Editorial Commentary

Future expectations for respiratory disease assessment in dynamic chest radiography

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Comment on: FitzMaurice TS, McCann C, Nazareth D, *et al.* Feasibility of dynamic chest radiography to calculate lung volumes in adult people with cystic fibrosis: a pilot study. BMJ Open Respir Res 2023;10:e001309.

Keywords: Dynamic chest radiography (DCR); cystic fibrosis (CF); whole-body plethysmography (WBP)

Submitted Sep 04, 2023. Accepted for publication Nov 13, 2023. Published online Dec 06, 2023.
doi: 10.21037/jtd-23-1394
View this article at: https://dx.doi.org/10.21037/jtd-23-1394

I extend my sincere gratitude to the editor of the *Journal of Thoracic Disease* for granting me the gracious opportunity to submit an editorial commentary on the seminal work of FitzMaurice *et al.* (1). Recently published in *BMJ Open Respiratory Research*, their study presented a pioneering exploration of the applicability of a lung function assessment technique termed dynamic chest radiography (DCR) in adult patients with cystic fibrosis (CF). This investigation, involving a cohort of 20 adult patients with CF, delved into the correlation between lung volume subdivisions derived from the projected lung area (PLA) during distinct respiratory phases (deep inspiration, tidal breathing, and full expiration) and the corresponding volume equivalents deduced from whole-body plethysmography (WBP). This study also introduced a linear regression model for predicting lung volume subdivisions based on the PLA, subsequently benchmarking these predictions against WBP outcomes.

In this study, DCR (Konica Minolta, Tokyo, Japan) utilized a wide-field dynamic flat-panel detector and advanced digital image processing to capture continuous chest radiographs with high temporal resolution during the respiratory cycle, which is noteworthy for its judicious use of pulsed radiographs to mitigate radiation exposure (2). The PLA, a fundamental parameter, was demarcated as the discernible lung contour within the image, excluding the regions obscured by the left heart border. The computation of the PLA is rooted in the average pixel density of the lung field, with automated tracing enabling its calculation.

As shown in *Table 1*, the findings underscore the robust correlations between the DCR-derived lung volume subdivisions at various respiratory stages and the corresponding volume equivalents deduced from the WBP measurements. While spirometry involves airflow quantification, this study leveraged plethysmography, an encompassing modality that gauges lung capacity, diffusion proficiency, airway resistance, and reactivity. Significantly relevant to CF management is the percent predicted forced expiratory volume in one second (%FEV1), a spirometric measurement employed for severity assessment, treatment evaluation, prognostic indications, and acute exacerbation diagnosis (3-5). However, the inherent limitations of %FEV1, including its restricted sensitivity and relevance only to specific patient subsets (such as those beyond six years of age), have promptly established the significance of periodic lung volume and diffusion capacity evaluations via plethysmography (6-8).

The distinctive attribute of this study is its proposal of a model—a prediction equation—harvesting the DCR-measured lung field area as a predictor variable, along with age, height, and weight, to estimate lung volume subdivisions. The model exhibited notable predictive precision. Nonetheless, the study is limited by the inability to capture images during full expiration in select cases, which is a constraint imposed by radiation exposure

Table 1 Correlations between DCR lung volume subdivision and WBP equivalents

DCR lung volume subdivision	Calculation	WBP volume equivalent	r	P
Total lung area	PLAinsp	TLC	0.78	<0.001
Inspiratory capacity area	PLAinsp-PLAte	IC	0.72	<0.001
Functional residual lung area	PLAinsp-IC area	TGV	0.91	<0.001
Residual lung area	PLAexp	RV	0.82	<0.001

The respiratory phases for each lung area were as follows: maximum inspiratory position (PLAinsp), maximum expiratory position (PLAexp), tidal inspiratory position (PLAti), and tidal expiratory position (PLAte). DCR, dynamic chest radiography; WBP, whole-body plethysmography; TLC, total lung capacity; IC, inspiratory capacity; TGV, thoracic gas volume; RV, residual volume.

thresholds. This constraint resulted in the omission of the residual lung area assessment, despite its substantial correlation, warranting further exploration in future research.

In the context of evaluating pulmonary function in individuals with respiratory conditions including chronic obstructive pulmonary disease, interstitial pneumonia, and CF, there has been an influx of dynamic digital radiography and image processing methodologies. Previous studies have highlighted the use of DCR to evaluate respiratory function and treatment efficacy, specifically for CF (9,10). The extant literature portrays DCR as displaying connections with unique assessment metrics, such as PLA, diaphragmatic excursion, and displacement velocity, all in relation to spirometry (11,12). Remarkably, this study explored the interplay with plethysmography, broadening the horizons of diverse assessment paradigms and amplifying accuracy in disease evaluation.

Attributes of DCR, encompassing its adaptability for image capture in various physiological postures—upright and seated—augment its potential for repetitive imaging, thus accentuating its minimally invasive disposition attributed to controlled radiation exposure and expedited examination durations. These attributes enable comprehensive evaluation during forced respiratory endeavors and the quiescence of tidal breathing. The synergy of image-processing capabilities further engenders nuanced assessments, ranging from blood flow dynamics (13) to lung motion velocity tracking through vectors (14). While recognizing the valuable information provided by lateral DCR images, it is important to be mindful of intricacies arising from anatomical overlaps that can introduce complexities, thereby affecting the two-dimensional evaluation capability of DCR. However, this limitation is offset by DCR's innate simplicity, which renders it suitable for clinical applications.

With the envisaged augmentation of data from an expanding array of cases, the ascendancy of DCR as a promising assessment methodology is imminent.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the editorial office, *Journal of Thoracic Disease*. The article has undergone external peer review.

Peer Review File: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1394/prf

Conflicts of Interest: The author has completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-1394/coif). The author has no conflicts of interest to declare.

Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Cite this article as: Hanaoka J. Future expectations for respiratory disease assessment in dynamic chest radiography. J Thorac Dis 2023;15(12):7159-7161. doi: 10.21037/jtd-23-1394