Background

Stent underexpansion has been linked to poor outcomes in patients including increased likelihood of stent thrombosis. Measuring stent underexpansion with intravascular ultrasound (IVUS) in the cath lab is challenging due to the large number of images acquired and difficulty in image interpretation. Hence, algorithms that automatically perform this task may be beneficial. DeepIVUS is a deep learning model developed for the automatic segmentation of IVUS images. In this study, we evaluate the accuracy of the DeepIVUS model for predicting stent underexpansion.

Methods

IVUS images from 295 pullbacks were manually contoured by experienced observers and split into training (n = 260) and validation (n = 35) datasets. Approximately 25% (1,175) of the validation dataset frames contained a stent, and model performance was evaluated on these. The DeepIVUS model was trained to predict the internal and external elastic lamina from the training data. IVUS frames with a cross-sectional area less than 90% of the reference cross-sectional area were deemed to be underexpanded.

Results

The DeepIVUS model showed excellent agreement for lumen area (concordance correlation coefficient = 0.96) and plaque area (concordance correlation coefficient = 0.91) on the validation dataset. Underexpanded frames were identified with a sensitivity of 86% and a specificity of 90%. The area under the receiver-operating characteristic curve was 0.88. At a patient level, all underexpanded vessels were detected.

Conclusion

Detection of stent underexpansion with the DeepIVUS platform showed excellent agreement with expert analysts