INTERVENTIONAL PULMONOLOGY: ROLE IN LUNG CANCER MANAGEMENT

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DISCLOSURES

• CONSULTANT - BOSTON SCIENTIFIC
• CONSULTANT - MEDTRONICS
• CONSULTANT - AURIS SURGICAL ROBOTICS
• CONSULTANT - INTUITIVE SURGICALS
DEFINITION

• INTERVENTIONAL PULMONOLOGY (IP) IS A NEW SPECIALTY THAT FOCUSES ON MINIMALLY INVASIVE TECHNIQUES IN THE DIAGNOSIS, TREATMENT AND PALLIATION OF DISEASES OF THE CHEST.

• VERY FEW INTERVENTIONAL TRAINING PROGRAMS IN THE U.S
OVERVIEW

• IP APPLICATIONS FOR DIAGNOSIS, TREATMENT AND PALLIATION OF THORACIC MALIGNANCIES

• TECHNOLOGY OVERVIEW

• TISSUE TECHNOLOGY INTERACTIONS

• FUTURE APPLICATIONS AND ADVANCES
ANATOMICAL CONSIDERATIONS

- 17-25 GENERATIONS
- TRACHEA 20-25 MM
- MAINSTEM 12-16 MM
- SEGMENTAL 5-8 MM
- THERAPEUTIC SCOPE 5.8 MM
  DIAGNOSTIC 5.2 MM OD
TECHNOLOGICAL ADVANCES

• PERIPHERAL ACCESS – EMN
• IMAGE GUIDED PROCEDURES- EMN, VBE, VERAN
• DIRECT VISUALIZATION- (R) EBUS, SPYGLASS
• CATHETER BASED TECHNOLOGY- APC, CRYO, LASER, CSA
• COMMON DISEASES/PROCEDURE- ENDO-LVRS, BT
• TREATMENT & PALLIATION – BT, STENTING
• SIMPLIFIED PROCEDURES- PLEUROSCOPY
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DIAGNOSIS
Electromagnetic Navigation

“Mapquest”

“Lungquest”
COMPARABLE TO GPS
Navigation Catheter

• Locatable guide sensors transmit location from 6 degrees of freedom: X, Y, Z, Roll, Pitch and Yaw

• Continuous data acquisition
### Edge™ Navigation Catheter Components

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<td>Edge™ locatable guide</td>
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<td>Edge™ bronchoscope adapter</td>
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**Edge™ Navigation Catheter**

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<td><img src="image1" alt="Edge™ 180° extended working channel" /></td>
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<td><img src="image3" alt="Edge™ 45° extended working channel" /></td>
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I-LOGIC SYSTEM
EMN- CASE ILLUSTRATION

• 57 YO MAN OF JAPANESE ANCESTRY
• PRESENTED WITH RESPIRATORY SYMPTOMS INCLUDING COUGH
• FOUND TO HAVE A 1.2 CM NODULE IN LUNG
• MILDLY PET POSITIVE.
• RECOMMENDED LOBECTOMY
• SMALL HILAR LYMPH NODES
NODULE-LUNG WINDOWS
BEFORE AND AFTER TREATMENT WITH PRAZIQUANTEL
EMN CASE PRESENTATION

• SMOKER

• INCIDENTAL DIAGNOSIS

• PET MILDLY POSITIVE
EDGE CATHETER 90°
BIOPSY

• ADENOCARCINOMA

• ADEQUATE LUNG FUNCTION

• RUL-LOBECTOMY
EMN CASE PRESENTATION

• 76 YEAR OLD FORMER HEAVY SMOKER

• CT DONE FOR SCREENING

• 6 MM NODULE GREW TO 8 MM IN INTERVAL F/U
BIOPSY

- SMALL CELL LUNG CANCER
- PET POSITIVE
- MRI NEGATIVE
- LOBECTOMY 14 LYMPH NODES NEGATIVE.
- DISEASE FREE- 6 YRS.
- RECURRENCE IN RETROPERITONEUM
CONFOCAL ENDOMICROSCOPY

• 59 YR OLD FEMALE NON SMOKER

• RUL LOBECTOMY FOR ADENOCARCINOMA 2011

• MOTHER HAS H/O LUNG CANCER

• TWIN SISTER WITH SLOW GROWING LUNG NODULES.
CONFOCAL VIEW.
Combination IPOX stain (TTF-1 brown; Napcin A red): Positive/Positive
FUTURE DIRECTIONS IN PERIPHERAL LUNG ACCESS
ROBOT ASSISTED BRONCHOSCOPY

- REMOTE CONTROLLED
- MOTHER-DAUGHTER CONCEPT
- STABILITY
- HANDS FREE BIOPSIES
- THERAPEUTIC OPTIONS?
ROBOT ASSISTED BRONCHOSCOPIES

- DIRECT ENDO LUMINAL ASSESSMENT
- US ASSISTANCE FOR EXTRA LUMINAL LESIONS
- SELECTIVE WASHINGS
- IMPLANTATION OF FIDUCIALS
ENDOBRONCHIAL ULTRASOUND

LYMPH NODE STATIONS
NEW IASLC NODAL MAP

- Important features include better definition of the subcarinal zone as extending down to the level of origin of the left lower lobe and right middle lobe bronchus.
- The border between left- and right-side paratracheal nodes is the left lateral border of the trachea (not the midline).
- The 4R nodal area extends from the lower border of the left innominate vein to the lower border of the azygous vein.
- The 4L nodal region extends from the level of the top of the aortic arch to the upper border of the left-side pulmonary artery medial to the ligamentum.
- The level 2 regions extend from the border of level 4 to the upper border of the manubrium in the midline.
- The supraclavicular nodes extend from the lower border of the clavicles to the lower border of the cricoid.
ULTRASONOGRAPHIC AIRWAY ANATOMY

• The central airway is visualized as seven layers, each about a mm thick.

• Mucosa, submucosa, inner and outer cartilage lining, cartilage tissue, external fibroelastic connective tissue and loose connective tissue.
PRINCIPLES OF ULTRASONOGRAPHY

• PIEZOELECTRIC MATERIAL (PZT, PT, QUARTZ, CERAMIC, BONE).
• TISSUE IMPEDANCE TO SONIC WAVES = CONTRAST
• TIME OF REFLECTION = DISTANCE FROM PROBE
• LOWER FREQUENCY = HIGHER PENETRATION BUT LOWER SPATIAL RESOLUTION
• CONDUCTING MEDIUM = SALINE FILLED BALLOON
• ACOUSTIC SIGNALS – MECHANICAL VIBRATION-ELECTRIC SIGNALS-GRAY SCALE IMAGES.
ENDO BRONCHIAL ULTRASOUND

• RADIAL/ CURVILINEAR
• ULTRASOUND
• 360 DEGREE CROSS-
• SECTIONAL VIEW
• 20-30, 7.5 MHZ
• PENETRATION OF 1.5 TO
• 12 CM
• IMAGE DIAMETER 3 TO 9 CM
• RESOLUTION UP TO 1 MM
• PROBE SIZE 1.4 TO 2.0 MM
RADIAL PROBE ULTRASOUND

- BLACK ARROW - NORMAL WALL
- WHITE ARROW - TUMOR

2.4 mm
5.1 mm
EBUS CASE ILLUSTRATION

• 70 YR OLD LADY WITH NEWLY DIAGNOSED BREAST CANCER
• CHEST CT SHOWS BILATERAL HILAR AND MEDIASTINAL LYMPHADENOPATHY
• PET SCAN SHOWS INCREASED FDG UPTAKE.
• NON-SMOKER
BREAST CANCER WITH BILATERAL LYMPHADENOPATHY
SARC OIDOSIS
AE NODE

• 57 yr old man with hematuria and flank pain while vacationing in Paris

• L renal cell CA resected

• ? Renal vein involvement in surgical specimen

• CT chest with AE density
Smear prep: Clusters of atypical vacuolated cells with enlarged nuclei, prominent nucleoli

Cell block: Clusters of atypical vacuolated cells with enlarged nuclei, prominent nucleoli

PAX8 immunostain: Subset of cells with positive nuclear reactivity
TECHNICAL ASPECTS

• ROSE RECOMMENDED BUT HAS NOT BEEN SHOWN TO INCREASE DIAGNOSTIC ACCURACY
  RESPIRATION 2014; 88:500-517

• 21G VS 22G DOES NOT INFLUENCE DIAGNOSTIC ACCURACY
  RESPIROLOGY 2011 16(1) 90-94; JOBIP 2011; 18: 239-246

• SUCTION VS NO SUCTION (CAPILLARY TECHNIQUE) DOES NOT INFLUENCE DIAGNOSTIC ACCURACY
  CHEST 2012. 142 (3): 568-573

• MODERATE SEDATION VS GA- NO DIFFERENCE IN DIAGNOSTIC ACCURACY
  AJRCCM 2015. 191 (7) 796-803.
CLINICAL UTILITY OF EBUS

- EBUS-TBNA SYSTEMATIC REVIEW AND META-ANALYSIS
- 22 STUDIES
- >2000 PATIENTS
- SENSITIVITY: 0.88-0.93 (95% CI 0.79-0.94)
- SPECIFICITY: 1 (95% CI 0.92-1)
- EQUIVALENT TO MEDIASTINOSCOPY SENSITIVITY, NPV, DIAGNOSTIC ACCURACY
- EXTREMELY VALUABLE IN RE-STAGING

FUTURE DIRECTIONS

• FRANCINE TIPS
• COBALT CHROMIUM/NITINOL
• BRAIDED STRUCTURE
• LINEAR ULTRASOUND WITH PERIPHERAL ACCESS
• PIZO ELECTRIC MATERIALS
• 19, 21, 22, 25 G
THERAPEUTIC APPLICATIONS
FIDUCIAL PLACEMENT

• FACILITATE SBRT
• LOCALIZATION
• COBRA, VESICOIL, BI-TRI NODE, VORTEX, TORNADO, WORM
• RF TRANSPONDERS-BEACON
EBUS GUIDED FIDUCIAL PLACEMENT
EBUS-THERAPEUTIC OPTIONS

- 71 YR OLD LADY WITH BREAST CANCER
- MASTECTOMY, RADIATION, CHEMO
- CAVITIES WITH FUNGAL BALL
- SUBMASSIVE HEMOPTYSIS
- RECOMMENDED PNEUMONECTOMY
- LIPOSOMAL AMPHO 10 MG/ML CONC, 2.5 MG/KG DOSE
EBUS-THERAPEUTIC OPTIONS.
POST TREATMENT
VALVE TREATMENT FOR BPF
VALVE APPLICATIONS

- AIRLEAK

- HYPERINFLATION IN TRANSPLANT PATIENTS

- DEFLATE LUNG FOR RADIATION
PALLIATIVE OPTIONS
APC AND CRYOPROBE

- Non Contact Coagulation/Cutting with Thermal Energy
- Flow (0.8 to 3L), Current (10 W to 80W), Pulse (3, 16/SEC)
- Flexible Probe (1.8, 2 MM) 110 cm
- Heat Based (FIO2 < 0.4)

- Nitrous Oxide Cryogen
- Joule Thompson Effect
- Freeze-Thaw Cycle
- Flexible Probe 96 cm
APC  CRYO
APC CRYO
AIRWAY RECANALIZATION
AIRWAY RECANALIZATION
TRACHEAL PAPILLAMATOSIS
TRACHEAL PAPILLAMATOSIS

- 6 YEARS OUT
- NO EVIDENCE OF RECURRENCE
- CIDOFOVIR 2.5MG/ML
- APC 30W, 1L, 3PUL/SEC
CRYOSPRAY ABLATION

- Catheter based even spray of liquid nitrogen (-196 C)
- Low/high flow options
- Rigid bronch in most cases
- Gas egress important (700 fold expansion)
- 5 sec high flow penetrates 5 mm
- Spares collagen matrix
- Airway, pleural applications
CRYO SPRAY ABLATION

- COLD THERAPY MORE TISSUE SPARING
- LESS GRANULATION TISSUE
- REDUCE NEED FOR STENTS
- LESS AIRWAY EDEMA POST PROCEDURE
- SOME COAGULATION EFFECTS
- REDUCED FIO2 NOT NECESSARY
CRYOSPRAY ABLATION

PRE

POST
CORE CATHETER
RIGID BRONCHOSCOPY
AIRWAY STENTING-RP
TRACHEO BRONCHIAL STENTING
POST TRANSPLANT STENOSIS.
FUTURE DIRECTIONS

• PERIPHERAL TUMOR ABLATIONS (MICROWAVE, RF, CRYO)

• DRUG ELUTING STENTS

• EXHALED CONDENSATES

• ENDOMICROSCOPY SYSTEMS
TALC PLEURODEISIS
THORACOSCOPY

- 7-11 mm port
- Flexible/Rigid Thoracoscope
- Double port for CSA
- Pleural biopsies
- Pleurodeisis with talc
- Chest tube
- Shorter recovery time
THE ART OF MEDICINE CONSISTS OF AMUSING THE PATIENT WHILE NATURE CURES THE DISEASE.

- VOLTAIRE