

available at [www.sciencedirect.com](http://www.sciencedirect.com)journal homepage: [www.elsevier.com/locate/rmed](http://www.elsevier.com/locate/rmed)

## LETTER TO THE EDITOR

### Reply to Hochhegger et al.

Dear Editor,

We like to thank dr Hochhegger and colleagues for their important comment on our paper "Distribution of emphysema in heavy smokers: Impact on pulmonary function". They highlight an important issue in automated quantification of emphysema, which cannot easily be solved. While the first studies comparing the extent of low attenuation areas to the extent of emphysema used high dose CT scans<sup>1,2</sup> current studies investigating emphysema with CT scans often use low dose protocols<sup>3,4</sup> because of the intrinsic risk of applied radiation.<sup>5</sup> Yuan et al. have shown that using a low-dose protocol results in increased emphysema scores, caused by increased noise levels, which should be corrected for.<sup>6</sup> Therefore, we applied a noise filter before quantifying the extent of low attenuation areas.<sup>7</sup> Schilham et al. have previously shown that applying such a noise reduction filter results in emphysema scores that are comparable to emphysema scores obtained from high dose CT scans performed in the same session.<sup>7</sup> We agree with Dr Hochhegger et al. that application of such a noise reduction filter can only reduce the problem, but won't solve the issue completely. Therefore, we would like to state that automated quantification of low attenuation areas on CT is not suitable to detect emphysema on an individual basis, but it can be used to detect progression of disease as long as all parameters are kept constant.<sup>8</sup> However, we believe that in a large cohort, automated quantification can be used to investigate associations, as is done in this investigation.

We have shown that distribution of CT emphysema has a small and therefore probably a clinical irrelevant impact on spirometry results; an effect, which was independent of the applied density threshold. Therefore, it is unlikely that the increased noise levels in the CT scans of our population had have impact on the observed trends.

Although it has been recommended previously to use at least 200 mA for automated quantification of emphysema, we believe that the dose issue and intrinsic risk on radiation-induced cancer is too important. Therefore, we like to advocate using a low dose protocol in combination

with a noise reduction filter for automated quantification of emphysema instead of high dose protocol.

### Conflict of interest

The authors have no conflict to declare.

### References

1. Gevenois PA, De MV, De VP, Zanen J, Yernault JC. Comparison of computed density and macroscopic morphometry in pulmonary emphysema. *Am J Respir Crit Care Med* 1995;152(2):653–7.
2. Muller NL, Staples CA, Miller RR, Abboud RT. "Density mask". An objective method to quantitate emphysema using computed tomography. *Chest* 1988;94(4):782–7.
3. Dransfield MT, Washko GR, Foreman MG, Estepar RS, Reilly J, Bailey WC. Gender differences in the severity of CT emphysema in COPD. *Chest* 2007;132(2):464–70.
4. Vestbo J, Anderson W, Coxson HO, et al. Evaluation of COPD longitudinally to identify predictive surrogate end-points (ECLIPSE). *Eur Respir J* 2008;31(4):869–73.
5. Brenner DJ, Hall EJ. Computed tomography – an increasing source of radiation exposure. *N Engl J Med* 2007;357(22):2277–84.
6. Yuan R, Mayo JR, Hogg JC, et al. The effects of radiation dose and CT manufacturer on measurements of lung densitometry. *Chest* 2007;132(2):617–23.
7. Schilham A, Van Ginneken B, Gietema H, Prokop M. Local noise weighted filtering for emphysema scoring of low-dose CT images. *IEEE Trans Med Imaging* 2006;25(4):451–63.
8. Madani A, Zanen J, de Maertelaer V, Gevenois PA. Pulmonary emphysema: objective quantification at multi-detector row CT—comparison with macroscopic and microscopic morphometry. *Radiology*; 2006:2382042196.

Hester A. Gietema\*

Pieter Zanen

Arnold Schilham

Bram van Ginneken

Rob J. van Klaveren

Mathias Prokop

Jan Willem J. Lammers

University Medical Center, Radiology, Heidelberglaan 100,  
3584 CX Utrecht, Netherlands

\*Corresponding author. Tel.: +31 887556687.

E-mail address: [h.gietema@umcutrecht.nl](mailto:h.gietema@umcutrecht.nl) (H.A. Gietema)

DOI of original article: 10.1016/j.rmed.2009.10.032.

20 November 2009