Research Article

Retrospective study on predictive scoring system for amputation in open fracture of tibia type III

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ABSTRACT

Background: Mangled leg remains a challenge in the surgical treatment. Mangled extremity severity score (MESS) is often used as a predictive scoring system. However MESS considered less sensitive because there are still many patients facing amputation legs should be maintained in the end. For that reason, it is necessary to evaluate the counting system has been used.
Methods: The study design was a retrospective study using medical records of patients with open fractures of the tibia grade III in emergency room of Dr. Soetomo hospital. From the data on patient medical records, MESI, PSI, HFS, LSI, MESS and NISSSA was calculated. Then the results are assessed by sensitivity, specificity, PPV and NPV.
Results: Patients who undergo amputation were 12 people and who successfully maintained limb were 46 people. The sensitivity ranged from 50% (MESI) until 75% (HFS), a specificity ranging from 61% (HFS) until 85% (NISSA). Positive predictive value ranged between 23% (PSI) and 53% (NISSA) and negative predictive value ranged from 81% (PSI) until 91% (NISSA).
Conclusions: This study failed to demonstrate the usefulness of the six counting system because it only shows the sensitivity and specificity in distinguishing limb amputation injuries that require immediate and that allows it to be maintained. Some have incorrectly predicted the counting system, where some patients were successfully maintained limb had been predicted for amputees and vice versa.

Keywords: Predictive scoring system, Amputation, Open fracture, Tibia

INTRODUCTION

Severe injuries in the limbs (mangled leg) remain a challenge in the surgical treatment. Mangled extremity severity score (MESS) is often used as a predictive scoring system to make decisions for handling the injured limb, whether it will be maintained or amputated. However MESS considered less sensitive because there are still many patients facing amputation legs should be maintained in the end.[1-4] For that reason, it is necessary to evaluate the counting system has been used recently.

METHODS

The study design was a retrospective study using medical records of patients with open fractures of the tibia grade III in the emergency room Dr. Soetomo General Hospital from January 1st, 2004 until December 31st, 2004. The research was conducted at the Dr. Soetomo Hospital in May-June 2005.

From the data of patient medical records, MESI, PSI, HFS, LSI, MESS and NISSSA was calculated. Then the results are assessed by sensitivity, specificity, PPV and

NPV. Student t-test with p<0.05 was used to compare between groups.

RESULTS

Table 1 show the average value of calculation system prediction evaluated on patients who received amputations since the beginning, secondary amputation and non-amputation. The thresholds for the recommended choice for amputation that was recommended at each counting system used in this evaluation.

Table 1: The average grade calculation system.

	MESI	PSI	HFS	LSI	MESS	NISSSA
Range	3-73	4-11	5-22	2-12	2-10	2-13
Threshold	20	8	15	6	7	9
Success attempt at salvage	13.7	7.1	12.6	4.9	4.2	4.3
Early amputation	10	10	18.5	9	8	11
Secondary amputation	9	7.5	19	7	10	11

Table 2: Frequency of amputation and salvage in scoring system.

Predicted	Observed		Total
	Amputation	Salvage	
MESI			
Amputation	6	8	14
Salvage	6	38	44
Total	12	46	58
PSI			
Amputation	7	24	31
Salvage	5	22	27
Total	12	46	58
HFS			
Amputation	9	18	27
Salvage	3	28	31
Total	12	46	58
LSI			
Amputation	6	14	22
Salvage	4	32	36
Total	12	46	58
MESS			
Amputation	7	8	15
Salvage	5	38	43
Total	12	46	58
NISSA			
Amputation	8	7	15
Salvage	4	39	43
Total	12	46	58

Table 2 shows the frequency of amputation and maintained limb experienced by patients and predicted

through all six counting system. Patients who undergo amputation (from the start and secondary) were 12 people and who successfully maintained limb were 46 people.

Table 3: Validate of each counting system.

Score system	Sensitivity	Specificity	PPV	NPV
MESI	0.50 (6/12)	0.83 (38/46)	0.43 (6/14)	0.86 (38/44)
PSI	0.58 (7/12)	0.48 (22/46)	0.23 (7/31)	0.81 (22/27)
HFS	0.75 (9/12)	0.61 (28/46)	0.33 (9/27)	0.90 (28/31)
LSI	0.67 (8/12)	0.69 (32/46)	0.36 (8/22)	0.89 (32/36)
MESS	0.58 (7/12)	0.83 (38/46)	0.47 (7/15)	0.88 (38/43)
NISSA	0.67 (8/12)	0.85 (39/46)	0.53 (8/15)	0.91 (39/43)

Table 3 shows the sensitivity, specificity, positive predictive value, and negative predictive value for each counting system. The sensitivity ranged from 50% (MESI) until 75% (HFS), a specificity ranging from 61% (HFS) until 85% (NISSA). Positive predictive value ranged between 23% (PSI) and 53% (NISSA) and negative predictive value ranged from 81% (PSI) until 91% (NISSA).

DISCUSSION

Severe lower leg injury remains a challenge in surgical treatment. Much controversy arose regarding what criteria can be used as a standard for deciding on amputation. Many scoring system is designed to objectively assess the severity of leg injuries to assist the surgeon in predicting of limb salvage or amputation.[1,5-7]

This study evaluate the scoring system, the most widely used is mangled extremity syndrome index (MESI), predictive salvage index (PSI), hannover fracture scale (HFS), limb salvage index (LSI), mangled extremity severity score (MESS) and nerve injury, ischemia, soft-tissue injury, skeletal injury, shock, age (NISSSA).

Mangled extremity syndrome index (MESI)

This system emphasizes the degree of injury to the lower limbs (soft tissue, nerves, blood vessels, and bones), Injury Severity Score, severity and duration of ischemia, age, comorbidities and shock, with a value of 20 as a boundary line that divides a possible limb salvage and indications of amputation.[8]

In this study, MESI only had a sensitivity of 50%, specificity 83%, PPV 43% and NPV 86%. So with MESI system are only 50% of patients who should have the possibility to be amputated above the threshold value,

and 83% of patients who successfully maintained limb would have a value below it. The incidence of amputation as predicted was only 43%, while the success of limb salvage as predicted by 83%.

In this study, we found some difficulties in the use of MESI, including the description of component fracture that there is no specification comminutive fractures without segmental configuration, because this fracture configuration will always be accompanied by severe soft tissue damage. In neglected cases, the value will be very high because one point is given for each additional hour when the treatment is given over 6 hours, so time had a big contribution compared to other components.[8,9]

In this system, the shock component was not described whether transient or prolonged.

Predictive salvage index (PSI)

In this study, PSI provides a sensitivity of 58%, specificity 48%, PPV 23% and NPV 81%. In this system there are no clear boundaries on the severity of soft tissue and bone injuries, which only described as mild, moderate and severe. Obviously this will lead to differences interpretation in a different doctor.[10]

Hannover fracture scale (HFS)

Many reports assessing the HFS that it was difficult to use because of the large number of parameters and soft tissue should be assessed as detailed as possible. In this study, a component of bacterial contamination is difficult to measure, because it will need time for the examination of the bacteria to be assessed. In case multiple fracture there was difficulty in choosing the degree of fracture that will be used.[11]

HFS for this study had sensitivity 75%, specificity 61%, PPV is only 33%, and a NPV of 90%.

Limb salvage index (LSI)

The system is based on seven criteria: arteries, nerves, bone, skin, muscle, deep venous injury and ischemic time. This system does not include other important components such as the age of the patient and other accompanying injuries. Many experts did not recommend this system for assessing acute injury. These studies have difficulty in assessing the description injury of the deep structure prior to exploration. In this study we found a sensitivity of 67%, specificity 69%, PPV 36% and NPV 89%.[12]

Mangled extremity severity score (MESS)

This system is the most widely used because it has a variable that is not too much, did not require major

surgery for the evaluation, and it looks easy to use. From this study we found a sensitivity of 58%, specificity 83%, PPV 47% and NPV 88%.[4]

Nerve injury, ischemia, soft-tissue injury, skeletal injury, shock, age (NISSSA)

This system is a modification of the MESS with the aim to increase the sensitivity and specificity in predicting amputation, but in this study we only found a slightly increased value compared with MESS, with the sensitivity 67%, specificity 85%, PPV 53%, NPV 91%.[1,11]

CONCLUSION

This study failed to demonstrate the usefulness of the six counting system because it only shows the sensitivity and specificity in distinguishing limb injuries that require immediate amputation and that allows it to be maintained.

Although HFS has the highest sensitivity (75%) but the specificity is low (61%), NISSA has the highest specificity (85%) but the sensitivity only 67%. In addition, some counting system have been incorrectly predicted, which are some patients were had a maintained limb successfully had been predicted for amputees and vice versa.

Therefore, these counting systems have clinical value that need to be enhanced by a variety of other factors as discussed ahead.

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