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Research Article

An evaluation of the clinical utility of mangled extremity severity score in severely injured lower limbs

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ABSTRACT

Background: The management of severe lower limb injury is one of the most controversial subjects in the field of Orthopedic surgery. While the advancement of sophisticated microsurgical reconstruction technique has created the possibility of successful limb salvage in even the most extreme cases, it has become painfully obvious that the technical possibilities are double-edged swords. The aim of study was to analyze and ascertain the clinical utility of mangled extremity severity score (MESS) in severely injured lower limbs.
Methods: The current study was undertaken in the Department of Orthopedics among 50 patients who sustained high-energy injuries and approached a tertiary care center to seek care. The study design included both retrospective and prospective evaluation. Retrospectively 25 and prospectively 25 lower limbs in 54 patients with high-energy injuries were evaluated using mangled extremity severity score to assist in the decision-making process for the care of patients with such injuries. MESS served as study tool. Differences between the mean MESS scores for amputated and salvaged limbs were explored.
Results: Crush injury of leg with fracture of tibia and fibula was observed in 78% of injured limbs. The most common mechanism of injury was high-energy trauma. Road traffic accidents accounted for 72% of patients. Mean hospitalization for primary amputation was 19.3 (8-26) days and for delayed amputation limbs was 36.6 (15-62) days and for salvaged limbs was 45.5 (14-128) days. In the prospective study, out of 7 injured limbs with a MESS score of equal or more than 7, 6 limbs were amputated and 1 limb was salvaged. Out of the remaining 18 injured limbs with a MESS score of less than 7, 17 limbs were successfully salvaged and one limb was amputated. In the retrospective study, 10 injured limbs with a MESS score of equal or more than 7 were amputated (mean score 8.4 with range of 10-8) and the remaining 15 injured limbs with a MESS score of less than 7 were salvaged (mean score 4.57 with range of (4-6)); suggesting a significant difference in the mean scores.
Conclusions: MESS is a cost-effective, relatively simple and readily available scoring system, which assists the surgeon to identify variables that may ultimately influence the outcome of a severely traumatized extremity with arterial compromise due to high-energy injury.

Keywords: MESS, Merit, Clinical, Utility, Lower limbs, Severe injury

INTRODUCTION

The purpose of limb salvage procedures following severe lower limb trauma is the conservation of a viable and fully functional limb. Unfortunately, while limb preservation is frequently possible, the salvaged limb may have significant functional deficits and may have ultimately required secondary ablation.[1] Severe traumatic injuries to the lower extremities have proven to be a profound challenge to the surgeon. With the high incidence of multiple systems involved (integument, nerve, bone, and vascular structures), these injuries require a multidisciplinary approach for appropriate management.[2]

Intricate decisions inevitably center around whether to attempt limb salvage or to proceed with primary amputation. With multiple surgical specialties represented in the care of these patients, the General/Trauma surgeon usually assumes the role of team leader.[3] In an attempt to identify those severely injured lower limbs, which could be successfully salvaged and those, which should proceed to primary amputation, a number of predictive indices were devised. Mangled extremity severity score (MESS) is one of them.[4]

The management of massive lower extremity trauma is a subject of considerable controversy.[5] While the advancement of sophisticated microsurgical reconstruction technique has created the possibility of successful limb salvage in even the most extreme cases, it has become painfully obvious that the technical possibilities are double-edged swords.[6-8] The purpose of this study was to identify variables that may ultimately influence the outcome of a severely traumatized extremity with arterial compromise. This presumably would assist the surgeon in the initial decision making process about whether to follow extensive reconstruction efforts. The objective of the present study was to analyze and ascertain the clinical utility of Mangled extremity severity score (MESS) in severely injured lower limbs.

METHODS

The current study was undertaken in the Department of Orthopedics in collaboration with Department of General Surgery among 50 patients who sustained high-energy injuries and approached a tertiary care center to seek care. The study design included both retrospective and prospective evaluation. Retrospectively 25 and prospectively 25 lower limbs in 54 patients with high-energy injuries were evaluated using Mangled extremity severity score to assist in the decision-making process for the care of patients with such injuries. MESS served as study tool. Differences between the mean MESS scores for amputated and salvaged limbs were explored.

The details of the retrospective cases were captured from the Medical Records Department (MRD). The inclusion criteria were; Mangled lower extremity, Gustilo Type-IIIA femur and tibial fractures with a hospital stay of more than four days, severe muscle damage, associated nerve injury and major blood loss or bone injury; associated with a fibular fracture and displacement of more than 50% and comminuted and segmental fracture, Gustilo Type-IIIB femur and tibial fractures, Gustilo Type-IIIC femur and tibial fractures, Vascular injuries of lower limb except the foot, including dislocations of the knee, ankle, closed tibial or femoral fractures and penetrating wounds with vascular injury noted on color Doppler or at the time of surgery, Gustilo Type-III open pilon fractures.

The injured limbs that were traumatic, near-amputation with only a small bridge of tissue connecting the distal extremity, thus were not reconstructable; Severely injured limbs with an unreconstructable foot; Patients with traumatic limb avulsions, isolated foot or digit injury and Patients who expired in less than one week from admission were excluded from this study.

Advanced trauma life support (ATLS) protocol was followed on admission of the patients. a detailed case history was recorded once the patient became stable. X rays of the mangled extremity were taken. For all the mangled extremities pulse oximeter reading was noted and monitored till improvement of vascularity. Color Doppler of mangled extremity was done whenever peripheral pulses were absent and perfusion was in suspicion. Patients were shifted to the operation room and initial management of the mangled extremity was started. MESS was done at the time of admission or on the operation table (Table 1).

Debridements were done every two to four days. Vascular repair, primary fracture alignment and stabilization were carried out. The second look debridement under anesthesia was undertaken 48 to 72 hrs after the injury. Serial wound cultures were done and appropriate antibiotics were administered. Salvage protocol was put on hold if the general condition of the patient deteriorated or once the severe infection of injured limb was observed or renal failure set in making amputation unavoidable. Gradual delayed primary closure / split-thickness skin grafting / myocutaneous flap coverage was undertaken when required. Iliac bone grafting was undertaken in patients with bone loss or lack of healing process at the fracture site. Once adequate soft tissue coverage had been obtained, patient was discharged and followed up at regular intervals of two weeks for progression of fracture healing. External fixator was replaced with a cast when infection subsided, adequate soft tissue coverage was obtained and the fracture healing was progressing satisfactorily. External fixator or cast was removed once the fracture was well united and physiotherapy was advised as per the need. Maximum period of follow- up in the study period was 28 months; minimum follow-up period was two months. Average duration of follow-up was six months.

Table 1: Mangled extremity severity score.

Type	Characteristics	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) high-velocity gunshot wounds, crush injury	3
4	Very high-energy	Above + gross contamination, soft tissue avulsion.	4
Shock group			
1	Normotensive hemodynamics	BP stable in field and in operation theatre	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 fluids only in operation theatre	2
Ischemia group			
1	None	A pulsatile limb without signs of ischemia	0*
2	Mild	Pulse reduced or absent but perfusion normal	1*
3	Moderate	Pulseless; parasthesia, diminished capillary refill	2*
4	Advanced	Pulseless, cool, paralyzed and numb without capillary refill	3*
Age group			
1	<30 years		0
2	>30 - <50 years		1
3	>50 years		2
*Points x 2 if ischemia time exceeds six hours, BP - blood pressure			

The study adhered to the tenets of the Declaration of Helsinki for research in humans. Informed consent was obtained from patients after discussion of the advantages and risks. Permission of Institutional ethics committee (IEC) was sought before the commencement of the study. All the questionnaires were manually checked and edited for completeness and consistency and were then coded for computer entry. After compilation of collected data, analysis was done using Statistical Package for Social Sciences (SPSS), version 20 (IBM, Chicago, USA). The results were expressed using appropriate statistical methods.

RESULTS

Data of fifty patients who sustained high-energy injuries and approached the study place to seek care was included in this study. Retrospectively 25 and prospectively 25 lower limbs in 54 patients with high-energy injuries were evaluated using Mangled extremity severity score to assist in the decision-making process for the care of patients with such injuries. Majority of the patients were males (n=44, 88%) and the mean age of the patients was 35.6 years. Right lower limb was commonly injured (n=28, 56%). Crush injury of leg with fracture of tibia and fibula was observed in 78% of injured limbs. The most common mechanism of injury was high-energy trauma. Road traffic accidents accounted for 72% of patients.

The mean hospitalization for primary amputation was 19.3 (8-26) days and for delayed amputation limbs was 36.6 (15-62) days and for salvaged limbs was 45.5 (14-128) days. There were 13 of Gustilo Type IIIA limbs, 21 of Type IIIB and 18 of Type IIIC fractures observed. All the injured limbs with MESS score of equal or more than 7 were of Gustilo Type IIIC.

In the retrospective study, 10 injured limbs with a MESS score of equal or more than 7 were amputated (mean score 8.4 with range of 10-8) and the remaining 15 injured limbs with a MESS score of less than 7 were salvaged (mean score 4.57 with range of 4-6); suggesting a significant difference in the mean scores. In the retrospective study of 25 injured limbs, five limbs (25%) had primary amputation and one limb (5%) had delayed amputation.

In the prospective study, out of 7 injured limbs with a MESS score of equal or more than 7, 6 limbs were amputated and 1 limb was salvaged. Out of the remaining 18 injured limbs with a MESS score of less than 7, 17 limbs were successfully salvaged and one limb was amputated. The mean score for salvaged limbs was 4.5 (3-7) and for amputated limbs was 8.81 (6-12), suggesting a significant difference in the mean scores. In the prospective study of 25 injured limbs, three limbs had primary amputation and three limbs had delayed amputation. In the prospective study, maximum period of follow-up was 28 months and minimum period was two months. In the retrospective study, maximum period of follow-up was done at the end of six and half years and minimum period of follow up was done at the end of two and half years.

To summarize, out of a total of 50 injured lower limbs, 7 limbs (14.0%) were amputated, 43 (86.0%) salvaged limbs had good function. MESS could predict amputation of severely injured lower limbs, having score of equal or more than 7 with 92% sensitivity and 98.5% specificity.

DISCUSSION

Many stress the inherent risk of amputation with an arterial injury below the knee (Howe, 1987).[9] Hansen in analyzing his vast personal experience with managing open fractures, noted that protracted limb salvage attempts may destroy a person physically, psychologically, socially and financially, with adverse consequences for the entire family as well. In spite of best attempts, the functional results are often worse than an amputation. Thus, enthusiasm for limb salvage techniques must be tempered by a realistic assessment of the results, not just for the injured part but for the patient as a whole.[10] Another author emphasized this in their system for scoring arterial injuries, with an amputation rate of 80%. A cumulative amputation rate of 18% has been noted in various reports of infra- popliteal injuries.[11]

The management of severe lower limb injury is one of the most controversial subjects in the field of Orthopedic surgery. Advances in surgical technology may permit limb salvage in many lower limb trauma cases. Unfortunately, while most attempts of limb salvage are successful, many are not. Failed attempts at limb salvage result in prolonged hospitalization including multiple surgical procedures, pain and psychological trauma, as well as economic hardship to the patient. Frequently, overzealous attempts at limb salvage with prolonged unsuccessful attempts at rehabilitation result in a functionally useless limb, chronic disability and pain and may be followed later by delayed amputation.[4]

Many authors have attempted to quantify the severity of the trauma and to establish numerical guidelines for the decision to amputate or salvage the limb. These include the MESS, the PSI, the LSI, the nerve injury, ischemia, soft tissue injury, skeletal injury and age of the patient (NISSA) score and the Hanover fracture scale-97.[12]

Limb Salvage Index (LSI) scoring system, based on the analysis of 70 lower extremity injuries involving multiple systems, was formulated based on the degree of injury to the arterial, nerve, bone, muscle, skin, venous and warm ischemia time. LSI score of less than 6 predicts successful limb salvage whereas LSI score of 6 or more than six predicts amputations.[13]

MESS was based on four clinical criteria: skeletal/soft tissue injury, limb ischemia, shock and age. A point system was developed to grade the severity of each of the four criteria. The MESS was based on retrospective review of 26 limbs. They also reported a prospective trial validating by index with 26 patients at a separate trauma center. They concluded that a MESS score of less than 7 predicted salvage with 100% accuracy and a MESS score of equal or more than 7 predicted amputation with 100% accuracy.[8]

Ability of MESS to predict the outcome of amputation was tested among 119 patients with 122 blunt injuries to the lower limb associated with arterial injuries. They observed that MESS had a positive predictive value of 71%, a negative predictive value of 84% and an overall accuracy of prediction of 75%. It was concluded study that MESS is not sufficiently precise to allow the decision regarding amputation to be made at the initial operation.[14]

In our study, out of a total of 50 injured lower limbs, 7 limbs (14.0%) were amputated, 43 (86.0%) salvaged limbs had good function. In the prospective study, out of 7 injured limbs with a MESS score of equal or more than 7, 6 limbs were amputated and 1 limb was salvaged. In the retrospective study, 10 injured limbs with a MESS score of equal or more than 7 were amputated (mean score 8.4 with range of 10-8) and the remaining 15 injured limbs with a MESS score of less than 7 were salvaged. The result of this study is in agreement with previous study by Lin. In his retrospective study on 34 patients with 36 mangled lower extremities with Gustilo Type III C. Results suggest that many limbs with MESS score of equal to or more than 7 may be salvaged.[15]

Regarding sensitivity and specificity of MESS, it was observed that MESS could predict amputation of severely injured lower limbs, having score of equal or more than 7 with 92% sensitivity and 98.5% specificity. Our findings confirm the results of another prospective study from India. Investigators applied MESS to 50 patients with 56 mangled upper and lower extremities and after a follow-up of six months, found that MESS had high specificity and high sensitivity, suggesting that MESS score of equal to or more than 7 had 100% predictive value of amputation.[16]

CONCLUSION

On the basis of empirical evidences of this study it can be concluded that Mangled extremity severity score is a cost-effective, relatively simple and readily available scoring system, which assists the surgeon to identify variables that may ultimately influence the outcome of a severely traumatized extremity with arterial compromise due to high-energy injury.

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REFERENCES

1. Hartsuck JM, Moreland HJ, Williams GR. Surgical management of vascular trauma distal to the popliteal artery. Arch Surg. 1972;105:937-40.
2. Snyder WHI, Thal ER, Perry MO. Vascular injuries of the extremities: Fasciotomy. In: Rutherford RB, ed. Vascular Surgery, 3rd Ed. Philadelphia: WB Saunders, 1989, pp625-627.

3. Perry MO, Fantini G. Ischemia: Profile of an enemy. Reperfusion Injury of skeletal muscle. J Vasc Surg. 1987;6:231-4.
4. O'Sullivan ST, O'Sullivan M, Pasha N, O'Shaghnessy M, O'Connor TP. Is it possible to predict limb viability in complex Gustilo IIIB and IIIC tibial fractures? A comparison of two predictive indices. Injury. 1997;24:639-42.
5. Jupiter JB, Tsai TM, Kleinert HE. Salvage replantation of lower limb amputations. Plast Reconstr Surg.1982;69:1-8.
6. Chen CW, Qian YQ, Yu ZJ. Extremity replantation. World J Surg. 1978;2:513-24.
7. Lange RH. Limb reconstruction versus amputation decision making in massive lower extremity trauma. Clin Orthop Relat Res 1989;243:92-9.
8. Johansen K, Daimes M, Howey T, Helfet DL, Hansen ST. Objective criteria accurately predict amputation following lower extremity trauma. J Trauma. 1990;30:568-73.
9. Howe HR Jr, Poole GV Jr, Hansen KJ. Salvage of lower extremities following combined orthopedic and vascular trauma. Am Surg. 1987;53:205-8.
10. Hansen ST. Overview of the severely traumatized lower limb: Reconstruction versus Amputation. Clin Orthop Relat Res. 1989;243:17-9.
11. Yeager RA, Hobson RW II, Lynch TG, Jamil Z, Padberg FT, Lee BC, et al. Popliteal and infrapopliteal arterial injuries: Differential management and amputationrates. Am Surg. 1984;50:155-8.
12. Pimple MK, Desai MM, Hirak. The utility of MESS in mangled extremities. Indian J Orthop. 2002;369:168-73.
13. Russell W, Sailors DM, Whittle TB, Fisher DT, Phillips BR. Limb salvage versus traumatic amputation: A decision based on a seven-part predictive index. Ann Surg. 1991;213:473-81.
14. Farris IB, Raptis S, Fitridge R. Arterial injury in the lower limb from blunt trauma. Aust NZJ Surg 1997;67:25-30.
15. Lin Ch, Wei FC, Levin LS, Su Ji, Yeh WL. The functional outcome of lower extremity fractures with vascular injury. J Trauma. 1997;43:480-5.
16. Sharma S, Devgan A, Rathee N. Salvage or amputation: A critical evaluation of mangled extremity severity score system in severely traumatized lower limbs. Indian J Orthop. 2002;36:174-7.

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