Machine learning for in-hospital cardiac events prediction in patients with acute coronary syndrome: results from ADDICT-ICCU study

E. Gall¹, J.G. Dillinger¹, K. Hamzi², M. Elbaz³, E. Gerbaud⁴, N. El Beze⁵, A. Lequipar¹, S. Toupin², F. Picard⁶, A. Trimaille⁷, M. Goralski⁸, M. Bedossa⁹, A. Boccara¹⁰, T. Pezel¹, P. Henry¹

¹Hospital Lariboisiere, Cardiology, Paris, France
²Hospital Lariboisiere, Machine Learning and Research, Paris, France
³Toulouse Rangueil University Hospital (CHU), Cardiology, Toulouse, France
⁴Hospital Haut Leveque, Cardiology Intensive Care Unit and Interventional Cardiology, Bordeaux, France
⁵Hospital Bichat-Claude Bernard, Cardiology, Paris, France
⁶Hospital Cochin, Cardiology, Paris, France
⁷University Hospital of Strasbourg, Cardiology, Strasbourg, France
⁸Hospital Center Regional d’Orleans, Cardiology, Orleans, France
⁹Hospital Pontchaillou of Rennes, Cardiology, Rennes, France
¹⁰Andre Gregoire Intercommunal Hospital Center, Cardiology, Montreuil, France

On behalf of ADDICT-ICCU Investigators

Funding Acknowledgements: Type of funding sources: Foundation. Main funding source(s): Fondation Coeur et Recherche

Background: Acute coronary syndrome (ACS) remains a major cause of mortality worldwide. However, the accuracy of current prediction tools for in-hospital cardiac events after an ACS remains insufficient for individualized patient management strategies.

Purpose: To assess in patients with ACS the feasibility and accuracy of machine learning (ML)-based model using all data available at admission to predict in-hospital cardiac events.

Methods: We conducted a sub-study of ADDICT-ICCU registry, an observational prospective study including all consecutive patients admitted to intensive cardiac care unit (ICCU) in 39 centres throughout France between 7 and 22 April 2021. We evaluated 16 clinical, 4 biological and 6 transthoracic echocardiogram (TTE) features. ML involved automated feature selection with model building by random forest (RF), and then hyperparameter tuning was done by repeated cross-validation. The primary outcome was the occurrence of composite outcomes defined by death, resuscitated cardiac arrest or cardiogenic shock requiring medical and/or mechanical haemodynamic support.

Results: Of 1,499 consecutive patients, 765 (mean age 63±15 years, 70% male) were admitted for ACS. The overall in-hospital cardiac event rate for ACS patients was 4.0%. Feature selection was performed using RF with the log-rank–based variable importance, and 6 of the available features at admission were selected for the RF model (1 clinical, 1 biological, and 4 from TTE) including mean blood pressure, renal function, cardiac output, filling pressures, tricuspid annular plane systolic excursion and pulmonary arterial systolic pressure. The ML model exhibited a higher area under the curve compared with TIMI score, GRACE score, and traditional stepwise model score for prediction of in-hospital cardiac events (ML score: 0.96 vs TIMI: 0.54, GRACE: 0.68, traditional stepwise score: 0.87; all P < 0.001).

Conclusions: The ML-model exhibited a higher prognostic value to predict in-hospital cardiac events compared with all traditional scores.
ML model for MACEs prediction
ML model performance (AUC)