

Utilizing a Machine Based Learning Algorithm to Predict Mortality in Acetaminophen Overdose

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Background: The decision to transplant in cases of acetaminophen (APAP) induced acute liver failure (ALF) requires early, accurate identification of patients with the highest likelihood of mortality. The accuracy of current clinical decision tools is limited.

Hypothesis: We hypothesize that a machine based learning algorithm (MBLA) will more accurately identify the clinical outcomes of APAP induced ALF patients as compared to the most commonly utilized clinical decision tool (Kings College Criteria (KCC)).

Methods: Our study is a retrospective cohort. We compared the accuracy of a MBLA (support vector machine) and the KCC to predict clinical outcomes; patients were classified as survivors or non-survivors. The study sample is comprised of a cohort of patients admitted between July 2004, and June 2014, to the transplant ICU at an academic, tertiary care center. Study variables (pH, PT, creatinine, and encephalopathy stage) were obtained at two time points: 1) time of admission and 2) 24 hours. Inclusion criteria: APAP toxicity and ALF (defined as acute liver injury and coagulopathy) within one week of the overdose. Exclusion criteria: history of previous kidney/renal disease, prisoner, pregnant, or patient received a transplant. Statistical analysis was performed using R version 2.12.1.

Results: Complete cases were found for 40 patients (16 deaths). The KCC, at arrival, classified 26/40 (65%; 95% CI 48%-79%) cases correctly. The KCC, at 24 hours, classified 29/40 (73%; 95% CI of 48%-79%) cases correctly. At 24 hours, the MBLA classified the outcome of 39/40 (98%; 95% CI of 85%-100%) cases correctly (one death was misidentified as a survivor). The MBLA was significantly more accurate than the KCC at arrival and 24 hours (p values <0.001 and 0.004 , respectively).

Discussion: The MBLA significantly outperformed the KCC in predicting the outcomes of patients that developed ALF from APAP. The ability to accurately identify patients at high risk for mortality at 24 hours would allow earlier listing for transplantation. A larger, independent data set is required to validate the results of this study.

Conclusion: MBLAs may provide a useful tool to assist clinical decision making for determining the need for hepatic transplantation in cases of APAP toxicity.