PREDICTING ANNULOPLASTY BAND SIZE FOR ENDOSCOPIC MITRAL VALVE SURGERY: APPLIED AI TO CT SCAN MEASUREMENTS

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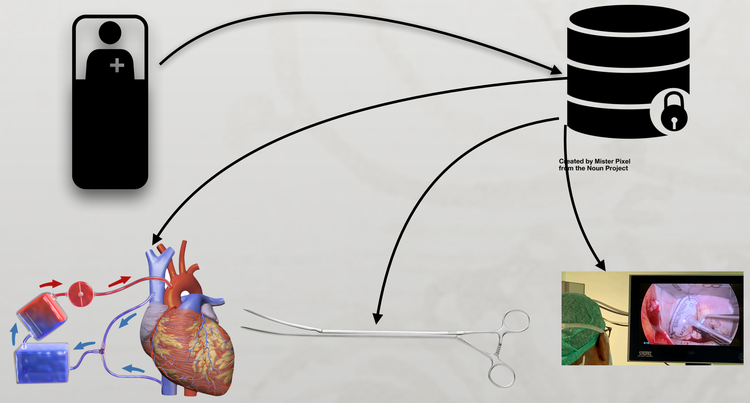
Introduction

Background: Endoscopic mitral valve surgery is becoming standard of care. However it has steep learning curve and annular sizing is difficult with conventional sizers.

Methods



Study design and Participants

A retrospective analysis was performed on 990 patients who underwent mitral repair at one institution from July 2015 to December 2026. 318 of them had CT scans suitable for mitral valvular apparatus measurements (intertrigonal distance, anterior leaflet max length, etc). A machine learning pipeline was created in order to predict annuloplasty band size (from 26 to 42 mm). Mitral measurements were done in MPR modality.

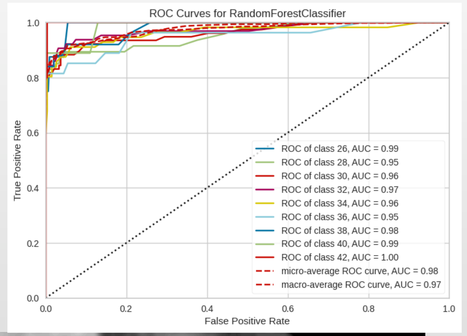
```
Pipeline
Pipeline(steps=[('preprocessor', StandardScaler()),
                ('pca', PCA(n_components=2)),
                ('classifier', RandomForestClassifier(max_depth=5))])
    StandardScaler
    StandardScaler()
    PCA
    PCA(n_components=2)
    RandomForestClassifier
    RandomForestClassifier(max_depth=5)
```

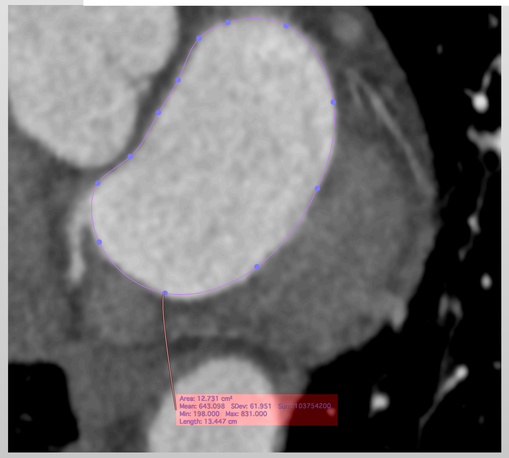
Statistical methods and analysis

We have build a Machine Learning model in order to predict with high accuracy the outcome variable. The we have performed the importance variable analysis and planted the relative graph and table for most important variables. Two sided statistics were performed with a significance level of 0.05. For all analysis R Statistical Computing Environment[3] were used with sci-kit Learn package for Python to build the model and eventually to deploy it when necessary.

Results

The final model had high accuracy on the traing dataset, about 99 %. The final model (best model among the trained) was able to predict the annular size with 90% accuracy on unseen data. A linear combination (PCA fo two components) of intertrigonal distance and anterior leaflet lengths was the main linear combination in the model.





Conclusions

Linear combination of mitral valve measurements can predict annular size in clinical setting. Its value is highly valuable for young and inexperienced groups.

References

1. Ho TK. (1998). "The Random Subspace Method for Constructing Decision Forests" (PDF). IEEE Transactions on Pattern Analysis and Machine Intelligence. 20 (8): 832–844.
2. Janssen KJM, Donders ART, Harrell FE, et al. Missing covariate data in medical research: To impute is better than to ignore. Journal of Clinical Epidemiology. 2010;63(7):721-727. doi:10.1016/j.jclinepi.2009.12.008.
3. R Core Team. R: A Language and Environment for Statistical Computing. Vienna, Austria: R Foundation for Statistical Computing; 2017. http://www.R-project.org/.