ORIGINAL ARTICLE

Evaluation and Reliability of Mangled Extremity Severity Scoring in Traumatic Amputation Versus Limb Salvage

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ABSTRACT

Introduction: To salvage or amputate a severely injured limb is one of the most difficult decisions an orthopaedic surgeon may face. Several scoring system have been proposed for it. Observing paucity of any Pakistani study, we analyzed predictability of amputation or salvage in an extremity by using Mangled extremity severity score.

Objective: To determine the clinical utility of MESS in predicting limb salvage versus primary amputation.

Study Design: Prospective descriptive study.

Setting: Orthopaedics department, Jinnah Postgraduate Medical Center, Karachi.

Subjects & Methods: 50 consecutive patients with 52 mangled extremities of either sex or any age admitted between May2005 to July2008 were included. MESS used to assist in the decision –making process.

Results: High energy trauma (86%)was commonest mechanism of injury. Out of 52injured limbs, 38 (73.1%) with a MESS score of equal or more than 7 were amputated while remaining 14 (29.9%) with MESS less than 7 in which 12 (23.1%) were successfully salvaged and 2 (3.84%) were amputated. Mean score for amputated limbs was 8.67±0.83 & salvaged limb was 3.07±0.99. Mean MESS score of amputated limbs was significantly high than salvaged limbs (p=0.0001). MESS could predict amputation of severely injured lower limbs, having score of equal and more than 7 with 95%sensitivity, 100% specificity, 100 % positive predictive value & 85.7% negative predictive value.

Conclusion: MESS, a relatively simple & objective scoring system is highly accurate in the predictability of limb viability in patients with lower extremity trauma.

Keywords: Mangled extremity, MESS, scoring system.

INTRODUCTION

Limb amputations are increasing due to high-energy trauma due to road accidents or work related injures and terrorist activities.[1]

The situation is getting worse in Pakistan. The number of road traffic accidents has multiplied 17.5 times during a 30 year period (1956 – 1996) where as the number of vehicles has multiplied by 15.8 times during the same period in Pakistan.[2]

The management of massive extremity trauma is a subject of considerable interest and controversy. The emergent management of these injuries with vascular compromise/ neurological deficit/ significant skin loss/ crushed muscles/ avulsed tendons/ major fractures with bone loss and exposed dead bone challenges the decision making process of the surgeon and the patient[3,4]. The main question being faced by the surgeon and patient remains whether the injured limb can be salvaged or not? And if yes whether it will have some useful function or will become a liability. Until recently the decision of limb salvage versus primary amputation was primarily based upon subjective clinical parameters rather than objective ones[1].

Several scoring system have been proposed to differentiate patients who would benefit from primary amputations from those where salvage should be attempted[5]. MESS is an important contribution, which guides surgeons in logical decision making in this regard. However MESS has not been tested under Pakistani conditions where improper onsite handling of injured limb, delay in medical care, lack of adequate medical facilities and hot weather may have negative impact on the predictive value of the MESS. Considering the importance of these injuries and non availability of any published data, either

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prospective or retrospective from Pakistan testing the predictive value of the MESS or any other scoring system under Pakistani conditions, a need was felt to test the predictive value of MESS in deciding primary amputation versus salvage of the injured limb. It is hypothesized that the predictive value of MESS scoring should be different under Pakistani conditions as compared to those reported from countries with advanced health care system.

MATERIAL AND METHOD

Total 50 consecutive patients admitted to orthopaedics department of Jinnah Postgraduate Medical Center with severely injured extremity during three years (May 2005 + 11 July 2008) were included this prospective descriptive study. The patients with intra cranial hematoma, flail chest, hemothorax, diabetic patients and Berger disease are excluded. Vitals were recorded and all resuscitative measures were instituted. Initial management of mangled extremity was started in the form of thorough irrigation with copious normal saline, followed by meticulous debridements, pressure bandage, temporarily splintage and antibiotics as well as tentanus prophylaxis. MESS (Table 1) was applied, proformas were filled and its predictability was evaluated for amputation and limb salvage. Out of total 52 injured limbs, 38 cases under went immediate amputation as these have MESS score of equal or more than 7. The decision for salvage of limb was taken in total 14 limbs. Out of these 14 limbs 12 limbs were successfully salvaged and delayed amputation was carried out in 2 limbs. Both these patients have massive crush injury and soft tissue repair procedures like flaprotation have failed.

In the salvage patients primary fracture alignment and stabilization were carried out. Gradual delayed primary closure, split thickness skin grafting and fasciocutaneous flap coverage was undertaken as and when required.

Table: Mangled Extremity Severity Score

Type	Characteristic	Injuries	Points
Skeletal/ Soft tissue Group			
1	Low energy	Stab wounds, simple closed fractures, small caliber gunshot wounds	1
2	Medium energy	Open or multiple-level fractures, dislocations, moderate crush injuries	2
3	High energy	Shotgun blast (close range	3
4	Massive energy	Logging, railroad, oil rig accident	4
Shock Group			
1	Normotensive hemodynamics	BP stable in field and in Or	0
2	Transiently hypotensive	BP unstable in field but responsive to intravenous fluids	1
3	Prolonged hypotension	Systolic BP less than 90mmHg in field and responsive to intravenous fluid only in OR	2
Ischemia Group			
1	None	A pulsatile limb without signs of ischemia	0*
2	Mild	Diminished pulses without signs of ischemia	1*
3	Moderate	No pulses by Doppler, sluggish capillary refill paresthesia, diminished motor activity	2*
4	Advanced	Pulseless, cool, paralyzed and numb without capillary refill	3*
AgeGroup			
1	<30 years		0
2	>30<50 years		1
3	>50 years		2
Aggregate Score			

*Points × 2 if ischemic time exceeds six hours

OR, operating room; BP, blood pressure

Data Analysis Procedure

A statistical package for social science (SPSS-10) was used to analyzed data. Frequency and percentage were computed for qualitative variable like gender, Gustilo type, mode of injury, limbs involvement. Mean, standard deviation, 95% confidence interval, median, interquartile range, minimum and maximum observation of age, pulse, systolic and diastolic blood pressure, respiratory rate were computed for quantitative variables. Average score of MESS and hospital stay were computed for ampulated and salvaged limbs. Independent sample test was applied to compare mean MESS score and hospital stay between amputated limbs and salvaged limbs. P<0.05 was considered significant. The scoring system MESS (Table 1) were evaluated for predicting amputation verses limbs salvage by sensitivity, specificity, positive and negative predictive values.

RESULTS

In study, there were 50 patients with 52 mangled extremities [43 (86%)] males and 7 [14%] females. 42 (84%) were between 20 to 37 years of age and only 8 (16%) were between 38 to 49 years of age (Fig. 1 and Fig.2). Injuries included in the study were gustilo type IIIA, IIIB and IIIC (Fig. 3).

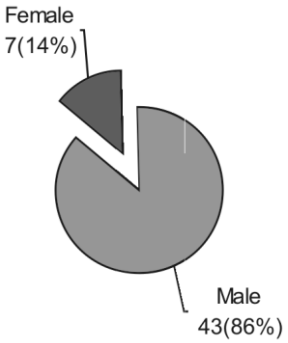

Figure 1: Gender Distribution n = 50

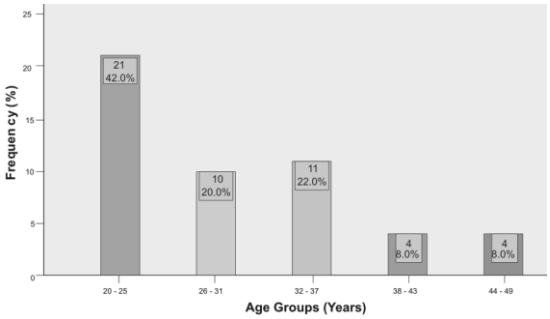

Figure 2: Age Distribution of the Patients n = 50

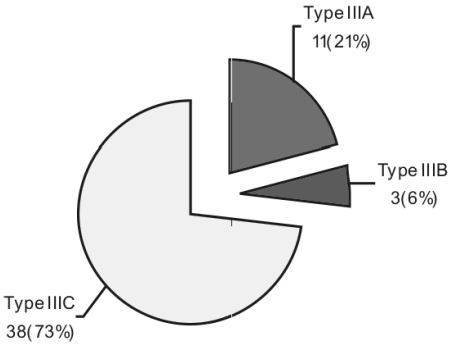

Figure 3: Gustilo Type n=52 limbs of 50 patients

All the injured limbs with MESS score of 7 were of gustilo type IIIC.

Clinical Utility of Mess in Predicting Limbs

Table 2: Salvage Versus Amputation

MESS Score	Salvaged Limbs	Amputated Limbs	Total
< 7	12	2	**14**
≥ 7	0	38	**38**
Total	**40**	**12**	**52**

Sensitivity = 95%
Specificity = 100%
Positive predictive value = 100%
Negative Predictive value = 85.7%

The commonest mechanism of injury was high energy trauma (i.e. 86%) in which train accident were 11(22%), heavy motor like truck, bus, dumper and oil taker accident were 27(54%), motor bike and car accident was in 5(10%), 3(6%) cases inured due to fall of wall and 4(8%) were slipped from stair and slippery area. Road traffic accidents is the leading cause of fractures accounting for 64% (32 cases). The highest number of persons injured in these accidents were pedestrians accounting for 30 patients (60%).

Out of 52 injured limbs, 38(73.1%) injured limbs with a MESS score of equal or more than 7 were amputated while remaining 14(29.9%) injured limbs with MESS score of less than 7 in which 12(23.1%) were successfully salvaged limbs and 2(3.84%) underwent delayed amputation. Mean MESS score for amputated limbs was 8.67 ± 0.83 and a salvaged limb was 3.07 ± 0.99. Mean MESS score of amputated limbs was significantly high

than salvaged limbs (p=0.0001). Similarly average hospital stay of salvaged limb was significantly higher than amputated limbs (p=0.0001). MESS could predict amputation of severely injured lower limbs, having score of equal and more than 7 with 95% sensitivity, 100% specificity, 100% positive predictive value and 85.7% negative predictive value. (Table 2)

DISCUSSION

Severe trauma to the lower extremity with resultant vascular compromise often leaves the surgeon with a very difficult, clinical decision; whether to salvage or amputate[6,7,8].

Various classification systems for fractures and injury severity scores have been developed which guide the surgeon in making appropriate decisions[8]. An attempt to quantify the severity of the trauma and to establish numerical guidelines of the decision to amputate or salvage the limb has been proposed by many authors[9].

Our experience of treating more than 1500 acute orthopaedic emergencies and 300 open injuries to the lower limb every year prompted us to evaluate the MESS scoring system, which was first proposed by Helfet et al in 1990 and later validated by others as well[3,4]. Ideally a trauma limb salvage index would be 100% sensitive (all amputated limbs with trauma limbs salvage scores at or above the threshold) and 100% specific (all salvaged limbs with scores below the threshold) and the receiver operating characteristic curve would have an area of 1 (perfect accuracy). However, such ideal results are seen in few clinical studies[10]. This same fact is also highlighted by our study.

We are reporting the results of an independent, prospective evaluation of MESS, an injury severity scoring system for lower extremity trauma designed to assist in the decision to amputate or salvage a severely injured limb.

In our cases the usual victims were young males. Considering this fact, it must be realized that the final functional outcome of treatment in the young age group has a critical impact on the national economy and health system. Most of our patients suffered from high energy trauma. This is the reason that majority of patients had Gustilo type IIIC fractures.

Our study showed a significant difference in the mean MESS values in the limbs that were salvaged (3.07) and those that were amputated (8.67). In a prospective study by Helfet et al, mean MESS values were 4 for the salvaged limbs and 8.8 for the amputated limbs[3]. As our reconstruction facilities are not comparable to developed countries. Therefore mean salvage score is lower in our study.

In India, Sharma et al[4], prospectively applied MESS to 50 patients with 56 mangled extremities and after a follow up of six months found that MESS had high specificity and sensitivity. Their results showed that MESS score equal to or more than 7 had 100% predictive values. Similar results were also found by Lin et al, Slauterbek et al 79 and Kumar[11,12]. Therefore, results of our study are consistent with both western and Indian studies. Robertson applied MESS to 164 patients in 1991, in his series observed that in severely injured lower limbs, certain case, required amputation even when their MESS was <7, However there were no false positive results, indicating 100% specificity.

This suggest that the method lacks sensitivity. This is similar observation as seen in our study.

Boss et al[13] in this study calculate sensitivity and specificity for MESS, LSI, PSI, NISSSA, and HFS for ischemic and non ischaemic limbs. This analysis, however, did not validate the clinical utility of any of the scoring systems. However, they agreed with the fact that generally MESS was highly specific but has low sensitivity.

An interesting observation is that despite counseling and MESS >7, four patients did not give consent for amputation. We can understand that amputation is a big social stigma and repugnant to the patients as well as their relatives, in a largely agriculture based society of a developing country like Pakistan. Similar observation was also made in an Indian study[4]. These cases then undergo secondary amputation. The main reason in majority of cases where consent was given for secondary of repeated medical and surgical interventions like repeated debridement, dressings and costly antibiotics. This also emphasized the same fact that MESS value of equal to and greater than seven has a 100% predictable value for amputation. This is also the same observation as seen in prospective study by Helfet et al[3].

Finally we would like to comment that when MESS was first proposed in 1990, the authors concluded that MESS score of 7 or more was 100% predictive of amputation. The performances of MESS in our prospective cases also duplicate these findings that MESS has high specificity 100% and sensitivity 95%.

Two patients in our study had massive crush injury in road traffic accidents. But their MESS value was <7 as they were normotensive so limb fell in mild ischaemic group. Also they were not advised to have a primary amputation. Their MESS scores were on higher side i.e. 6 and 4. One patient (with MESS of 6) was referred from interior Sindh for salvage and presented after 6 hours. He had profoundly devitalized soft tissues and unfortunately all soft tissue repair procedures like flap rotation failed, and therefore delayed amputation was performed. These two patients had hospital stay of 176 days and 62 days respectively. Therefore we suggest that to enhance sensitivity and specificity of this scoring system either criteria of MESS value >7 as an indication of primary amputation should be lowered by 0.5 or 1 point or severe crushing soft tissue injuries should be given an extra point each, so that patients are saved from futile salvage efforts to save a mangled extremity, or from carrying a functionally useless limb.

It is the natural inclination of the surgeon and wish of the patient and relatives to preserve the limb whenever possible. However a group of patients going for limb salvage can undergo more and more complex operations, and will stay longer in hospital and will suffer more complications than primary amputees. So we recommend that appropriate scoring system should be used to take this critical decision[13].

To our knowledge, the present study is the first independent prospective evaluation of the lower extremity severity scores in Pakistan, although a few articles have been published from India[4,11].

The strength of this study includes its prospective design as most of the studies evaluating injury scores are retrospective[14,15,16,10]. Another plus point of this study is that whereas in most western studies, clinical bias appears due to the fact that the same people who design the score also test the scoring system[14,15,16,10]. This clinical bias is avoided since we have not designed the scoring system and have simply tested the scoring.

Even through the preliminary results of this study appear very promising a limitation of study is that MESS is applied in a single center. Multicenter trials will be required next to evaluate its effectiveness.

Although predicted value for amputation of a MESS score higher than or equal to 7 appears to be high, there is a hope that in future, with improved available facilities of plastic and vascular surgery at JPMC, a limb with a score of higher than or equal to 7 will be salvaged.

CONCLUSION

MESS, a relatively simple and objective scoring system is highly accurate in the predictability of limb viability in patients with lower extremity trauma. Combined with experience and clinical acumen of the surgeon, it can be safely used to make an extremely difficult decision whether to salvage or amputate.

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