J Bras Pneumol. 2020;46(2):e20200060
https://dx.doi.org/10.36416/1806-3756/e20200060

CORRESPONDENCE

Difference between slow vital capacity and forced vital capacity in the diagnosis of airflow limitation

Carlos Alberto de Castro Pereira[1]

In an article published in the JBP, Fernandez et al.[(1)] evaluated 187 patients referred for pulmonary function testing and concluded that a difference between slow VC (SVC) and FVC (ΔSVC−FVC) > 0.20 L is useful for defining airflow limitation (AFL) in patients with normal test results and for reducing the number of cases designated as nonspecific (i.e., cases in which there is a proportional reduction in FVC and FEV_1). In 82 of those patients, AFL had already been characterized by forced spirometry.[(1)]

The value of 0.20 L was suggested in the Brazilian Thoracic Association 2002 Guidelines for Pulmonary Function Testing.[(2)] In 2019, Saint-Pierre et al.[(3)] evaluated functional test results of 13,893 individuals and reported that a preserved FEV_1/FVC ratio with a reduced FEV_1/VC ratio was observed in 20.4% of cases. The low predicted value used in that study to characterize the lower limit for the FEV_1/FVC ratio greatly decreases the sensitivity of this parameter for detecting AFL.

Several considerations should be made regarding ΔSVC−FVC. The higher degree of alveolar gas compression during a forced maneuver results from several factors, including obstructive disease, greater muscle effort, and higher thoracic gas volume to be compressed. Since gas compression is based on muscle effort during a maximal expiratory maneuver, some degree of compression can be found in all normal individuals. Soares et al.[(4)] measured lung volumes in a sample of 244 normal individuals in Brazil. In that sample, 10% had a ΔSVC−FVC > 0.20 L. In comparison with the remaining individuals in the sample, those 10% were found to be more frequently male, to be taller, and to have higher FVC, a characteristic profile of what is called the normal variant, given the increased expiratory effort generated in men with larger lungs.

Similarly to Fernandez et al.,[(1)] most authors use percentages of the predicted values for SVC, assuming that these values are equal to those derived for FVC. They are not. Kubota et al.[(5)] evaluated pulmonary function in 20,341 normal individuals in Japan and found that, due to the expected loss of elastic recoil, the ΔSVC−FVC increases with age, although a greater difference was also found in certain younger individuals. It is not surprising that Saint-Pierre et al.[(3)] acknowledge that, in the elderly, in whom the prevalence of COPD is higher, the FEV_1/SVC ratio should not be considered.

In the study by Fernandez et al.,[(1)] half of the sample consisted of obese individuals. A ΔSVC−FVC > 0.20 L was significantly associated with a body mass index > 30 kg/m². Likewise, Saint-Pierre et al.[(3)] observed lower values for the FEV_1/SVC ratio versus the FEV_1/FVC ratio in obese individuals. Reference values do not generally include obese individuals, and, therefore, ΔSVC−FVC data in obese individuals without cardiopulmonary disease are not available for large samples. Campos et al.[(6)] evaluated 24 individuals before and after bariatric surgery and showed that ΔSVC−FVC dropped from 0.21 L to 0.080 L after the intervention. Obese individuals have lower FVC relative to SVC. Many obese individuals have the so-called nonspecific pattern, and caution should be exercised in assuming that the measurement of SVC alone solves the problem, without those of TLC and RV. An SVC within the predicted range does not exclude the possibility of a reduced TLC if an appropriate percent prediction equation is used.

In the study by Fernandez et al.,[(1)] the values for specific airway conductance and for RV did not differ between the groups with and without a ΔSVC−FVC > 0.20 L. These data are surprising, since consistency with other data indicative of obstruction should have been observed. Finally, mid and end-expiratory flows, which could detect obstruction in the presence of an FEV_1/FVC ratio within the predicted range, were not reported.

Patients with obstructive disease more frequently have a ΔSVC−FVC > 0.20 L when compared with normal individuals—20% of 190 cases evaluated at the *Centro Diagnóstico Brasil* compared with 10% of normal individuals (unpublished data)—however, that difference in patients with mild airflow limitation was similar to that observed in normal individuals.

We consider it unwise, in patients whose forced spirometry parameters, including end-expiratory flows, are within the normal range, to characterize the presence of AFL solely on the basis of a ΔSVC−FVC > 0.20 L, or even > 0.25 L, as suggested by Saint-Pierre et al.[(3)] Obtaining acceptable and reproducible values for measurement of SVC is time consuming. This time-consuming factor does not justify the routine use of measuring SVC in high-volume laboratories, given the uncertain meaning of this measurement compared with that of forced spirometry.

REFERENCES

1. Fernandez JJ, Castellano MVCO, Vianna FAF, Nacif SR, Rodrigues Junior R, Rodrigues SCS. Clinical and functional correlations of the difference between slow vital capacity and FVC. J Bras Pneumol. 2019;46(1):e20180328. https://doi.org/10.1590/1806-3713/e20180328
2. Pereira CA. Espirometria. In: Sociedade Brasileira de Pneumologia e Tisiologia. Diretrizes para Testes de Função Pulmonar. J Pneumol. 2002;28(Suppl 3):S1-S82.
3. Saint-Pierre M, Ladha J, Berton DC, Reimao G, Castelli G, Marillier M, et al. Is the Slow Vital Capacity Clinically Useful to Uncover Airflow Limitation in Subjects With Preserved FEV1/FVC Ratio?. Chest.

1. Disciplina de Pneumologia, Universidade Federal de São Paulo – UNIFESP – São Paulo (SP) Brasil.

2019;156(3):497–506. https://doi.org/10.1016/j.chest.2019.02.001

4. Soares MR, Pereira CAC, Lessa T, Guimarães VP, Matos RL, Rassi RH. Diferença entre CV lenta e forçada e VEF_1/CV e VEF_1/CVF em adultos brancos normais em uma amostra da população brasileira. In: Proceedings of the 18th Congresso Paulista de Pneumologia e Tisiologia; 2019 Nov 20-23; São Paulo. Pneumol Paulista. Supplementary edition: P35.
5. Kubota M, Kobayashi H, Quanjer PH, Omori H, Tatsumi K, Kanazawa M, et al. Reference values for spirometry, including vital capacity, in Japanese adults calculated with the LMS method and compared with previous values. Respir Investig. 2014;52(4):242–250. https://doi.org/10.1016/j.resinv.2014.03.003
6. Campos EC, Peixoto-Souza FS, Alves VC, Basso-Vanelli R, Barbalho-Moulim M, Laurino-Neto RM. Improvement in lung function and functional capacity in morbidly obese women subjected to bariatric surgery. Clinics (Sao Paulo). 2018;73:e20. https://doi.org/10.6061/clinics/2018/e20

Authors' reply

Jonathan Jerias Fernandez[1,2], Maria Vera Cruz de Oliveira Castellano[3], Flavia de Almeida Filardo Vianna[3], Sérgio Roberto Nacif[1], Roberto Rodrigues Junior[4], Sílvia Carla Sousa Rodrigues[1,5]

In the article by Fernandez et al., a diagnosis of obstructive lung disease (OLD) was made if there was a reduced FEV_1/slow VC (SVC) ratio and/or a reduced FEV_1/FVC ratio.[(1)] The finding of a ΔSVC−FVC ≥ 200 mL alone did not define OLD. As the correspondence points out, in 82 of 187 cases, the FEV_1/FVC ratio had already revealed OLD; however, in 46 (25%) of those 187 cases, there was disagreement between diagnoses, a finding that is similar to that of Saint-Pierre et al.[(1,2)] In 21 of 73 cases with normal spirometry and in 15 of 32 cases considered nonspecific based on the analysis of forced expiratory maneuver parameters, obstruction was revealed only by a reduced FEV_1/SVC ratio.[(1)]

Kubota et al.[(3)] evaluated normal individuals and found a greater ΔSVC−FVC in the elderly, probably because of air trapping or heterogeneous lung emptying in the forced expiratory maneuver because of the loss of elastic recoil; that difference was less pronounced in young individuals. Therefore, the authors suggested that "reference values for SVC would be preferable for the interpretation of pulmonary function in the elderly".[(3)] Pistelli et al.[(4)] also calculated predicted values for SVC, finding a difference of only 50 mL between the mean values for SVC and FVC; however, the age group studied (8-64) was younger than that in the study by Kubota et al. (17-95 years).[(3,4)] There are no spirometry predicted values for SVC in Brazilians.

In our study, the values for specific airway conductance did not differ between those with and those without a ΔSVC−FVC ≥ 200 mL, a finding that may be attributable to the characteristics of the sample, which also included individuals with interstitial lung diseases (such as sarcoidosis, hypersensitivity pneumonitis, and fibrosis with emphysema), in whom changes in volume and flow can be masked by the balance of interstitial and airway involvement. In addition, reductions in FEV_1% and FEV_1/(F)VC, OLD, increased functional residual capacity, and reduced inspiratory capacity/TLC (i.e., findings of airflow limitation and air trapping) were predictors of a ΔSVC−FVC ≥ 200 mL.

ΔSVC−FVC correlates positively with body mass index, and analysis of FEV_1/SVC may increase the prevalence of the diagnosis of OLD. In general, functional residual capacity and expiratory reserve volume are the volumes most affected in obese individuals, and impairment of TLC is less pronounced. In individual cases, especially if there is dissonance with the clinical findings, plethysmography is essential for assessing the mechanisms underlying the reduction in (F)VC and FEV_1.

The finding of reduced end-expiratory flows alone (similarly to that of ΔSVC−FVC ≥ 200 mL alone) should be supported by other functional test results in order to confirm OLD. In the study by Saint-Pierre et al.,[(2)] discordant cases (i.e., normal FEV_1/FVC, but reduced FEV_1/SVC) had lower $FEF_{25-75\%}$ values.

Determination of the ΔSVC−FVC provides an additional piece of information, since, although that difference can occur in healthy individuals due to dynamic compression of the airways (young individuals) or loss of elastic recoil (elderly individuals), it can also be due to airflow limitation. Recommendations by the American Thoracic Society continue to support the use of the highest VC value as the denominator of the FEV_1/(F)VC ratio.[(5)]

In the Pulmonary Function Laboratory of the *Instituto de Assistência ao Servidor Público Estadual de São Paulo* (São Paulo Institute for the Medical Care of State Civil Servants), we perform approximately 800 tests/month. We serve a wide age group with a wide variety and great complexity of diseases. The SVC maneuver is performed without disrupting the laboratory's routine, and the analysis of its parameters additionally provides information about bronchodilator response.

REFERENCES

1. Fernandez JJ, Castellano MVCO, Vianna FAF, Nacif SR, Rodrigues Junior R, Rodrigues SCS. Clinical and functional correlations of the difference between slow vital capacity and FVC. J Bras Pneumol. 2019;46(1):e20180328. https://doi.org/10.1590/1806-3713/e20180328
2. Saint-Pierre M, Ladha J, Berton DC, Reimao G, Castelli G, Marillier M, et al. Is the Slow Vital Capacity Clinically Useful to Uncover Airflow Limitation in Subjects With Preserved FEV1/FVC Ratio?. Chest. 2019;156(3):497–506. https://doi.org/10.1016/j.chest.2019.02.001
3. Kubota M, Kobayashi H, Quanjer PH, Omori H, Tatsumi K, Kanazawa M, et al. Reference values for spirometry, including vital capacity, in Japanese adults calculated with the LMS method and compared with previous values. Respir Investig. 2014;52(4):242–250. https://doi.org/10.1016/j.resinv.2014.03.003
4. Pistelli F, Bottai M, Viegi G, Di Pede F, Carrozzi L, Baldacci S, et al. Smooth reference equations for slow vital capacity and flow-volume curve indexes. Am J Respir Crit Care Med. 2000;161(3 Pt 1):899-905. https://doi.org/10.1164/ajrccm.161.3.9906006
5. Culver BH, Graham BL, Coates AL, Wanger J, Berry CE, Clarke PK, et al. Recommendations for a Standardized Pulmonary Function Report. An Official American Thoracic Society Technical Statement. Am J Respir Crit Care Med. 2017;196(11):1463–1472. doi:10.1164/rccm.201710-1981ST

1. Laboratório de Função Pulmonar, Instituto de Assistência ao Servidor Público Estadual de São Paulo - IAMSPE - São Paulo (SP), Brasil.
2. Universidade Federal do ABC, Santo André (SP) Brasil.
3. Serviço de Doenças do Aparelho Respiratório, Hospital do Servidor Público Estadual de São Paulo, São Paulo (SP) Brasil.
4. Disciplina de Pneumologia, Faculdade de Medicina do ABC, Santo André (SP) Brasil.
5. Laboratório de Função Pulmonar, Alta Excelência Diagnóstica, São Paulo (SP) Brasil.