

Individualized Treatment in Patients with Cardiovascular Disease Using AI

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Abstract. After coronary stent implantation, prolonged dual antiplatelet therapy (DAPT) increases bleeding risk, requiring personalization of DAPT duration. The aim of this study was to develop and validate a machine learning model to predict optimal DAPT duration after contemporary drug - eluting stent implantation in patients with coronary artery disease. The One - Month DAPT, RESET (Real Safety and Efficacy of 3 - Month Dual Antiplatelet Therapy Following Endeavor Zotarolimus - Eluting Stent Implantation), and IVUS - XPL (Impact of Intravascular Ultrasound Guidance on Outcomes of Xience Prime Stents in Long Lesion) trials provided a derivation cohort (n=6568). Using the X - learner approach, an individualized DAPT score was developed to determine the therapeutic benefit of abbreviated (1–6 months) versus standard (12 - month) DAPT using various predictors. The primary outcome was major bleeding; the secondary outcomes included 1 - year major adverse cardiac and cerebrovascular events and 1 - year net adverse clinical events. The risk reduction with abbreviated DAPT (3 months) in the individualized DAPT–determined higher predicted benefit group was validated in the TICO (Ticagrelor Monotherapy After 3 Months in the Patients Treated With New Generation Sirolimus - Eluting Stent for Acute Coronary Syndrome) trial (n=3056), which enrolled patients with acute coronary syndrome treated with ticagrelor. The validation cohort comprised 1527 abbreviated and 1529 standard DAPT cases. Major bleeding occurred in 25 (1.7%) and 45 (3.0%) patients in the abbreviated and standard DAPT groups, respectively. The individualized DAPT score identified 2582 (84.5%) participants who would benefit from abbreviated DAPT, which was significantly associated with a lower major bleeding risk (absolute risk difference [ARD], 1.26 [95% CI, 0.15–2.36]) and net adverse clinical events (ARD, 1.59 [95% CI, 0.07–3.10]) but not major adverse cardiac and cerebrovascular events (ARD, 0.63 [95% CI, –0.34 to 1.61]), compared with standard DAPT in the higher predicted benefit group. Abbreviated DAPT had no significant difference in clinical outcomes of major bleeding (ARD, 1.49 [95% CI, –1.74 to 4.72]), net adverse clinical events (ARD, 2.57 [95% CI, –1.85 to 6.99]), or major adverse cardiac and cerebrovascular events (ARD, 1.54 [95% CI, –1.26 to 4.34]), compared with standard DAPT in the individualized DAPT–determined lower predicted benefit group. Machine learning using the X - learner approach identifies patients with acute coronary syndrome who may benefit from abbreviated DAPT after drug - eluting stent implantation, laying the groundwork for personalized antiplatelet therapy.

Keywords: drug-eluting stents, dual antiplatelet therapy, machine learning, percutaneous coronary intervention, treatment effect heterogeneity

Acknowledgements: (Optional)

The abstract contains approximately 250 words and does not exceed two pages in length.