P4-10

Machine Learning to Estimate Tricuspid Annular Plane Systolic Excursion and Lateral Tricuspid Annulus Peak Systolic Velocity

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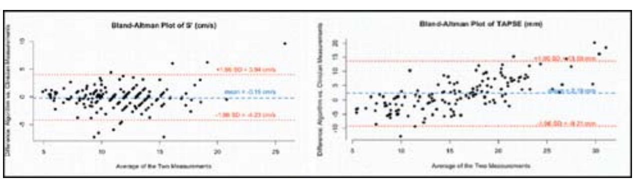
Background: Accurate assessment of right ventricular (RV) function using transthoracic echocardiogram (TTE) is known for interobserver variability. Tricuspid annular plane systolic excursion (TAPSE) and lateral tricuspid annulus peak systolic velocity (S') are two commonly used TTE functional markers. This study is the first to use machine learning to estimate these RV systolic functional parameters. **Method:** This is a single-center retrospective study of adult patients with TTE between 2019 - 2020. After excluding patients with poor image quality or missing RV functional assessment, 147 patients were identified. The TAPSE and S' for each patient were manually assessed by two trained observers. Supervised machine learning was used to derive an algorithm to automate estimation of TAPSE and S' using a derivation cohort. These algorithms were then tested for its accuracy using a test cohort. **Results:** The algorithm predicted S' with an estimation error mean of -0.15 cm/s, 95% CI [-4.023, 3.94] and TAPSE 2.19 mm, 95% CI [-9.21, 13.59] respectively. The root mean square error for S' and TAPSE were 2.08 and 6.20 respectively. Bland-Altman plot demonstrated a reasonable degree of agreement between the two methods for S' and TAPSE. **Conclusions:** This study is the first to use supervised machine learning algorithms to predict the conventional RV functional parameters, S' and TAPSE. This may serve as an important tool to systematically predict and potentially reduce inter-observer variability in assessment of longitudinal systolic function of RV.



P4-11

Fully Automated Artificial Intelligence Assessment of Aortic Stenosis by Echocardiography

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Background: Aortic stenosis (AS) is a common form of valvular heart disease, present in over 12% of the population aged 75 years and above. Transthoracic echocardiography (TTE) is the first line of imaging in the adjudication of AS severity but is time consuming and requires expert sonographic and interpretation capabilities to yield accurate results. Artificial intelligence (AI) technology has emerged as a useful tool to address these limitations but has not yet been applied in a fully hands-off manner to evaluate AS. Here, we correlate artificial neural network measurements of key hemodynamic AS parameters to experienced human reader assessment. **Methods:** 2-dimensional and Doppler echocardiographic images from patients with normal aortic valves and all degrees of AS were analyzed by an artificial neural network (Us2.ai, Singapore) with no human input to measure key variables in AS assessment. Trained echocardiographers blinded to AI data performed manual measurements of these variables, and correlation analyses were performed. **Results:** Our cohort included 256 patients with an average age of 67.6 ± 9.5 years. Across all AS severities, AI closely matched human measurement of aortic valve peak velocity (r = 0.97, p < 0.001), mean pressure gradient (r = 0.94, p < 0.001), aortic valve area by continuity equation (r = 0.88, p < 0.001), stroke volume index (r = 0.79, p < 0.001), left ventricular outflow tract velocity time integral (r = 0.89, p < 0.001), aortic valve velocity time integral (r = 0.96, p < 0.001), and left ventricular outflow tract diameter (r = 0.76, p < 0.001). **Conclusions:** Artificial neural networks have the capacity to closely mimic human measurement of all relevant parameters in the adjudication of AS severity. Application of this AI technology may minimize inter-scan variability, improve interpretation and diagnosis of AS, and allow for precise and reproducible identification and management of patients with aortic stenosis.

P4-12

The Computer Knows the Guidelines: Use of Supervised Machine Learning Models in Automation of Expert-Driven Classification of Aortic Stenosis Severity

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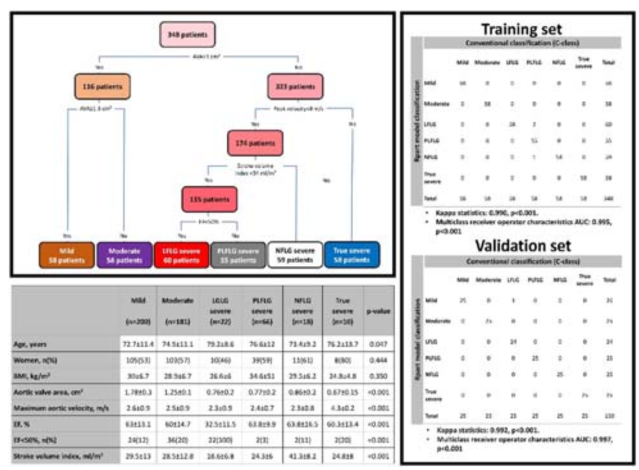
Background: We investigated a supervised machine learning (ML) algorithm in automation of the severity aortic stenosis (AS) severity classification and compare it to guidelines conventional classification for accuracy as well as the internal hierarchical model diagnostic strategy. **Methods:** We studied 497 AS patients [age: 74±11 years, 56% women, ejection fraction (EF): 61±15%, 409 preserved and 88 reduced] with different conventional guidelines (C-Class) severities [mild: 200, moderate: 181, low flow low gradient severe (LFLG): 22, paradoxical low flow low gradient severe (PLFLG): 66, normal flow low gradient severe (NFLG):18, and true severe: 10]. Synthetic minority oversampling technique (SMOTE) was used to balance the C-class yielding 498 patients (82 in each severity category). The dataset was 70:30 split to training and testing sets. Rpart decision tree-based model was used on the training set to predict C-class using conventionally used echocardiographic attributes [aortic valve area, peak aortic velocity, EF (absolute value and ≥ or <50%), and stroke volume index], and was validated on the unseen testing set. **Results:** Training set composed of 348 patients (58 in each C-class). Rpart model accurately classified patients according to C-Class (kappa statistic: 0.990, p<0.001, multiclass receiver operator characteristic AUC: 0.995, p<0.001). The model classification tree showed a hierarchical pattern of the attributes that followed the same algorithm suggested in the expert-consensus guidelines (figure 1). Similar results were observed when testing the model on the unseen testing set (150 patients, 25 in each severity category) where all cases except 1 were classified to their appropriate C-class categories (kappa statistics 0.992, p<0.001, multiclass receiver operator characteristic AUC: 0.997, p<0.001). **Conclusions:** Supervised machine learning algorithm can be used to automate aortic stenosis classifications with great accuracy. Interestingly, when presenting the model with data that is conventionally used for classifications in everyday practice to learn the classification, it accurately imitated the same steps used in the expert-consensus guidelines in production of the decision tree used for classification.



	Mild (n=200)	Moderate (n=181)	LGLG severe (n=22)	PLFLG severe (n=66)	NFLG severe (n=18)	True severe (n=10)	p-value
Age, years	72.7±11.4	74.5±11.1	79.2±8.6	76.6±12	73.4±9.2	76.2±13.7	0.047
Women, n(%)	105(53)	103(57)	10(46)	39(59)	11(61)	8(80)	0.444
BMI, kg/m²	30±6.7	28.9±6.7	26.6±6	34.6±51	29.5±6.2	24.8±4.8	0.350
Aortic valve area, cm²	1.78±0.3	1.25±0.1	0.76±0.2	0.77±0.2	0.86±0.2	0.67±0.15	<0.001
Maximum aortic velocity, m/s	2.6±0.9	2.5±0.9	2.3±0.9	2.4±0.7	2.3±0.8	4.3±0.2	<0.001
EF, %	63±13.1	60±14.7	32.5±11.5	63.8±9.9	63.8±16.5	60.3±13.4	<0.001
EF<50%, n(%)	24(12)	36(20)	22(100)	2(3)	2(11)	2(20)	<0.001
Stroke volume index, ml/m²	29.5±13	28.5±12.8	18.6±6.8	24.3±6	41.3±8.2	24.8±8	<0.001

P4-13

The Impact of Echocardiographic and Socioeconomic Indices on AI-based Medical Record Notifications for Management of Aortic Stenosis

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Background: We used artificial intelligence (natural language processing, NLP) to develop and implement an echocardiography (Echo)-based clinical decision support algorithm to streamline management of patients with severe aortic stenosis (SAS). We studied Echo and socioeconomic factors that correlate with higher probability of NLP-based identification of SAS. **Methods:** NLP was used to screen index Echo's (Figure 1). Following NLP detection of SAS, an automatic notification was sent to the ordering clinician's electronic health record inbox suggesting referral to our structural heart valve clinic. Aggregated zip code-based United States Census data and the area deprivation index were merged with each patient based on their address at the time of Echo. Echo variables were parsed using NLP. The endpoint is follow-up (either Echo, structural heart clinic visit, or aortic valve replacement) after EHR notification. Univariate analysis was performed to assess for predictors of the endpoint. **Results:** Of the 1,496 patients identified with SAS, 24% required an EHR notification and 53% of those underwent follow up. Patients with a generated notification had a higher odds of being black (OR=1.9; p<0.001), inpatient (OR=1.7; p<0.001), and with moderate or worse concomitant tricuspid regurgitation (OR=1.4; p=0.033). They also resided in areas with a lower average ADI national and state rank (Table 1). 47% of patients with a notification did not have a follow up (Figure 1B shows reasons for no follow-up in our system). **Conclusions:** Echo-driven, NLP-based EHR notifications can be reliably deployed in clinical practice. Understanding of patient clinical and socioeconomic characteristics should be further explored to personalize management of SAS patients.