Thoracic Surgery and Lung Cancer
A Comprehensive Review

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Verbal Disclosure

- I do not have any real or apparent conflicts of interest that may have a direct bearing on the subject matter of this continuing education program.

- This pertains to relationships with pharmaceutical companies, biomedical device manufacturers, or other corporations whose products or services are related to the subject matter of this presentation topic.
Lung Cancer
Cancer in the United States

- 1,658,370 new cases diagnosed in 2015.
- 589,430 deaths annually (1620/day).
- Second-most common cause of death in the US
  - Exceeded only CAD which accounts for 1 out of every 4 deaths.
  - Poisoning/overdose in male 40-50 age group

- 5 year survival rate for all cancers diagnosed in 2004-2010 was 68%
  - 49% in 1975-1977
  - Reflects earlier diagnosis as well as improvements in treatment
Costs of Cancer

- $88.7 Billion (2011)
2015 Cancer Statistics in Maine

- **8,810 New Cases**
  - 1360 Lung/Bronchus
  - 1100 Prostate
  - 1010 Female Breast
  - 610 Colon/Rectum
  - 540 Urinary Bladder
  - 390 Non-Hodgkin Lymphoma
  - 340 Uterine Corpus
  - 320 Leukemia/Melanoma
  - 50 Uterine Cervix

- **3300 Deaths**
  - 970
  - 150
  - 180
  - 240
  - 110
  - 140
  - 50
### 2015 Leading Sites of New Cancer Cases

**Male**
- Prostate (26%)
- Lung & Bronchus (14%)
- Colon and Rectum (8%)
- Urinary Bladder (7%)
- Melanoma (5%)
- Non-Hodgkin Lymphoma (5%)
- Kidney (5%)
- Oropharyngeal (4%)
- Leukemia (3%)

**Female**
- Breast (29%)
- Lung & Bronchus (13%)
- Colon & Rectum (8%)
- Uterine (7%)
- Thyroid (6%)
- Non-Hodgkin Lymphoma (4%)
- Melanoma (4%)
- Pancreas (3%)
- Leukemia (3%)
2015 Leading Cancer Deaths

**Male**
- Lung & Bronchus (28%)
- Prostate (9%)
- Colon & Rectum (8%)
- Pancreas (7%)
- Liver (5%)
- Leukemia (5%)
- Esophagus (4%)
- Bladder (4%)
- Non-Hodgkin Lymphoma (4%)
- Kidney (3%)

**Female**
- Lung & Bronchus (26%)
- Breast (15%)
- Colon & Rectum (9%)
- Pancreas (7%)
- Ovarian (5%)
- Leukemia (4%)
- Uterine (4%)
- Non-Hodgkin Lymphoma (3%)
- Liver (3%)
Lung Cancer

- Greatest cause of cancer deaths worldwide
- Greatest cause of cancer deaths in the U.S.
- 221,200 new cases expected 2015
- > 160,000 deaths
- Lung cancer represents 15% of cancer cases, 29% of cancer deaths
- 13% of patients have never smoked.
Lung Cancer
State of Maine Statistics

- 2011 96.5/100,000 for all ages
  - 1282 per year (663 male, 619 female)
  - Mortality 51.8/100,000 (total # 920)
  - Mortality is higher in Maine than US (46.7/100,000)

- Maine male mortality 64.9/100,000
  - vs US at 57.8/100,000

- Maine female mortality 41.7/100,000
  - Vs US at 40.5/100/000

- From 2000-2010 Maine age-adjusted all cancer rate was significantly higher than US SEER rate (496.8 vs 467.1)
Maine Cancer Surveillance Report 2014

- 1294 adults dx lung cancer per year
- 75.2% of lung cancers are diagnosed at a late stage
- Maine females more likely to be diagnosed at an early stage
- Lung cancer has the highest cancer death rate in Maine
  - 13.2 % decrease over a 9-year period
  - Average annual decline 1.7%
  - Maine lung cancer death rates still remain higher than US rates during the same time period.
3 Facts That Can Impact Patient's Future

- **Tobacco Use**: Accounts for 80% of lung cancer deaths.
- **Routine CT Screenings**: Can reduce the risk of death in heavy, current, and ex-smokers by 20%.
- **Survival Rate**: Of patients diagnosed early (in stage I) is 85%, higher than those diagnosed in stage IV.
Fact #1: Tobacco Use Accounts for 80% of Lung Cancer Deaths
Common adverse effects of Tobacco smoking

- Larynx cancer
- Oral cavity cancer
- Esophagus cancer
- Myocardial infarction
- Systemic atherosclerosis
- Lung cancer
- Chronic bronchitis
- Emphysema
- Peptic ulcer
- Bladder cancer
- Pancreas cancer

“Almeida, I’m so proud of you sweetie. You haven’t smoked for a week!”
Quitting Smoking: 10-Year Trends

The CDC analyzed data on smoking cessation among 27,157 United States adults between 2001 and 2010. The analysis revealed the following.

<table>
<thead>
<tr>
<th>Number who wanted to quit</th>
<th>68.8%</th>
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<tbody>
<tr>
<td>Number who attempted to quit in past year</td>
<td>52.4%</td>
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<td>Number who recently quit</td>
<td>6.2%</td>
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<td>Number advised to quit by a healthcare provider</td>
<td>48.3%</td>
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<tr>
<td>Number who used counseling and/or medications to attempt quitting</td>
<td>31.7%</td>
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</table>

Source: Adapted from: CDC. Quitting Smoking Among Adults—United States, 2001-2010. Morbidity and Mortality Weekly Report. November 11, 2011. Available at www.cdc.gov/mmwr/preview/mmwrhtml/mm6044a2.htm?s_cid=mm6044a2_w

Changes when smokers quit

Immediately
- Air around you no longer dangerous to children and other adults.

20 minutes
- Blood pressure drops to normal
- Pulse rate drops to normal
- Temperature in hands and feet increase to normal

8 hours
- Carbon monoxide level in blood drops to normal
- Oxygen level in blood increases or normal

48 hours
- Nerve endings start regrowing
- Ability to smell and taste is enhanced

2-12 weeks
- Circulation improves
- Breathing improves
- Walking becomes easier

1-9 months
- Coughing and sinus congestion decreases
- Shortness of breath decreases
- Overall energy increases
- Lungs increase ability to self-clean and reduce infection

1 year
- Excess risk of coronary heart disease is half that of a smoker

5 years
- Stroke risk reduced to that of a non-smoker
- Risk of cancer of the mouth, throat, and esophagus is half that of a smoker

10 years
- Life expectancy comparable to a non-smoker
- Lung cancer death rate is about half the rate of a smoker
- Risk of cancer of mouth, throat, esophagus, bladder, kidney and pancreas decrease
- Precancerous cells are replaced

15 years
- Risk of coronary heart disease comparable to that of a nonsmoker
Fact #2: Routine CT Screenings can reduce the risk of death in heavy, current and ex-smokers by 20%.

Fact #3: Survival rates of patients diagnosed early (Stage I) is 85% higher than those diagnosed in Stage IV.
Why Evaluate Your Patient?

- Determine if a nodule is malignant or benign
- If malignant, determine a pathologic type
- If malignant, determine prognosis based on stage
- Determine goal of treatment
  - Curative intent
  - Palliative
  - Follow-up studies only
Why Find a Nodule Early?

<table>
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<tr>
<th>Stage</th>
<th>Frequency of Diagnosis</th>
<th>Five-Year Survival (%)</th>
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<td>IIIB</td>
<td>15%</td>
<td>3%–6%</td>
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<tr>
<td>IV</td>
<td>40%</td>
<td>&lt;1%</td>
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</table>
Why Find A Nodule Early?

Chart 2. 5-year relative survival rate: small cell lung cancer

- Stage I: 31%
- Stage II: 19%
- Stage III: 8%
- Stage IV: 2%
Rationale for Lung Cancer Screening

- Early-state lung cancer patients have a much higher 5-year survival rate (between 60-80%) 
- Changing smoking habits could reduce lung cancer incidence and deaths
- Cessation programs have long-term cessation rates of on 20-35% at one year
- The risk for lung cancer does not decrease for many years after smoking cessation.
# Lung Cancer 5-Year Survival Rates

## Non-Small Cell

- **Stage I**
  - 1a (59-73%)
  - 1b (43-58%)

- **Stage II**
  - 2a (36-46%)
  - 2b (25-36%)

- **Stage III**
  - 3a (19-24%)
  - 3b (7-9%)

- **Stage IV**
  - (2-13%)

## Small Cell

- **Stage I**
  - 1a (40%)
  - 1b (20%)

- **Stage II**
  - 2a (40%)
  - 2b (20%)

- **Stage III**
  - 3a (15%)
  - 3b (10%)

- **Stage IV**
  - (1%)
National Lung Screening Trial (NLST)

- NLST compared 2 ways of detecting lung cancer
  - Low dose helical CT
  - Standard Chest X-Ray
- To determine if CT screening could reduce lung cancer specific mortality relative to Chest X-Ray
NLST

- Enrollment: August 2002 - April 2004
- 53,454 participants with equal ethnic distribution between the 2 arms:
  - 90.8% white
  - 4.4% African American
  - 1.7% Hispanic/Latino
  - 2.0% Asian
- Participants randomized 3 annual screenings with low dose CT or CXR.
NLST

- Criteria for Participation:
  - 55-74 years of age
  - Smoking history of at least 30 pack-years
  - Former smokers who quit within 15 years

- Two sets of centers:
  - 10 Coordinating sites, 25 satellite sites
  - American College of Radiology Imaging Network hosted 23 sites.
NLST Results

- Participant compliance > 90%
- Lung cancer incidence/100,000 person-years:
  - 645 in CT arm, 572 in CXR arm
- Lung cancer mortality/100,000 person-years:
  - 247 in CT arm, 309 in CXR arm
  - Represents 20% reduction in lung cancer in CT arm

All cause mortality reduced by 6.7% in CT arm, though largely due to reduction in lung cancer deaths.
Lung Cancer Risk Assessment

- Smoking history, past or present
- Radon exposure
- Occupational exposures
- Cancer history
- Disease history (COPD, pulmonary fibrosis)
- Secondhand smoke exposure
- Absence of symptoms or signs of lung cancer
High Risk Status

- Age 55 – 74 and >30 pack year history of tobacco and smoking cessation < 15 years prior
- Age > 50 and > 20 pack year tobacco use and one additional risk factor other than secondhand smoke exposure
Moderate and Low Risk Status

- **Moderate**
  - Age > 50 years old
  - And > 20 pack year tobacco use or secondhand smoke exposure
  - No additional risk factors

- **Low**
  - Age < 50 years and/or
  - <20 pack-year history of smoking
Moderate and Low Risk patients do not require routine lung cancer screening based on the NCCN guidelines and evidence based medicine.
So, what if my patient is high risk? What do I do?

- Baseline low dose helical CT of the chest (LDCT)
  - $225.00 at MGMC
  - (National payment rate is $118.15)

- If a lung nodule is found, determine if it is solid, partly solid vs. ground glass or non solid

- If no lung nodule is present, annual LDCT screening for at least 3 years and until age 74
  - After 2 years, may want to continue yearly screening vs case by case.
Solitary Pulmonary Nodule found on X-ray or CT

- Compare with old study CXR or CT
  - If growth, consider diagnostic intervention PNAB, or VATS
  - Solid nodule, No growth >2 yr
    - Benign calcification or fat
      - No history of malignancy ± smoking history
        - ≤4 mm (micronodule)
          - If age ≥35, follow-up CT after 12 and 24 months
            - If age 18-35, follow up CT after 12 months
              - All ages, longer follow-up for ground glass nodules
        - >4-8 mm (intermediate)
          - If age ≥35, follow-up CT after 3, 9, and 24 months
            - If age 18-35, follow up CT after 6-12, and 24 months
              - All ages, longer follow-up for ground glass nodules
          - Consider PNAB, VATS, or PET
            - Attention to part solid/ground glass nodule
              - If co-morbidities and PET(-) consider follow up CT after 3, 9, and 24 months and longer for ground glass nodule
        - >8 mm (suspicious)
          - If growth, consider diagnostic intervention PNAB, or VATS

- No study available
  - CT
    - Nodule, any size
      - History of malignancy
        - Follow-up CT after 3, 6, 12 months or according to clinical protocol
        - If growth, consider diagnostic intervention PNAB, bronchoscopy, or VATS
          - Lesion resolution, no action
      - Immuno-compromised or fever
        - Short-term follow-up, ≤ 4-6 weeks and to resolution or Consider diagnostic intervention PNAB, bronchoscopy, or VATS
          - Lesion resolution, no action

- If no growth, no action
According to repeated nationwide surveys,

More Doctors Smoke CAMELS
than any other cigarette!

Doctors in every branch of medicine were asked, "What cigarette do you smoke?"
The brand named most was Camel!

You'll enjoy Camels for the same reasons so many doctors enjoy them. Camels have cool, cool mildness, pack after pack, and a flavor unmatched by any other cigarette.

Make this sensible test: Smoke only Camels for 30 days and see how well Camels please your taste, how well they suit your throat as your steady smoke. You'll see how enjoyable a cigarette can be!

THE DOCTORS' CHOICE IS AMERICA'S CHOICE!

For 30 days, test Camels in your "T-Zone" (T for Throat, T for Taste).
I'M SENDING CHESTERFIELDS to all my friends. That's the merriest Christmas any smoker can have—Chesterfield mildness plus no unpleasant after-taste

Ronald Reagan

See RONALD REAGAN starring in "HONG KONG" a Fine-Thomas Paramount Production Color by Technicolor

CHESTERFIELD

Buy the beautiful Christmas-card carton

www.whitehouse.org
Blow in her face and she'll follow you anywhere.

Hit her with tangy Tipalet Cherry. Or rich, grape-y Tipalet Burgundy. Or luscious Tipalet Blueberry. It's Wild!

Tipalet. It's new. Different. Delicious in taste and in aroma. A puff in her direction and she'll follow you, anywhere. Oh yes... you get smoking satisfaction without inhaling smoke.

Smokers of America, do yourself a flavor. Make your next cigarette a Tipalet.

New from Muriel. About 5 for 2s.
Smoking causes fatal lung cancer.
CT vs PET Scan for Lung Cancer
Lung Cancer

- Small Cell Lung (SCLC)
  - 17%

- Non-Small Cell (NSCLC)
  - 80%
    - Adenocarcinoma
    - Squamous Cell
    - Large Cell (Carcinoid)

- Others
  - 3%
    - Sarcomatoid carcinoma
    - Carcinoid tumors
    - Adenosquamous carcinoma
Small Cell Lung Cancer (SCLC)

- “Oat Cell” due to flat appearance
- Most arise in large airways (primary and secondary bronchi)
- Also prostate and cervical
- Rapidly growing, aggressive carcinoma
- Often metastatic at presentation
- 98% pts. newly diagnosed have a smoking history
- Uranium mining, radon exposure
- More responsive to chemotherapy and radiation
- Ultimately carries poor prognosis
SCLC Treatment

• Divided into two stages
  – Limited: Still in chest
  – Extensive: Metastatic at presentation

• Limited
  – Chemotherapy
    • Cyclophosphomide, cisplatinum, doxorubicin, vincristine
  – With concurrent Radiotherapy
  – Little role for surgery

• Extensive
  – Chemotherapy
  – Radiation limited to palliative symptoms
    • Dyspnea, pain, bone mets, brain mets
SCLC Prognosis

• **Limited**
  - 14-20 month median survival
  - 20% live >5 years

• **Extensive**
  - 8-13 month median survival
  - 1-5% live >5 years
Non-Small Cell Lung Cancer (NSCLC)

- Primarily treated with surgical resection
- Relatively insensitive to chemotherapy
  - Neoadjuvant (chemotherapy prior to surgery)
  - Adjuvant (post-operative chemotherapy)

- Types
  - Squamous cell carcinoma
  - Adenocarcinoma
  - Large cell carcinoma

- Most common lung cancer in non-smokers
  - Mostly adenocarcinoma
Squamous Cell Carcinoma

- More closely associated with a smoking history than any other lung cancer histotype.
- Male > Female
- Often preceded by years of metaplasia or dysplasia in bronchi epithelium
  - Identified by bronchoalveolar lavage
- Squamous cell *in situ* is undetectable by xray
- Becomes symptomatic when grows to obstruct bronchus
  - atelectasis
  - infection
Squamous Cell Cancer on CT
Squamous Cell Carcinoma
Adenocarcinoma

- Most common lung cancer in lifelong non-smokers and women
- 40% of all lung cancers
- Tend to be located peripherally in lung tissue
  - As opposed to SCLC and squamous cell which tend to be centrally located
- Treated surgically by lobectomy or pneumonectomy
- Highly heterogenous tumors
  - Numerous subtypes
Large Cell Carcinoma

- 5-10% of lung cancers
- "Diagnosis of Exclusion"
  - Cells lack microscopic characteristics of other lung cancers
- Patients typically present with cough and weight loss.
Classification of Malignant Tumors (TNM)

Cancer staging system describing extent of cancer in a particular patient.

- **T**: Tumor size and whether it has invaded local tissues
- **N**: Lymph node involvement
- **M**: Metastasis to distant parts of the body
Classification of Malignant Tumors

Primary Tumor:  

- **Tis:** Carcinoma in situ. Early form of carcinoma characterized by absence of invasion of local tissue.
- **T0:** No Evidence of a primary tumor
- **T1:** Tumor < 3cm without invasion into local tissue
- **T2:** Tumor > 3cm with/without localized invasion
- **T3:** Tumor with surgically resectable tissue invasion
- **T4:** Tumor with nonresectable tissue invasion
Classification of Malignant Tumors

- Lymph Nodes:  N
  - NX: Nodal involvement cannot be assessed
  - N0: No lymph node involvement
  - N1: Mets to ipsilateral local nodal tissue
  - N2: Mets to ipsilateral distant nodal tissue
  - N3: Mets to contralateral nodal tissue
Classification of Malignant Tumors

Distant Metastasis: M

- **MX**: Distant mets cannot be assessed
- **M0**: No distant mets
- **M1**: Distant mets

By definition, any M1 classification designates Category IV cancer
Staging of Malignant Tumors

- **Stage 0**: Carcinoma in situ
- **Stage I**: Cancers are localized to one part of the body
- **Stage II**: Cancers are locally advanced
- **Stage III**: Cancers more distantly advanced, but still in local tissue
- **Stage IV**: Cancers have metastasized, or spread to other organs or throughout the body.
## Stage Groups According to TNM Descriptor and Subgroups

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Other Pulmonary Diseases

- Interstitial Lung Disease (Pulmonary Fibrosis)
- Pulmonary Sarcoidosis
- Tuberculosis
- Mesothelioma
- Bronchiolitis Obliterans
Interstitial Lung Disease (Pulmonary Fibrosis)

- Lung is affected in 3 ways
  - Lung is damaged in some known or unknown way
  - Walls of alveoli become inflamed
  - Fibrosis begins in the interstitium

- Fibrosis results in permanent loss of elasticity and ability to transfer oxygen across tissue membranes

- Mild or Severe
- Insidious or progressive
- Course very unpredictable
- As disease progresses, lung becomes progressively thickened and stiff
- Work of breathing becomes more difficult and demanding.
Causes of ILD

- Pneumoconiosis
  - Occupational disease caused by inhalation of dust
    - Silicosis
    - Asbestosis
- Hypersensitivity pneumonitis
- Sarcoidosis
- Bronchiolitis obliterans
- Goodpasture’s syndrome
- Collagen vascular disease
  - Marfan’s Syndrome, Ehlers-Danlos Syndrome
Asbestosis

- Chronic inflammation and fibrosis of lung parenchyma caused by inhalation and retention of asbestos fibers
- Not malignant in and of itself, but places pt. at a higher risk for lung cancer and mesothelioma.
- Results in restrictive lung disease
Asbestosis
Mesothelioma

- Rare form of cancer developing in the protective lining of organs
- Most common site: Pleura of lungs
- Usually caused by asbestos exposure
- Poor prognosis: best if caught in early stages
- Cure is exceedingly rare
- Little role of surgery
- Radiation for localized disease
- Chemotherapy is only treatment shown to improve outcome
Mesothelioma
Bronchiolitis Obliterans with Organizing Pneumonia (BOOP)

- Inflammation of bronchioles and surrounding tissue
- Often a result of chronic diseases like Rheumatoid Arthritis (RA) or drugs (amiodarone)
- Results in fibrosis of the alveoli
- Results in unresolving pneumonia; hence "Organizing"
  - Pneumonia=persistent alveolar exudate
- Treated with steroids with 2/3 recovering
Bronchiolitis Obliterans Organizing Pneumonia (BOOP)
Tuberculosis

• Common and potentially deadly infection caused by *Mycobacterium tuberculosis*
• Most commonly attacks the lungs
• Most pts will develop latent asymptomatic disease
• 1 in 10 will progress to active disease with 50% mortality if not treated
• 1/3 of world’s population is infected
  – 2007: 13.7M active cases, 9.3M new cases, 1.8M deaths
• Chronic cough, blood-tinged sputum, fever, night sweats
• Transmitted by aerosolized bacterium
• Vaccine available with 85% of infants inoculated yearly
• Treatment is with long-term antibiotics
  – Rifampin, isoniazid
Smoking causes fatal lung cancer
Thank you for your kind attention