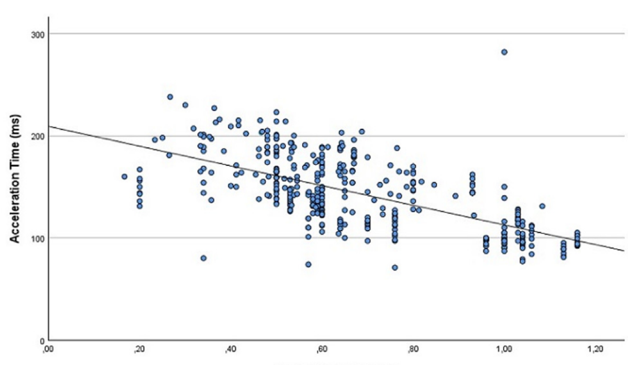
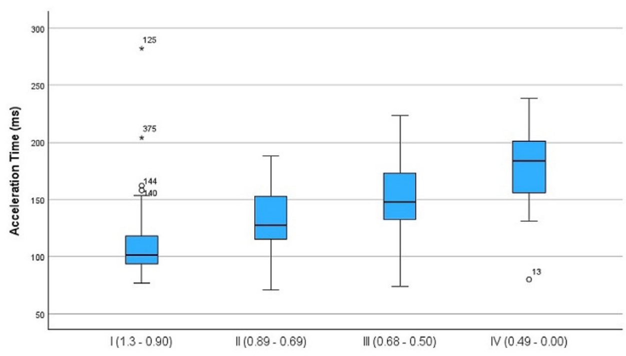
the study aims to investigate earlybird's potential to measure acceleration time at the ankle or proximal foot and compare these measurements with ABI.

Methods: A total of 97 study participants were included from to separate study cohorts. ABI was obtained for each individual. An earlybird probe was attached over the posterior tibial artery (ATP) at the medial malleolus, or the dorsal pedis artery (ADP) on the foot for measurements. Thirty five of the patients was measured two times by four raters, and 62 patients were examined by one rater at two separate measurements. Real time recording and post-processing were performed by in-house software, developed in MATLAB (MathWorks R2023a). The acceleration time was derived by an automatic algorithm. SPSS (IBM Corp. IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY) was used for descriptive statics, scatter- and box plots, and Pearson's correlation (*r*) analysis. The study was approved by the regional ethical committee.

Results: A total of 87 patients with peripheral arterial disease and 10 healthy subjects, with a mean age 66.3 (range 25 − 91 years), comprised the total group and 64.4% were male. In total, 404 measurements of accelerations time were plotted against the ABI, showing an overall strong correlation ($r = 0.635$, $p < .001$) (Fig. 1). Box plots were constructed for ischaemia classes based on ABI categories, as described by Teso *et al.*,[8] showing an increase in mean acceleration time for deteriorating ABI, although with overlapping interquartile ranges. 47.5% of the patient population was in class III (ABI 0.68 − 0.50).

Conclusion: Acceleration time can be measured with earlybird and could be a future tool for clinical decision making during endovascular treatment.





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Abstract P-042

Merging Geometrical, Biomechanical, and Clinical Data To Assess the Rupture Risk of Abdominal Aortic Aneurysms

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Objective: Reinforced by the latest ESVS guidelines, the maximum diameter remains almost the sole indicator for abdominal aortic aneurysm (AAA) repair. Introduced in 1999, it reflects a very conservative decision making, resulting in the elective repair of a large portion of stable AAAs. Regardless of accurately indicating risk on average in AAA patients, the diameter suboptimal predicts the risk emerging from AAAs in individual patients. Current AAA management also reflects the inability to understand which factors, and interactions amongst them, result in the rupture of the aneurysmatic aorta wall. As many risk factors contribute to AAA rupture risk, modern machine learning (ML) approaches may be able to integrate the heterogeneous risk, helping to improve the understanding of AAA rupture and then leading to more specific repair indication.

Methods: Being part of the ARI Eurostars project, 108 ruptured and 200 non-ruptured aneurysmal infrarenal aortas (204 male, 104 female patients) were retrospectively studied in this study. Patients underwent contrast enhanced computed tomography angiography (CTA) of the aorta at Karolinska University Hospital, Stockholm and University Hospital Augsburg, Germany, and the diameter ranges of 52.8 mm to 174.5 mm and 40.4 mm to 95.5 mm characterised ruptured and intact cases, respectively. In addition to the collection of general patient properties, geometrical and biomechanical features were extracted from CTA images (A4clinics Research Edition, Vascops GmbH). From in total 16 input features (sex, age, smoking status, six geometric and seven biomechanical variables), established ML models (Logistic Regression [LogR], Support Vector Machine with linear kernel [SVM-lin] and non-linear kernel [SVM-nlin], Gaussian Naive Bayes [GNB]) then classified AAA rupture. The models have been realised and trained in scikit-learn version 1.4.0, a phyton-based ML software package. As there were approximately two times more intact cases, Synthetic Minority Over-sampling Technique (SMOTE) was used to generate synthetic ruptured cases towards balancing the data set. Three-fold cross validation was used in training and validating of the ML models, and SHapley Additive exPlanations (SHAP) analysis ranked the importance of individual risk factors. Classifications were explored in the entire cohort and a sub-cohort of cases below 70 mm in diameter.

Results: Given the entire cohort, the diameter threshold of 55 mm in male and 50 mm in female, provided a 57.8% accurate rupture classification. It was 98.6% sensitive (AAA rupture identified correctly) and 45.2% specific (intact AAAs identified correctly). ML models improved accuracy remarkably (LogR: 89.7%, SVMlin: 89.41%, SVMrbf: 88.21%, and GNB: 86.86%). Classification accuracy decreased in the sub-cohort (55 mm/50 mm diameter threshold: 44.2%, LogR: 82.48%, SVMlin: 83.57%; SVMrbf: 81.55% GNB: 84.67%). Towards enhancing sensitivity, while maintaining an appropriate level of specificity, AAA rupture probability threshold was set to 35% for the ML-based model classification. Given this exercise, the LogR model performed best and resulted in a 96% sensitivity and 73.44% specificity, respectively. Finally, the SHAP analysis ranked the mean rupture risk index in the vessel wall, the diameter, and the rupture risk equivalent diameter as most important parameters for AAA rupture.

Conclusion: ML is a promising approach to assess AAA rupture risk and allows to merge heterogeneous risk factors. While the study once more demonstrated the importance of the diameter in AAA risk assessment, other risk factors are equally important. It is the coexistence of several risk factors that quantifies rupture risk, and a multi-parameter estimate significantly enhanced a purely diameter based decision making. The predictability of the proposed ML approach should also be tested in longitudinal studies to further scrutinise the approach.

Conflict of interest: T.C. Gasser is shareholder of Vascops GmbH, the manufacturer of software used in this work.