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学位の種類	博　士　（医　学）
学位記番号	博　士　乙　第　４１１　号
学位授与の要件	学位規則第４条第２項該当
学位授与年月日	平成２７年　３月１０日
学位論文題目	Airway Wall Area Derived from 3-Dimensional Computed Tomography Analysis Differs among Lung Lobes in Male Smokers. （男性喫煙者の 3 次元 CT を用いた気道解析における肺葉の影響に関する研究）
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別紙様式３

論　文　内　容　要　旨

※整理番号	415	氏　名（ふりがな）	Nguyen Van Tho（ぐえん　ばん　とう）
学位論文題目	AIRWAY WALL AREA DERIVED FROM 3-DIMENSIONAL COMPUTED TOMOGRAPHY ANALYSIS DIFFERS AMONG LUNG LOBES IN MALE SMOKERS （男性喫煙者の３次元 CT を用いた気道解析における肺葉の影響に関する研究）		

INTRODUCTION

Computed tomography (CT) has been used as a non-invasive tool for assessing morphological changes in chronic obstructive pulmonary disease (COPD). Airway wall area measured by quantitative CT reflects airway remodeling and is associated with clinical symptoms and pulmonary function tests in patients with COPD. The square root of airway wall area of a hypothetical airway with internal perimeter of 10 mm (√Aaw at Pi10) has been used as a comparable index of airway dimensions in many studies thanks to its adjustment for airway size. However, it is time-consuming to obtain √Aaw at Pi10 from all airways of the whole lungs.

We hypothesized that √Aaw at Pi10 differs among the five lung lobes and √Aaw at Pi10 derived from one certain lung lobe has a high level of agreement with that derived from the whole lungs in smokers.

METHODS

Each of 157 male smokers (102 COPD, 55 non-COPD) underwent pulmonary function testing and chest volumetric CT on the same day at the University Medical Center at Ho Chi Minh City. CT data were saved in the form of DICOM files and transferred to the Shiga University of Medical Science for analysis using Pulmonary Workstation 2 software (VIDA diagnostics, Coralville, IA, USA). All visible bronchial segments from the 3rd to 5th generations were segmented, labeled, and measured. √Aaw at Pi10 of the whole lungs was derived from all measurable bronchial segments of the whole lungs, while √Aaw at Pi10 of each individual lobe was derived from all measurable bronchial segments of that lobe.

（備考）１．論文内容要旨は、研究の目的・方法・結果・考察・結論の順に記載し、２千字程度でタイプ等で印字すること。

２．※印の欄には記入しないこと。

RESULTS

Using a mixed-effects model, √Aaw at Pi10 differed significantly among the five lung lobes ($R^2 = 0.78$, $P < 0.0001$). √Aaw at Pi10 of the right upper lobe (RUL) was significantly thinner than that of the four other lobes; √Aaw at Pi10 of the left lower lobe (LLL) was significantly thicker than that of the other lobes. The magnitude of the difference in √Aaw at Pi10 between each pair of lobes was greater in COPD than in non-COPD subjects.

The Bland-Altman plots show that √Aaw at Pi10 derived from the right or left upper lobe (LUL) had a high level of agreement with that derived from the whole lungs, while √Aaw at Pi10 derived from the right or left lower lobe did not.

√Aaw at Pi10 derived from each individual lobe was negatively associated with FEV_1/FVC, FEV_1 % predicted, and $FEF_{25-75\%}$ % predicted.

The percentage of low attenuation volume (LAV%) derived from each individual lobe was also negatively associated with FEV_1/FVC, FEV_1 % predicted, and DL_{CO}% predicted.

DISCUSSION

The difference in airway wall area among the five lung lobes implies that airway dimensions are heterogeneous in smokers, especially in those with COPD. This finding suggests that lung lobes should be taken into account when estimating airway dimensions from CT images for each subject, or when comparing airway dimensions between or within subjects.

Therefore, there are two options to estimate √Aaw at Pi10 for each subject: from all measurable bronchial segments of the whole lungs or from all measurable bronchial segments of the lobe that is representative of the whole lungs. The first option is usually time-consuming. The second option may be the alternative to save time. In this instance, √Aaw at Pi10 of RUL or LUL can be used as a surrogate for that of the whole lungs. The second option is supported by the finding that √Aaw at Pi10 or LAV% derived from each individual lobe correlated well with pulmonary function tests.

CONCLUSION

CT-derived airway wall area differs among the five lung lobes, and airway wall area of the right or left upper lobe is representative of the whole lungs in male smokers.

別紙様式８（課程・論文博士共用）

学位論文審査の結果の要旨

整理番号	415	氏　名	Nguyen Van Tho
論文審査委員			

（学位論文審査の結果の要旨）（明朝体１１ポイント、６００字以内で作成のこと。）

CT は慢性閉塞性肺疾患（COPD）の非侵襲的形態診断ばかりでなく、定量的 CT として肺気腫や気管支壁リモデリングの評価に用いられる。気管支壁のリモデリング評価の最新手法は三次元 CT データと解析ソフトを利用して、壁面積二乗根と内周囲長の回帰直線から仮想的な 10mm における壁面積二乗根（Pi10）を出す方法である。Pi10 はいくつかの研究で有用性が示されているが、算出に時間がかかるのが難点である。そこで、157 人の男性喫煙者において、肺葉ごとに Pi10 を算出し、肺葉による違いを明らかにするとともに、算出時間の短縮のために、どの肺葉の計測値が全肺を代表できるかの検討を行い、以下の点を明らかにした。

１．Pi10 は肺葉によって算出値が異なり、右上葉が最も小さく、左下葉が最も大きかった。
２．COPD では non-COPD と比べ、肺葉間の Pi10 値に、より大きな違いがみられた。
３．全肺 Pi10 との比較では、両側の上葉 Pi10 値は、ばらつきが小さく、両者に高い一致がみられたが、下葉 Pi10 値では気管支径の増加とともにばらつきが増加した。
４．右上葉 Pi10 が全肺を代表する指標として用いることができる。

本論文は、気管支壁のリモデリングの定量的 CT 評価法に新しい知見を与えたものであり、最終試験として、論文内容に関連した試問を受け合格したので、博士（医学）の学位論文に値するものと認められた。

（総字数　591　字）

（平成　27 年　1 月　26 日　）