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# EARLY ARTERIOVENOUS FISTULA FAILURE PREDICTION WITH ARTIFICIAL INTELLIGENCE: A NEW APPROACH WITH CHALLENGING RESULTS

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**BACKGROUND AND AIMS:** The native arteriovenous fistula is considered the vascular access of preference, since it is directly related to major survival, reduced complications, mortality, and costs. Still, its proper maintenance remains a challenge for nephrologists. A previous study from our group, which used the data of 117 arteriovenous fistulas, led to identify in the multivariable analysis age and vein diameters as predictive factors for early failure. On the other hand, Artificial Intelligence has been established as a tool to identify relationships between variables at deep levels, which might be unseen with more conservative methods like classic statistics. Therefore, through a Machine Learning technique known as Random Forest, the aim is to evaluate the same comorbidity, biological and Doppler ultrasound variables data to identify those with a major relation with the early failure of the native arteriovenous fistula.

**METHOD:** Retrospective cohort study, gathering the same data of the previous study (from 2011 to 2015): survival, ultrasound mapping (morphology and hemodynamics), comorbidities (blood pressure, severe arteriopathy, diabetes, Charlson's Index), and laboratory (haemoglobin, calcium, phosphorus, PTH, ferritin, PCR). Different Artificial Intelligence algorithms were tested, but the most suited one for the study's aim turned out to be Random Forest. A model was trained, dividing the data in two sets, training and validation, with an 80/20 ratio. The algorithm used 100 decision trees, with a maximum individual depth of 3 levels. The training was made with the variables that represented the 100%, 95%, 90% and 85% of impact in the fistula's maturation from a threshold according to Gini's Index.

**RESULTS:** Age 65.7 (32-88) years, male 59.8%. Hypertension 86.7%, diabetes 50.7% and vascular disease 41.3%. The trained model obtained provided the following results in the evaluation: accuracy 0.82, precision 0.86, AUROC 0.85, F1 0.86 (balance between precision and predictive value). The most relevant variables by decision order were age, phosphorous, PTH, ferritin and calcium. Morphologic and hemodynamic variables such as the vessels diameter, Peak Systolic Velocity, Charlson's Index or PCR, were also found to be relevant, but in a minor level.

**CONCLUSION:** In comparison with classic statistics, Machine Learning techniques might create a change of paradigm in predictive models for the patency of the vascular access for Haemodialysis. Even though the Artificial Intelligence-based model provided the same relevance for age in maturation failure as traditional models, other findings stand out, like the major participation of variables related with mineral metabolism or inflammation, rather than ultrasound based ones.