Mechanism, Glasgow Coma Scale, Age, and Arterial Pressure (MGAP): A new simple prehospital triage score to predict mortality in trauma patients

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- Trauma
  - the first cause of death before 40 yrs of age
  - responsible for numerous handicaps
  - high costs
- When care was provided at a trauma center -- overall risk of death was 25% lower
- Appropriate prehospital triage of trauma is important

Prehospital trauma scores

- Revised Trauma Score (RTS)
- Trauma Related Injury Severity Score (TRISS)
- Triage RTS (T-RTS)

Revised Trauma Score

Glasgow Coma Scale (GCS)	Systolic Blood Pressure (SBP)	Respiratory Rate (RR)	Coded Value
13-15	>89	10-29	4
9-12	76-89	>29	3
6-8	50-75	6-9	2
4-5	1-49	1-5	1
3	0	0	0

$$RTS = 0.9368\ GCS + 0.7326\ SBP + 0.2908\ RR$$

Trauma Related Injury Severity Score

$$Ps = 1 / (1 + e^{-b})$$

Where 'b' is calculated from:

$$b = b0 + b1(RTS) + b2(ISS) + b3(AgeIndex)$$

The coefficients b0 - b3 are derived from multiple regression analysis of the Major Trauma Outcome Study (MTOS) database. AgeIndex is 0 if the patient is below 54 years of age or 1 if 55 years and over. b0 to b3 are coefficients which are different for blunt and penetrating trauma. If the patient is less than 15, the blunt coefficients are used regardless of mechanism.

	Blunt	Penetrating
b0	-0.4499	-2.5355
b1	0.8085	0.9934
b2	-0.0835	-0.0651
b3	-1.7430	-1.1360

Triage Revised Trauma Score

Scoring

Glasgow Coma Scale		Systolic Pressure		Respiratory Rate	
GCS	Points	SBP	Points	RR	Points
15-13	4	>89	4	10-29	4
12-9	3	76-89	3	>29	3
8-6	2	50-75	2	6-9	2
5-4	1	1-49	1	1-5	1
3	0	0	0	0	0

Total score (the sum of scores above): 0–12

Injury Severity Score(ISS)

- 分六區計算
  - 頭頸,臉,胸,腹,四肢,外觀
- 各區分別從輕到重傷有1-6分
- 計算方法為最嚴重三區分數平方之總和
- ISS 計分為0-75(25+25+25 或一區分數為6)
- ISS > 15 則算嚴重創傷

Why MGAP score develop

- Paramedic-staffed prehospital setting as sociated with high number of missing values
- Weighting coefficients used for RTS and TRISS are probably out of date
- Both internal and external validation of a score is lacking
- Receiver operating characteristic (ROC) should not be considered as a definite answer

MATERIALS AND METHODS

- Derivation cohort
  - 22 centers in France and each center was asked to record cases in 2002
- Validation cohort
  - 1003 consecutive trauma patients from the same town and during the period, 2003 through 2005
- Informed consent was authorized

MATERIALS AND METHODS

- All the severe trauma patients were cared for by a mobile intensive care unit
- The on-scene triage was based on the clinical assessment by an emergency physician
- Patients pronounced dead on the scene were excluded
- Prehospital phase: age; sex; trauma characteristics; initial systolic arterial blood pressure; heart rate; respiratory rate; Glasgow Coma Scale; peripheral oxygen saturation
- hospital phase: systolic arterial blood pressure, heart rate, SpO2, and Glasgow Coma Scale

MATERIALS AND METHODS

- Abbreviated Injury Scale, Injury Severity Score (ISS), RTS→ TRISS score
- The primary end point was death (not ISS >15)
  - any cause occurring within 30 days after trauma

MATERIALS AND METHODS

- The score construction steps
  - first
    - semiparsimonious approach and only unbiased variables
    - colinearity between variables was considered when r >.8 (Spearman coefficient matrix correlation)
    - Discrimination of the final models was assessed by c-statistics and calibration by the Hosmer-Lemeshow statistic
    - An internal validation was performed using tenfold crossvalidation and expressed as the difference of c-index
  - Second
    - Transform the continuous variables selected by the model
  - Third
    - Simplify the weight allocated to each variable retained in the model

MATERIALS AND METHODS

- Statistical Analyses
  - Unpaired Student's *t*- test
  - Mann-Whitney *U* test
  - Fisher's exact method
- Sensitivity of at least 0.95. All *p* values were two-sided, $p < .05$ was considered significant, and SPSS 15.0 software

RESULTS

- Construction of the Score
  - univariate analysis of variables associated with mortality in the derivation cohort

Table 2. Univariate analysis of the derivation cohort (n = 1360) identifying variables associated with death

RESULTS

- the final model of the logistic regression with continuous variables

Table 3. Multivariate analysis of prehospital predictors of in-hospital death[a]

	Odds Ratio	95% Confidence Interval
Glasgow Coma Scale by point increase	0.71	0.68–0.75
Systolic arterial blood pressure by mm Hg increase	0.98	0.98–0.99
Penetrating trauma	4.11	2.24–7.73
Age by year increase	1.03	1.02–1.04

[a]Predictors were analyzed as continuous variables. Hosmer Lemeshow statistic: $\chi^2 = 3.56$; $p = .89$. c-index = 0.91.

RESULTS

- MGAP score calculation was defined using the results of this logistic regression

Table 4. Multivariate analysis of prehospital predictors of in-hospital death

	Odds Ratio [95% CI]	Points of the MGAP Score
Glasgow Coma Scale by point increase	0.71 [0.68–0.74]	GCS value
Systolic arterial blood pressure		
>120 mm Hg	1	+5
60–120 mm Hg	2.7 [2.0–3.6]	+3
<60 mm Hg	5.4 [4.1–7.3]	0
Blunt trauma (vs. penetrating)	0.24 [0.13–0.45][a]	+4
Age	0.21 [0.13–0.35][a]	+5
<60 yrs		
		Total: 3 to 29

MGAP, Mechanism, Glasgow Coma Scale, Age, and Arterial Pressure; GCS, Glasgow Coma Scale; OR, odds ratio; CI, confidence interval.
[a]The OR associated with penetrating trauma was 4.1 [2.3–7.6] and that associated with age >60 yrs, 4.7 [2.9—7.9], explaining the +4 and +5 points of the score. Lower MGAP scores are associated with higher mortality rate (Hosmer Lemeshow statistic: $\chi^2 = 5.16$; $p = .65$. c-index = 0.90).

RESULTS

- Derivation cohort
  - low (MGAP score 23–29): 45%, mortality of 2.8%
  - intermediate (MGAP score 18–22): 21%, mortality of 15%
  - high (MGAP score 3–17): 33%, mortality of 48%.
- Validation cohort
  - The low-risk group mortality was 2.8%
  - The intermediate-risk group mortality was 15%
  - The high-risk group mortality was 50%

RESULTS

- External Validation of the Score
  - validation cohort was not significantly different from that of the derivation cohort
  - MGAP score using ROC curve analysis was higher than that of T-RTS and RTS
  - Significantly lower than that of TRISS
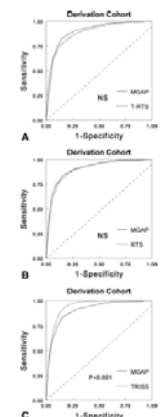
DISCUSSION

- The goal of our study was to develop a score
  - accurately predict death
  - could be applied easily
- Accuracy- better than the T-RTS and as did the RTS
- Sensitivity- better than T-RTS and RTS, approaching TRISS

DISCUSSION

- these characteristics were validated both internally and externally→ clinical practice
- The American College of Surgeons suggested an overtriage rate of 50% to attain an acceptable level of undertriage
- ISS>15
  - Intermediate end point
  - Misrepresent the injury severity assessment and mortality estimates

DISCUSSION

- Glasgow Coma Scale
- Systolic arterial pressure
  - Not 90 mmHg
  - categories for systolic arterial pressure (60, 60–120, 120 mm Hg) was supported mainly by clinical observation
- Type of trauma
  - RTS coefficients must be separated for blunt and penetrating injuries
  - is also supported by the inclusion of this variable in the TRISS
- Age
  - Increased mortality has been demonstrated as early as age 40 or 45 yrs
  - <60, >60

DISCUSSION

- Some variables do not included
  - Requirement for important fluid loading
  - Mechanical ventilation
  - Administration of catecholamines
- Two hypothesis
  - the statistical weight has been outlined by the statistical weight of other variables
  - Those Important therapeutic interventions have a marked impact on the patient prognosis

DISCUSSION

- prehospital triage should not be limited to only one score whatever its accuracy
  - an algorithm based on these decision schemes and incorporating the MGAP score could be a useful solution
  - the MGAP score was able to clearly delineate patients with low, intermediate, and high risk of death

DISCUSSION

- Limitation
  - this score may not apply to pediatric patients
  - MGAP score might be different in a paramedic-staffed prehospital system
  - the proportion of penetrating trauma (9%) was relatively low
  - the precise role of the MGAP score in the global process of prehospital triage
  - some variables were not taken into account in the predictive model
  - secondary triage of MGAP scoring did not assess
  - reproducibility of MGAP score did not assess
  - Details of the Glasgow Coma Score were not available

CONCLUSIONS

- MGAP score will lead to an improvement in prehospital triage in trauma patients
- The MGAP score should probably be incorporated into future decision schemes proposed in paramedic-staffed and physician-staffed prehospital systems.

Reference

- http://www.trauma.org/
- http://en.wikipedia.org/wiki/Revised_Trauma_Score