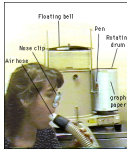


IDENTIFYING PATIENTS' LUNG DEFECTS USING MIDFLOW TIME

What is Spirometry?

Spirometry is an easy way to identify lung defects, requiring the patient to simply exhale into a tube



Good Lungs



Bad Lungs



Lung function can typically be described in three ways:

Normal – No evident defects

Obstructive – Obstruction occurs in the airways (cystic fibrosis, asthma, bronchitis)

Restrictive – Airflow is restricted (pneumonia, collapsed lung)

The Problem

Spirometry measures tend to mask the effects of small airways disease, creating difficulty for doctors trying to identify a patient's lung defects.

But there is hope!

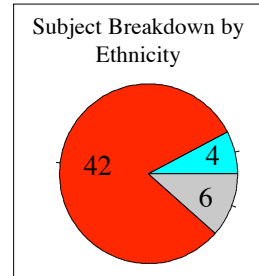
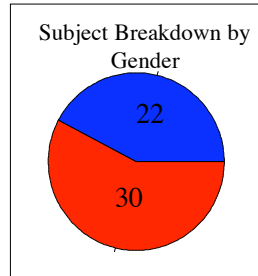
A new measure known as midflow time has been developed by doctors, and it is hypothesized that it could help identify small airways disease (SAD)

Research Objectives

- Examine midflow times in general
- See if we can characterize subjects with both Restrictive Defects and Small Airways Disease using only midflow time

The Data

Spirometry and other non-invasive tests were run on a total of 52 subjects who visited the Texas Tech University Health Sciences Center in Lubbock, Texas

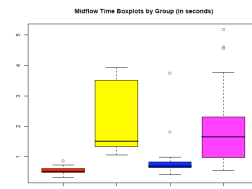


- Gender: Female - Red, Male - Blue
- Ethnicity: Caucasian - Red, Grey - Hispanic, Blue - Black
- Two of the Black female subjects would later be dropped from the dataset due to missing values

Analysis of Midflow Time

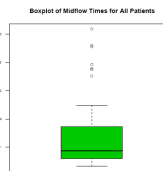
Median lies slightly below 1 second

7 patients are high outliers who have the potential to be patients with small airways disease



Normal, Obstructive, and Restrictive defects follow pattern hypothesized by doctors, while a none group was not hypothesized

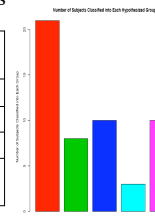
High outliers in restrictive defects indicate potential patients with small airways disease



Doctors' Hypotheses

Doctors hypothesized that patients could be broken up into groups based on the results of only four tests

Patients	FVC	FEV1	FEV1/FVC	Midflow Times
Normal	Normal	Normal	Normal	Normal
Obstructive	Normal	Low	Low	High
Restrictive	Low	Low	Normal	Short
Restrictive with SAD	Low	Low	Normal	High



* Normal is defined as ≥ 70 percent predicted; prediction of lung function for a subject is standardized for gender, size, age and ethnicity

Polytomous Logistic Regression

- Midflow time itself is not a good predictor of lung defect status (Prediction Accuracy is 50%)
- Table below gives the assessment of the predictive power of midflow time in combination with various other measures

Best Predictors	Prediction Accuracy
DLCO and DLCO/AV	80%
DLCO/AV and RV	78%
DLCO/AV	78%
DLCO	72%

*DLCO, AV and RV are all measures from non-invasive tests

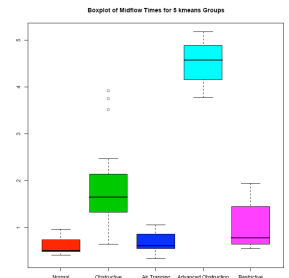
Clustering

Use of kmeans specifying five groups, as opposed to the four hypothesized by the doctors, yielded:

- Two normal, one restrictive, one obstructive, and one none group

Further investigation into the extra normal and the none group yielded:

- Extra normal group: Patients exhibiting an air trapping effect not detectable by spirometry
- None group: Patients showing signs of advanced obstruction



Conclusions

- Midflow time is not a good overall predictor of lung defects when the doctors' hypothesized groups are used as the true classifications.
- Doctors' hypothesized groups are not comprehensive, in that after subjects are classified there are subjects who do not "fit" into any group. Additional groups are found via clustering.
- Midflow time might be successful in general at differentiating between subjects with some type of obstructive defect (or features of obstructive defects like SAD) and subjects with no obstructive defects.
- Midflow time alone cannot be considered a good predictor of small airways disease, due to its inability to differentiate between obstructive defects. Midflow time could, however, be used to distinguish between patients with only restrictive defects and patients with both restrictive defects and small airways disease.

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