A machine learning model to aid patient selection for focal treatment of prostate cancer

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Background

Focal therapy (FT) is an increasingly utilised prostate cancer treatment option. However, current diagnostic tools have limitations in reliably identifying appropriate candidates. In modern healthcare, the growing availability of diagnostic tests is increasingly becoming data-intensive. As a result, machine learning (ML) algorithms have the potential to assist in medical diagnosis and management through extraction of meaningful patterns from complex datasets (1,2). Artificial intelligence (AI) may therefore offer a role in augmenting patient selection.

Aim

The aim of this study was to evaluate the accuracy of a developed ML model in selecting appropriate patients for FT.

Methods

Clinical data (baseline characteristics, imaging and histopathology results) from 231 men who underwent a radical prostatectomy for prostate cancer between April 2015 and April 2023, were used to build several models to predict eligibility for FT. Models were trained and evaluated using Receiver Operating Characteristic analysis on test sample sets, with performance compared against current selection criteria and gold-standard (radical prostatectomy specimen) outcomes to assess patient selection accuracy.

Results

- All ML algorithms achieved excellent performance when compared to current selection criteria. The highest performance was the random forest model, gradient boosting and XG boost with an Area Under the Curve (AUC) of 1.
- The same ML algorithms were compared against gold standard prostatectomy specimens and demonstrated a mean AUC of 0.76. Random forest performed with an AUC of 0.75 and was selected and focused due to its high performance in this context. Following hyperparameter tuning, AUC of the selected ML model improved to 0.91, a sensitivity of 0.5 and specificity of 0.88.
- Feature analysis identified localised International Society of Urological Pathology 1 to 3 prostate cancer was the most important predictor for model accuracy, followed by the Gleason grade groups of transperineal prostate biopsy.

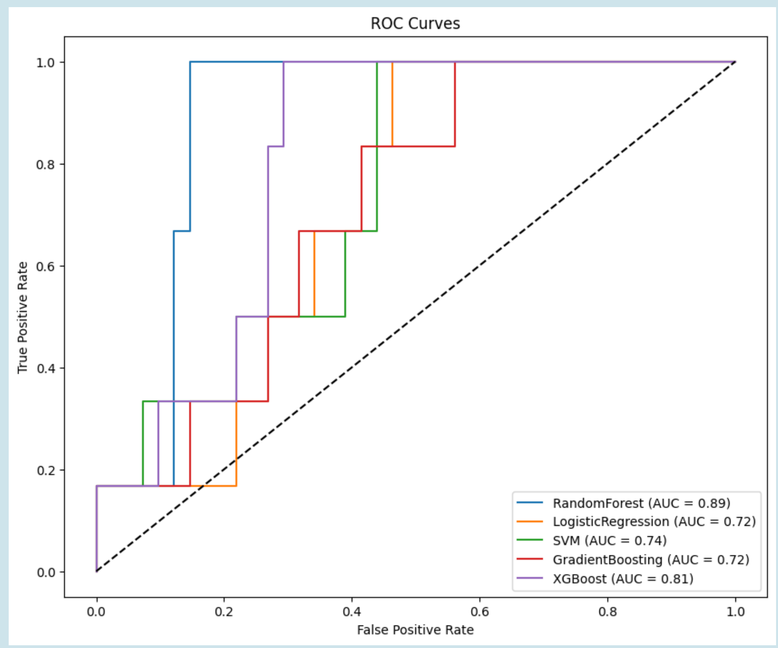

Figure 1: Receiver operating characteristic (ROC) curve of multiple machine learning models against gold standard prostatectomy following imbalanced data handling

Conclusion

Accurate FT patient selection is critical. In patients already selected for whole-gland treatment, our model may assist in confirming exclusion for FT. With further research, our model suggests that AI has a potential role in integrating clinical data to result in a singular prediction for prostate cancer treatment.

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