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LETTER

Lost in interpretation: should the highest VC value be used to calculate the FEV_1/VC ratio?

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Dear editor

Airflow obstruction or obstructive ventilatory defect (OVD) is defined as low forced expiratory volume in 1 second (FEV_1) to vital capacity (VC) ratio. VC can be measured in various ways, and the definition of "low FEV_1/VC" ratio varies.

VC can be measured during forced expiration before bronchodilators (forced vital capacity [FVC]) and after bronchodilators (post-FVC), and during slow expiration (slow vital capacity [SVC]) and during inspiration (inspiratory vital capacity [IVC]). Theoretically, in a healthy person, VC values should be the same regardless of the maneuver used. Nevertheless, SVC is usually larger than FVC except in patients with no OVD and body mass index <25 kg/m^2.[1] In obstructive lung diseases, FVC may be reduced, which may result in an increase of FEV_1/FVC ratio and misdiagnosis.[2] For that reason, American Thoracic Society–European Respiratory Society recommends using SVC or IVC to calculate the FEV_1/VC ratio.[2] Approximately, 10% of smokers have FEV_1% predicted $<80\%$ and FEV_1/FVC $>70\%$, a pattern known as preserved ratio impaired spirometry.[3] Of all the subjects with FVC below the lower limit of normal (LLN) and FEV_1/FVC $>$ LLN, only 64% have restriction in lung volumes. The rest 36% have a nonspecific Pulmonary Function Test pattern.[4] Approximately, 15% of patients with this nonspecific PFT pattern develop OVD in follow-up PFTs.[4] It is possible that a portion of patients with obstructive lung disease remain underdiagnosed when FVC is used to compute FEV_1/FVC ratio.

Previous studies have shown that when the highest value of VC was used, the prevalence of COPD was significantly higher.[1,5] Using a more sensitive test, like FEV_1/SVC instead of FEV_1/FVC, increases the prevalence of the disease. However, in the absence of true "gold standard" test, it may lead to overdiagnosis. The diagnostic test that can predict clinical outcomes better than the others is considered to be a better diagnostic test. Toren et al showed that if the largest VC is used to calculate the FEV_1/VC, more patients with chronic bronchitis are diagnosed with OVD.[5] On the other hand, individuals with no obstructive lung disease may be diagnosed with OVD.

Another potential problem with using FEV_1/SVC is that there are no available predicted values and LLNs for most populations. We should not compare the FEV_1/SVC, FEV_1/IVC, or FEV_1/post-FVC with predicted values and LLNs derived from FEV_1/FVC measurements. This approach has never been validated. Can the largest VC be used when the FEV_1/VC <0.7 criterion is applied? This diagnostic criterion does not use predicted values. The answer again is "probably not", as only the postbronchodilator FEV_1/FVC <0.7 criterion has been validated. Although the postbronchodilator FEV_1/FVC <0.7 is likely inferior to the FEV_1/FVC $<$ LLN criterion[6,7] to diagnose

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OVD and confirm obstructive pulmonary disease, Global Initiative of Chronic Obstructive Lung Disease recommends its use as it is simple and has been used in numerous clinical trials.[8] Thus, the only validated diagnostic criteria for OVD are the postbronchodilator $FEV_1/FVC < 0.7$ and the $FEV_1/VC <$ LLN, when LLN is available for this specific ratio. We should not diagnose OVD by using FEV_1/SVC, FEV_1/IVC, or FEV_1/post-FVC when the predicted values and LLNs are derived from FEV_1/FVC measurements.

Disclosure

The author reports no conflicts of interest in this communication.

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Authors' reply

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Dear editor

We are grateful for the valuable comments by Dr Fortis about our recent paper about the importance of slow vital capacity (SVC).[1,2] We seem to share the opinion that SVC is an overlooked aspect in spirometric diagnosing of chronic COPD. We also realized that we had missed a recent important paper by Fortis et al.[3]

There is a vast number of papers published debating on whether COPD should be diagnosed using the criterion forced expiratory volume in 1 second (FEV_1)/vital capacity (VC) <0.7 or the criterion FEV_1/VC below lower limit of normal (LLN).[4,5] Our study was performed in a general population aged 50–64 years, an age interval where the difference between these two criteria seems to be of minor importance. This is also reflected in the similar prevalence of COPD regardless of whether the criterion FEV_1/VC <0.7 or the criterion FEV_1/VC below LLN was used (16.4% vs 15.6%).

The main message from our paper was that use of only FVC will result in a considerable underdiagnosis of subjects with mild COPD.[2] This is important as the use of SVC has been downplayed in recent international and national recommendations, despite the original international recommendations.[4] In the age interval 50–64 years, we think that is the case regardless of the use of the criterion FEV_1/VC <0.7 or the criterion FEV_1/VC below LLN. We acknowledge Dr Fortis for the comment that we should use reference equations for SVC when applying the criterion FEV_1/VC below LLN. However, reference equations are mostly obtained in population where subjects with asthma, COPD, and obstructive symptoms have been excluded, conditions that are associated with deviating SVC and FVC. Hence, we think that we can also use published reference equations as proxies for the criterion FEV_1/VC below LLN.[6]

The increased prevalence of COPD when using the SVC concept may reflect an adequate diagnosis but may also reflect an overdiagnosis. Our results indicated, however, that the additional group of subjects added with the SVC concept was not respiratory healthy, as they had significantly increased prevalence of wheezing and higher residual volume, indicating air trapping. Whether this is of clinical relevance can only be elucidated in longitudinal studies.

Dr Fortis indicated in his letter and in the cited article that there may exist an interaction between body mass index (BMI), COPD, and the difference between SVC and FVC.[1,3] We have reanalyzed our material regarding the difference FVC–SVC according to BMI and $LLNCOPD_{FVC}$ (defined as FEV_1/FVC ratio below LLN). The correlation coefficient (Spearman, r_s) between FVC–SVC and BMI was 0.07 ($P<0.05$). Among those with $LLNCOPD_{FVC}$, r_s was 0.16 ($P=0.11$), and among those with no $LLNCOPD_{FVC}$, r_s was 0.06 ($P<0.05$). In Table 1, we have also outlined the difference FVC–SVC according to different BMI groups and $LLNCOPD_{FVC}$.

Our analysis from a general population sample aged 50–64 years corroborates the results reported by Fortis et al, as SVC seems to be considerably larger than FVC among subjects with $LLNCOPD_{FVC}$ and BMI >25 kg/m^2.[1] Among subjects with BMI ≤25 kg/m^2, there was no significant difference regarding SVC–FVC between those with or without COPD, but there was still a substantial difference between SVC and FVC.

Hence, we think our results indicate that there are substantial differences between SVC and FVC, and this

Table 1 The difference between SVC and FVC (SVC–FVC, mL) according to different groups of BMI and $LLNCOPD_{FVC}$ (defined as FEV_1/FVC below LLN)

BMI (kg/m^2)	Difference between SVC and FVC (SVC–FVC, mL)				
	N	$LLNCOPD_{FVC}$ N=100	Non-$LLNCOPD_{FVC}$ N=950	All N=1,050	*P*-value[a]
≤25	332	86 (24)	51 (11)	55 (10)	ns
>25–30	494	137 (27)	8 (11)	86 (10)	<0.05
>30	224	120 (43)	9 (14)	89 (13)	<0.05

Notes: Standard error is given in parenthesis. [a]*P*-value for the difference between $LLNCOPD_{FVC}$ and non-$LLNCOPD_{FVC}$.
Abbreviations: ns, not significant; BMI, body mass index; SVC, slow vital capacity; FVC, forced vital capacity; FEV_1, forced expiratory volume in 1 second; LLN, lower limit of normal.

difference should not be disregarded in spirometric diagnosis of COPD.

Disclosure

The authors report no conflicts of interest in this communication.

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