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Incremental Prognostic Value of the Activated Partial Thromboplastin Time and Creatinine in Addition to the Crash Score in Traumatic Brain Injury Patients

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Introduction

The CRASH score is one of the main validated prognostic models for Traumatic Brain Injury (TBI). This and other TBI scores have under-evaluated laboratory variables, including coagulopathy markers, which have been implicated on trauma outcomes. We have previously identified the Activated Partial Thromboplastin Time (aPTT) and Creatinine (Cr) as independent predictors of TBI mortality after adjustment for the CRASH score. Objective: To verify the incremental prognostic value of the aPTT and Cr in addition to the CRASH score to predict 14-day mortality outcome in TBI patients.

Methods

This is a prospective cohort that included consecutive TBI patients admitted to a Trauma ICU of a tertiary university hospital from March2012-January2015. Clinical, laboratory and radiological data were registered. A new model, CRASH-aPTT-Cr, was created by logistic regression adjustment and compared to the original CRASH score (CT model) regarding calibration (Hosmer-Lemeshow goodness-of-fit test [H-L] and Brier scores), discrimination (area under the receiver operating characteristic curve [AUC-ROC] and integrated discrimination improvement [IDI]) and clinical utility (net reclassification index [NRI]).

Results

A total 519 patients were included (mean age 41.4(±18.2) years, 85.1% male, median admission GCS 8 (quartiles 6-13)). Neurosurgery was performed on 44.9%. The 14-day mortality was 22.8%. The CRASH-aPTT-Cr score outperformed the CRASH score on calibration, as assessed by the H-L test or the Brier scores (0.118±0.216 vs 0.132±0.228, mean difference 0.015, 95%CI 0.004-0.026,p=0.006). The CRASH-aPTT-Cr score also had a better discrimination: AUC-ROC 0.844±0.024 (vs 0.813±0.024),p=0.067; and IDI 0.32±0.07 (vs 0.23±0.06),p=0.004. The NRI favored the CRASH-aPTT-Cr, with a net correct reclassification of 11.5% (95%CI 5.2–17.5%).

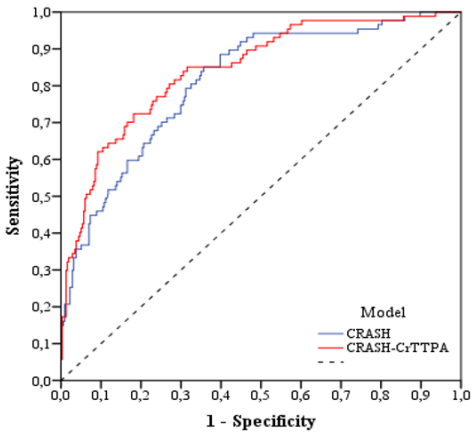
Conclusions

The addition of the aPTT and Cr to the CRASH score increased its accuracy. The aPTT may be an early marker of coagulopathy and the Cr a marker of basal frailty. Additional studies are required to externally validate this finding and further investigate its implications for TBI management.

Learning Objectives

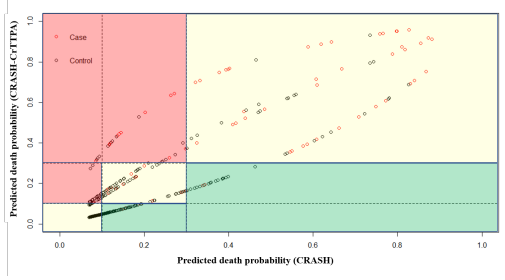
"By the conclusion of this session, participants should be able to: 1) Describe the importance of prognostic scores in TBI and critically evaluate then; 2) Discuss potential pitfalls on TBI prognosis, including the impact of coagulopathy and patient basal frailty; 3) Identify how to improve TBI management through prognostic evaluation."

Discrimination - ROC curves



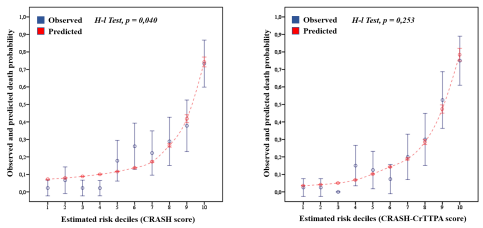
Discrimination analysis. AUC-ROC for CRASH and CRASH-CrTTPA scores.

Clinical utility - Net reclassification index

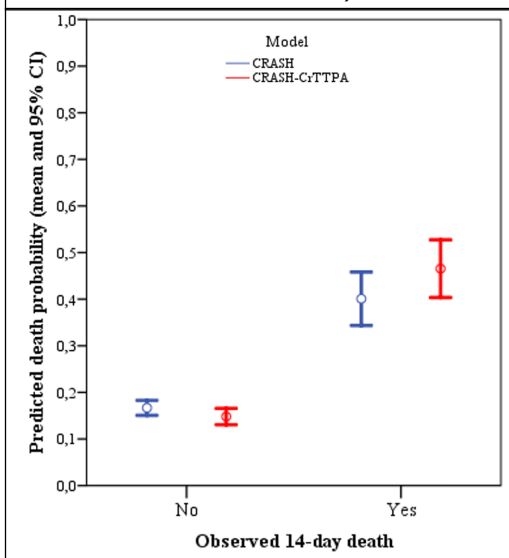


Clinical utility analysis. Net reclassification index. Cases (death outcome) and controls according to the predicted death probability by each model and risk (low <10%; moderate 10-30%; high >30%). Red area: cases correctly reclassified to a higher probability group threshold. Green area: controls correctly reclassified to a lower probability group threshold.

Calibration - Predicted vs observed probability - HL test



Calibration analysis. Predicted and observed death probability for CRASH and CRASH-CrTTPA scores and Hosmer-Lemeshow test (significant p value equals bad calibration).



Predicted death probability vs Observed outcome. Brier scores (difference between the predicted death (1) probability and observed outcome; Lower Brier scores means better calibration) and IDI (difference on the predicted death probability between dead and alive for each model subgroup; Higher IDI means better discrimination).