P-15

A HIGH SPATIAL AND TEMPORAL RESOLUTION LUNG SENSOR/TARGET, FOR STUDIES IN LUNG PHYSIOLOGY AND NAVIGATED BRONCHOSCOPY

Leira H[1,2], Langø T[3], Hofstad EF[3], Amundsen T[1]

1 St. Olavs Hospital, Dept. Thoracic medicine, Trondheim, Norway
2 Norwegian University of Science and Technology (NTNU), Dept. Circulation and Medical Imaging, Trondheim, Norway
3 SINTEF, Dept. Medical Technology, Trondheim, Norway

Lung respiratory movement is a challenging cause of reduced accuracy in navigated bronchoscopy, especially when navigation is based on preoperative imaging. Current imaging methods for lung movement evaluation, like fluoroscopy, 4D CT, and 4D MRI have limited usefulness in lengthy experiments and concurrent instrumentation. We have developed a removable lung sensor, to be used as a target for navigated bronchoscopy research, and for the study of lung respiratory behavior during disease and bronchoscopic intervention.

The lung sensors are made from balloon catheters fitted with electromagnetic tracking sensors. The method was evaluated in a ventilated swine model by recording the movement of the sensors in several lung lobes at various body positions and tidal volumes. The sensors were tracked at 40 Hz with a precision of ~0.5 mm. The sensors were later used to record lung target behavior during simulated navigated bronchoscopy.

The high spatial and temporal resolution allowed us to record lung segment movement in great detail. We were able to depict at high resolution the cardiac influence on lung movement and the normal respiratory hysteresis (the different tracks a lung segment follows at inspiration and expiration). We also detected distinct differences in the lung segment behavior between supine and lateral body position.

In electromagnetic navigated bronchoscopy, which relies on static preoperative CT-images, lung movement needs to be accounted for to achieve high accuracy, precision and biopsy success rate. Respiratory compensation techniques are implemented in some systems, but more erratic disturbances may be hard to correct for.

During the simulated navigated bronchoscopy, the bronchoscope did not affect lung segment movement while positioned in the trachea, main bronchus or lobe bronchus. In the wedge position, i.e. the position often used for biopsy and treatment, the lung target was displaced and its respiratory movement was inhibited and reoriented. The resulting movement track of a lung target would in such a state at no point correspond

to what is depicted in the preoperative CT scan, which may represent one important cause to the relatively low success rate in navigated bronchoscopy.