FUNCTIONAL RESPIRATORY IMAGING TO PREDICT POST-OPERATIVE FORCED EXPIRATORY VOLUME IN 1 SECOND AFTER LOBECTOMY/PNEUMONECTOMY

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Rationale

Current ACCP guidelines (Colice et al., Chest 2007) recommend usage of the segment count method and the perfusion scintigraphy method for calculating post-operative forced expiratory volume in 1 second (FEV1) in patients undergoing a lobectomy or pneumonectomy, respectively. In this trial, functional respiratory imaging (FRI) (De Backer et al., Radiology 2010) is evaluated for calculating post-operative FEV1 (poFEV1).

Methods

23 patients (14 analyzed [10 single lobectomy, 2 double lobectomy, 2 pneumonectomy], 9 dropouts [2 deceased, 3 lost in follow up, 4 sub-lobar resection]) were included in the trial. All patients underwent spirometry, perfusion scanning, and pneumotach controlled CT scanning at maximum expiration (RV) and inspiration (TLC), both before and after resection. Post-surgery tests were acquired after recovery and before the start of any adjuvant therapy. RV and TLC scans were used to segment lobar volumes and to calculate regional expansion (EXP). Furthermore, resistances (iRaw, before and after virtual resection) were acquired through computational fluid dynamics. poFEV1 was predicted using the guideline formulas and using the FRI based formula:

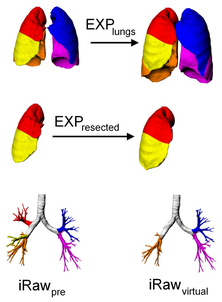
$$FEV_1^{post} = FEV_1^{pre} \cdot \left(1 - \frac{\left(1 - \sqrt[4]{\frac{iRaw_{virtual}}{iRaw_{pre}}} \right) \cdot EXP_{resected}}{EXP_{lungs}} \right)$$

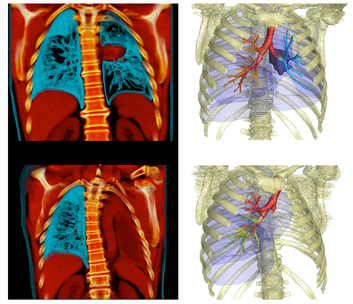
Results

Median actual poFEV1 is 2100 ml (1210 ml -- 3210 ml). The slopes of the fitted linear models between the actual and predicted poFEV1 are 1.10 (R^2=0.81, p<0.001*) and 0.98 (R^2=0.86, p<0.001*) for the ACCP prediction and the FRI prediction respectively. A paired t-test shows no significant difference between actual poFEV1 and FRI predicted poFEV1 (p=0.76) while ACCP predicted poFEV1 (p=0.002*) underestimates actual poFEV1. This is also reflected in the smaller root mean square error of the FRI method (213 ml versus 371 ml).

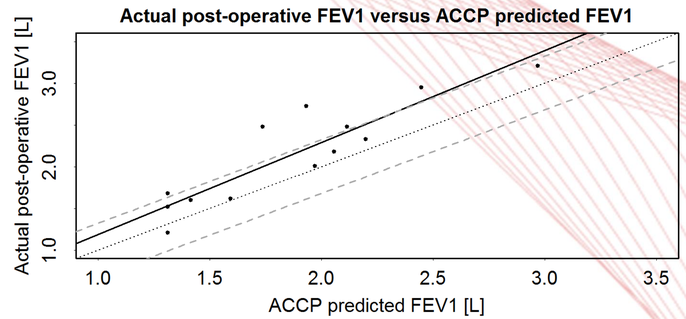
Conclusions

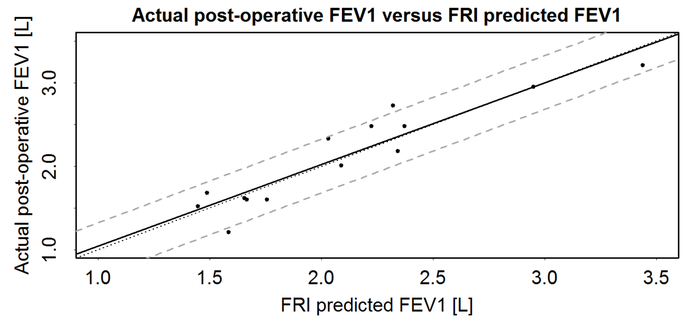
In contrast with the guideline formulas, there is no significant difference between the FRI predicted and the actual poFEV1. Furthermore, the root mean square error of the proposed method is 43% smaller than the standard method, and is lower than the minimally important changes in FEV1 (323 ml) as recently reported by Janssens et al. (Respiratory Medicine 2013). Also, the slope of the linear fit from the FRI prediction is very close to 1, indicating that the model is very well predicting reality.





FRI seems to be a better tool to predict post-operative FEV1 as compared to the current guidelines in patients undergoing lobectomy or pneumonectomy.





Funding

This study was funded by IWT, the Flemish government agency for Innovation by Science and Technology.