Interfraction Stability of Electromagnetic Navigational Bronchoscopy-placed Embolization Coil Fiducial Markers for Lung SBRT

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Disclosures: None
Background

• SBRT has become standard of care for patients with early-stage inoperable NSCLC

• Fiducials as surrogates of tumor position are being increasingly used
  – Cyberknife® Synchrony® system
  – Difficult to ascertain tumor location in patients with large amounts of consolidation/atelectasis
Background

- Fiducial placement
  - Transthoracic
  - Intravascular
  - Bronchoscopic
- Transthoracic approach associated with high rates of pneumothoraces
  - Mortality, morbidity and increased cost (hospital stays)
  - Pneumothorax rate ~ 25 – 30%
- Bronchoscopic method with much better side-effect profile

Electromagnetic Navigational Bronchoscopy (superDimension®)

• A minimally-invasive, CT-based localization device that navigates the bronchoscope to peripheral lesions
  – Planning Phase
  – Navigation Phase
Planning phase
Location Board
Procedure Screen
Fiducial types

• Gold seeds
  – Quite effective and stable in multiple sub-sites
  – High dislocation rate in the lung
    • 10-20%

• Embolization Coils
  – Very high retention rate secondary to better ability to anchor in small bronchi and soft tissues

Anantham, *Chest*, 2007
Hong, *IJROBP*, 2011
Study Aims

• To assess the feasibility and safety of ENB-placed embolization coil fiducials
• To assess the accuracy of ENB for placing fiducial markers
• To assess the stability of embolization coils throughout a five fraction SBRT treatment
Materials and Methods

- Retrospective analysis of planning CT scans and pre-treatment cone-beam CTs
  - 34 tumors and 106 ENB-placed embolization coils analyzed, 3 to 4 coils per tumor
- SBRT treatment courses of 5 fractions
  - 3D distance between the geometric center (centroid) of the contoured fiducial markers and the contoured tumor were compared between daily CBCTs and the respective planning CT
  - The distance form each implanted fiducial marker to the tumor surface was analyzed on each planning CT
Results

• Average distance between individual fiducials and tumor surface was < 1 cm
• Median migration
  – 1.5mm (0.01mm – 10mm)
Results

• Two of 33 patients exhibited asymptomatic pneumothoraces on post-ENB CXR
  – Subclinical, chest tube was not required, both patients discharged the following day

• Two tumors with fiducial placement > 5cm from the tumor
  – One patient incurred pneumothorax
  – One with collapsed airways leading to difficult procedure

• Three tumors with fiducial displacement of > 7mm between fractions
  – Two had fiducial placements > 5cm from tumor
  – One exhibited retraction of the tumor to the chest wall
Conclusions

• ENB placement of fibered platinum embolization coils
  – Low rate of iatrogenic pneumothoraces
  – Reliable placement in close proximity to the lung tumor with very minimal interfraction displacement
Limitations

- Relatively low density, limiting their use to kV imaging
- Operator experience with ENB is most likely predictive of accuracy of fiducial placement
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