16 with complaint of discharge from amputed site, for which debridement and wound wash was given on 6/2/16.

Figure 8: Clinical photos of the patient after amputation