

Beyond Absolute Measures: The Case for Using Predicted Spirometry Values in Anesthesiology Research

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INTRODUCTION

- Interscalene interscalene brachial plexus blocks are known to cause severe breathlessness in some patients, often requiring unanticipated admissions and postoperative ventilatory support
- Ascertaining which patients are higher risk for post block pulmonary complications is currently subjective although increased in patients with increased American Society of Anesthesiologists Physical Status, history of cardiac or lung disease, and increased body mass index.
- Xu et al, assessed the role of preoperative pulse oximetry readings as a prognosticating index of patients who would be likely to have post block breathing complications, determining that for every 1% decrease in preoperative pulse oximetry reading, there was a 32% higher likelihood of post block pulmonary complication
- Identifying a reliable prognosticating factor to identify patients who would be likely to have post block breathlessness could help eliminate post block adverse events - however, no other discrete parameters to our knowledge have been identified

METHODS

- Secondary analysis of data presented in a separate study (IRB # 23-0924, University of North Carolina, Chapel Hill, NC) compared absolute versus predicted values of FEV1 and FVC for patients undergoing interscalene blocks for shoulder surgery
- 45 patients were enrolled between July and November 2023, adults undergoing unilateral shoulder surgeries.
- Cohorts created dependent upon BMI – patients undergoing unilateral shoulder surgery who received an an interscalene block with general anesthesia, and control group of patients undergoing abdominal surgery with general anesthesia alone.
- Preoperative spirometry values of FVC and FEV1 were collected using MicroSpirometer (MD Spiro, Lewiston, ME, USA) using a disposable expiratory filter pre and post block.
- Inspiratory Vital Capacity volume was also collected pre and post block using bedside hospital issued incentive spirometers.
- Predicted FEV and FVC were calculated utilizing the online Centers for Disease Control and Prevention Spirometry reference value calculator via free open access by inputting patient information (gender, race, age, and height).
- All groups were analyzed for correlation and then a secondary analysis using fisher exact test for a cut off number to determine if a preop value of FEV1 or FVC could predict post operative dyspnea following interscalene blocks

COUNT NORMAL (>70% PREDICTED)

FVC < 2.5
FVC > 2.6
FEV1 < 2.0
FEV1 > 2.1

4
33
4
33

COUNT ABNORMAL (<70% PREDICTED)

7
7
9
4

TOTAL INCONSISTENT 19/74 (26%)

Table 1. Comparison of absolute and percent predicted values for all patients involved in our study regarding interscalene block for shoulder surgery based on FVC and FEV1 measured values. Total rate of discrepancy was 26%.

RESULTS

- Absolute values of spirometry (FVC, FEV1 and inspiratory VC) did not yield any correlation with dyspnea.
- No statistically significant predictive cutoff could be determined for these parameters. While all the 3 absolute values correlated well with each other, they did not correlate with % predicted FVC and % predicted FEV1.
- Patients can have similar or near identical measured FEV and FVC values, but because of their individual differences, their predicted values can vary significantly.
- % showed a better trend towards an association with post-operative dyspnea, however this did not reach statistical significance (p=0.07).

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Spirometry Reference Value Calculator

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Reference Value Calculator

Enter Age, Height, Gender and Race. To see Percent Predicted, you must enter observed FVC, FEV1, and FEV25-75% values in the appropriate boxes. Click Calculate to calculate the predicted values.

Reference Source: NHANES III (Hankinson-1999) Gender: Male

Race: Caucasian

Age:

Height: in

Optional Observed Values Below - Enter to calculate Percent Predicted

FVC (L):

FEV1 (L):

FEV25-75% (L/s):

FEV1/FVC%:

Calculated Values

	FVC (L)*	FEV1 (L)*	FEV1/FVC%	FEF25-75% (L/s)*
Predicted>	Blank	Blank	Blank	Blank
Percent Predicted	Blank	Blank	Blank	Blank
Lower Limit of Normal	Blank	Blank	Blank	Blank

* - Predicted values are for race selected above.

[Reset](#) [Calculate Values](#)

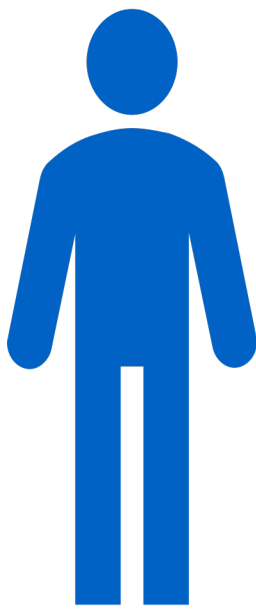
Disclaimer: This calculator is intended for use with the NIOSH Spirometry Workbook exercises and has NOT been approved by the FDA for clinical use.

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Content source: National Institute for Occupational Safety and Health





PATIENT A

PreOp FVC 4.00 L
AGE 19
HEIGHT 5' 7"
WEIGHT 82.7 KG
PREDICTED % FVC 110



PATIENT B

PreOp FVC 4.00 L
AGE 73
HEIGHT 6'1"
WEIGHT 90.3 KG
PREDICTED % FVC 58

Out of 45 patients, 9 had PreOp FVCs of 4.0 L: between 19- 73 years old, BMI between 20 – 37, and predicted FVC between 58% and 110%

DISCUSSION

- Neither FEV1 nor FVC as either raw or % predicted values was able to be used to predict breathlessness following interscalene nerve block.
- Absolute values, which typically are utilized in anesthesiology research, does not incorporate subject differences. Absolute numbers generated by spirometry are highly dependent on individual factors such as age, height, race and gender.
- Spirometry, while being a very valuable tool, suffers from its own limitations. It measures the strength of expiratory muscles such as intercostal and abdominal muscles, while phrenic nerve palsy primarily affects the diaphragm, the main inspiratory muscle.
- Focusing on means of measuring inspiratory muscle strength would be the most prudent in assessing muscle weakness to evaluate breathlessness post interscalene peripheral nerve block.
- Absolute numbers generated by spirometry are highly dependent on individual factors such as age, height, race and gender. Absolute values from spirometry are still widely used in regional anesthesia literature for assessing the effect of phrenic nerve palsy.
- Two patients can have similar or near identical measured FEV and FVC values, but because of their individual differences, their predicted values can vary significantly. When evaluating these differences, the inconsistency between the two in our entire study was 26%

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