[1] DEPARTMENT OF PEDIATRIC AND ADOLESCENT MEDICINE, ULM UNIVERSITY MEDICAL CENTER

[2] INSTITUTE OF GENERAL PHYSIOLOGY, ULM UNIVERSITY

Short-term Effects of a Novel Bronchial Drainage Device in Cystic Fibrosis Patients

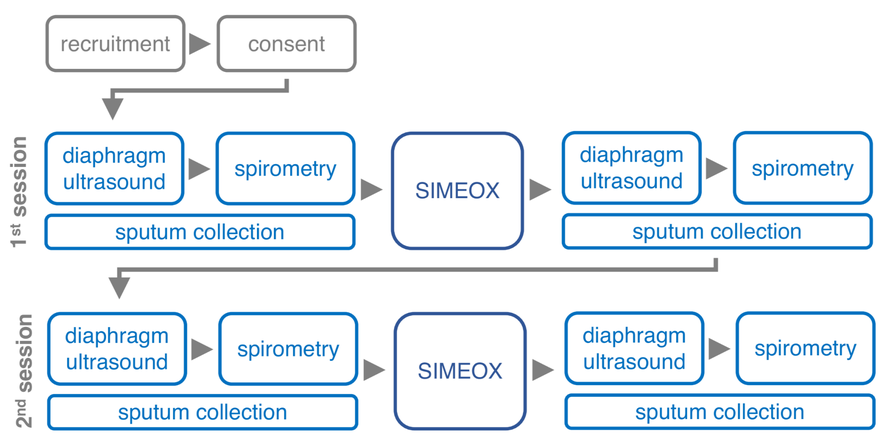
HANNA SCHMIDT[1,2], MONIKA TOTH[1], CHRISTINE KÄPPLER-SCHORN[1], UTE SIEBENEICH[1], SEBASTIAN FN BODE[1], DORIT FABRICIUS[1]

Introduction

In airways of Cystic fibrosis (CF) patients, impaired airway mucociliary clearance and mucus accumulation due to CFTR defects contribute to inflammation, progressive structural lung damage, and decline of lung function. Physiotherapy is essential to promote mucus mobilization and removal. For this purpose, a novel bronchial drainage device (BDD) (Simeox, PhysioAssist, France) using an oscillatory technology had been recently developed.

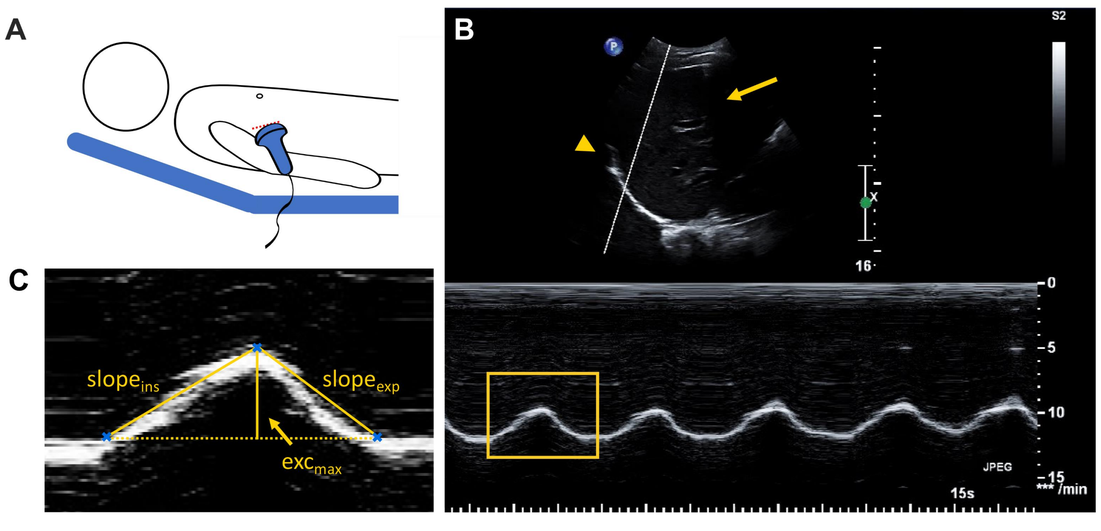
In this study, we investigated BDD short-term effects in patients with CF. We hypothesized that the novel BDD improves lung function and diaphragm mobility and affects sputum properties.

Study design



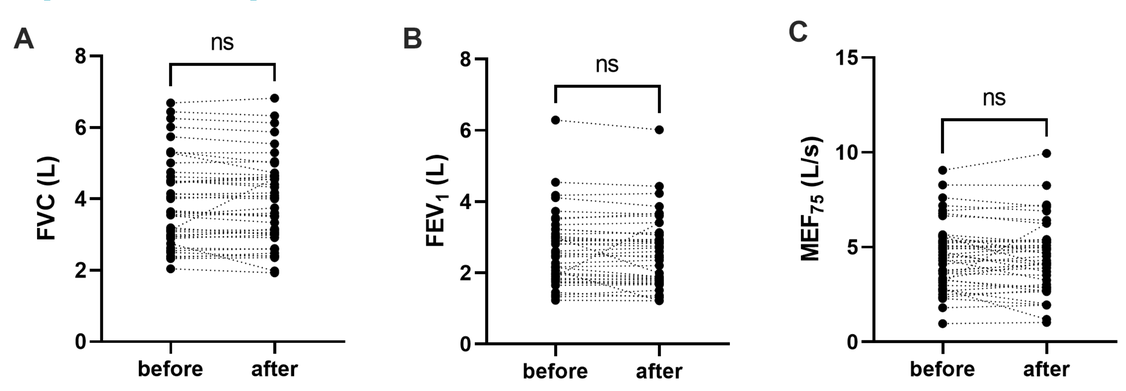
21 adult patients with stable CF lung disease participated in two physiotherapy sessions using the novel BDD. We assessed lung function parameters using spirometry and diaphragm mobility using m-mode ultrasound analysis before and after both study sessions. Spontaneous sputum samples were collected before and after using the BDD and analysed for viscosity and DNA concentrations.

Diaphragm mobility



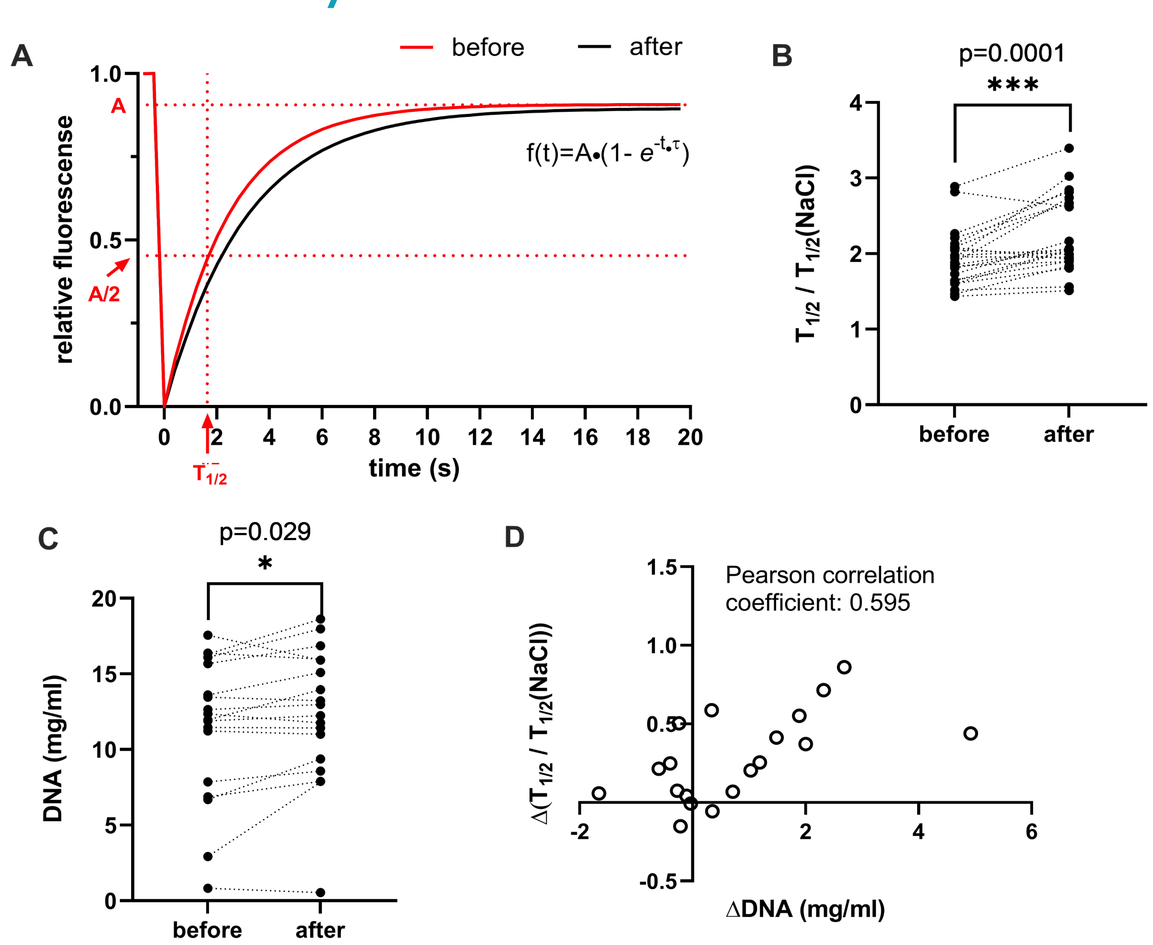
(A) Diaphragm mobility was assessed using ultrasound measurements in lying position during tidal breathing. (B) B-mode imaging (top) of the diaphragm (▲) dorsal to the liver (→) with corresponding M-mode record (bottom) over 5 breaths. (C) Representative analysis of a single breath from the M-mode record: maximum diaphragm excursion (exc_{max}), slope during inspiration ($slope_{ins}$), slope during expiration ($slope_{exp}$). (D) exc_{max} is increased after using the BDD compared to baseline (p=0.020, one-tailed, paired Student's t-test; n=40). (E-F) $slope_{ins}$ and $slope_{exp}$ were not significantly affected by the intervention (p=0.121 and p=0.057, one one-tailed, paired Student's t-test; n=40).

Spirometry



(A) FCV, (B) FEV1 and (C-E) mean expiratory flow at 75, 50 and 25% of FVC (MEF75, MEF50 and MEF25) did not differ before and after using the BDD. (p=0.662, p=0.474, p=0.601 for FVC, FEV1, MEF75 using two-tailed, paired Student's t-test; p=0.331 and p=0.314 for MEF50 and MEF25 using Wilcoxon matched-pairs signed rank test; n=42).

Mucus viscosity and DNA concentration



Sputum viscosity was determined in FRAP experiments. (A) Representative FRAP recovery curve of samples collected before and after using the BDD Halftime of recovery was calculated from a fitting curve with f(t)=A·(1-e-t·τ) and normalized to $T_{1/2}$ of saline (NaCl). (B) $T_{1/2}/T_{1/2}$(NaCl) was higher in sputum samples collected after using the BDD (p=0.0001; paired Student's t-test; n=23). (C) Total sputum DNA concentrations were elevated in samples collected after using the BDD (p=0.029; paired Student's t-test; n=19). (D) The difference of $T_{1/2}/T_{1/2}$(NaCl) between samples collected before and after using the BDD correlated with the difference of DNA concentration in the respective sample pair. Pearson correlation coefficient: 0.595; p=0.072; n=19. *FRAP: fluorescence recovery after photobleaching; $T_{1/2}$: halftime of recovery; A: final recovered intensity; t: time; τ: recovery time constant*

Summary

Use of the novel bronchial drainage device Simeox® improved diaphragm mobility and promoted the expectoration of highly viscous mucus in a cohort of Cystic Fibrosis patients.