ABSTRACT – OCT/OFDI IN AIRWAYS

Feasibility of Assessing the abnormal Paediatric Airway using Rotational Optical Coherence Tomography - The OCT Air Study

Anne Katrine Bak Poulsen[1], Signe Thim[1], Thomas Kjærgaard[2], Emil Holck[3], Sune Rubak[1]

[1] Danish Centre for Paediatric Pulmonology and Allergology, Department of Paediatrics and Adolescents Medicine, Aarhus University Hospital, Denmark

[2]Department of Ear Nose Throat, Aarhus University Hospital, Denmark

[3] Department of Cardiology, Aarhus University Hospital, Denmark

Introduction:

Abnormalities in the paediatric airway are usually diagnosed and assessed by a computerized tomography (CT)-scan and by performing diagnostic dynamic bronchoscopies (DDB). However, these methods have several limitations in the airway; CT-scans use a high dose of ionizing radiation, which generally should be avoided in children. Additionally, the CT-output is not dynamic, thus compromising the output due to the large impact of the respiratory motion on the airway's format and volume.

The DDB output is dynamic, but it is solely visually quantifiable by bronchoscopist, creating a risk of interobserver variability when grading stenoses.

These limitations create a demand for an alternative measuring method that is both objectively quantifiable and with the ability to obtain real-time dynamic cross-sectional images of the airway.

The catheter-based methods Optical Coherence Tomography (OCT) and Optical Frequency Domain Imaging (OFDI) can obtain dynamic cross-sectional images by using light close to the infrared range and thus without any radiation dosage. The methods are already implemented within other medical fields such as cardiology and ophthalmology, and this study aims to investigate whether these abilities also apply in the airway.

Methods:

OCT/OFDI of the airway was performed on nine paediatric subjects in relation to diagnostic bronchoscopies due to severe respiratory diseases/symptoms. One of the cases had the procedures performed twice.

The obtained data was subsequently analysed for anatomical abnormalities and divergences as well as normal structures using QCU-CMS (Leiden University, the Netherlands). The OCT/OFDI output was compared to the DDB- and CT-output, both regarding qualitative and quantitative findings of the procedures.

Additionally, a preliminary correction constant, that should be applied when analysing scans obtained from an air-filled environment instead of a liquid-filled environment is calculated based on 3D-printed phantoms of the porcine airway.

Results:

The data shows that OCT/OFDI imaging is useful in evaluating the paediatric airway. Generally, the findings of OCT/OFDI corresponds very well to the findings of DDB and CT-scans.
The data will be fully analysed and the quantitative data, including a value for the preliminary correction constant, will be presented at the DSPAP annual meeting in January 2024.

Conclusions:

OCT/OFDI as a diagnostic tool in the paediatric airway shows promising results.
While OCT/OFDI has been used extensively in other medical fields this study is one of the first to assess its feasibility and utility in the pediatric airway. The results of our study align with prior research in cardiology and ophthalmology, demonstrating that the methods can enhance procedural outcomes by improving accuracy of measurements.