

A Revolution in Lung Cancer Care

CT Lung Screening

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Saddleback Memorial

- Low dose CT screening technique
- Radiation Dose
- Benign vs Malignant lung nodules
- Screening Paradigm

Lung CT Screening

- Very low dose protocol
 - Low mA. Relatively noisy images.
 - Collimation only to lungs.
 - ASIR technology.

Low Dose Scanning with Adaptive Iterative Reconstruction (ASIR)



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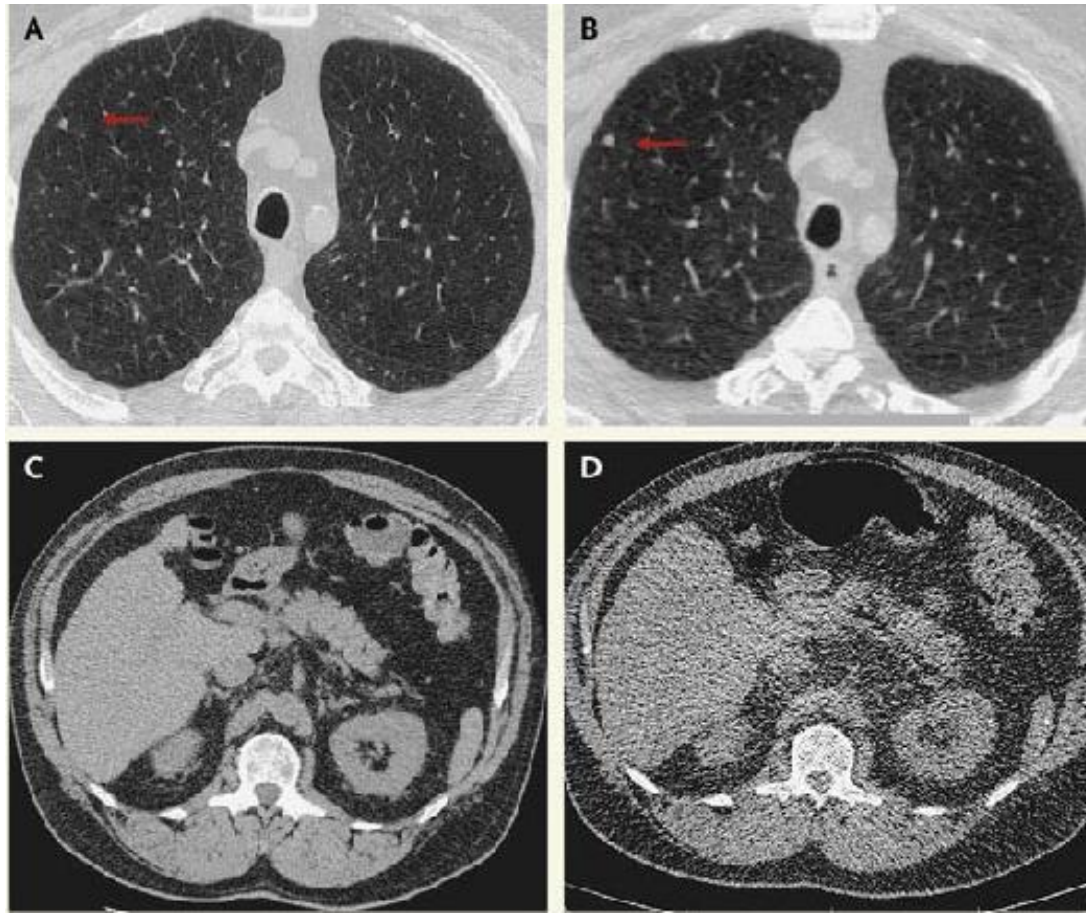


“standard dose” CT



65% dose-reduced
with ASIR

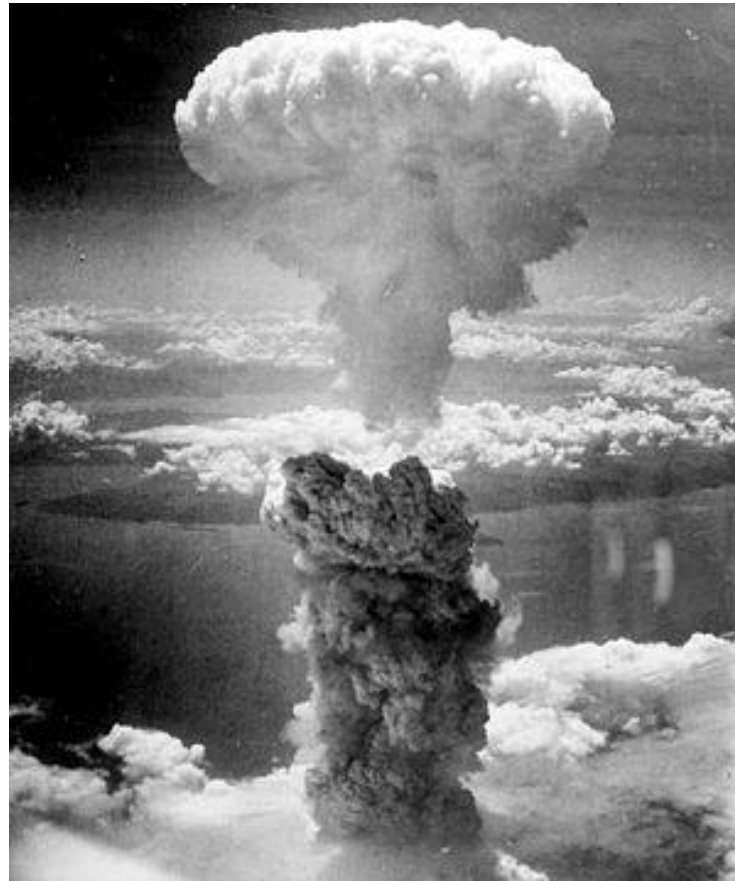
Low dose technique CT screening study



Diagnostic dose CT

Screening dose CT

Radiation Dose



Relative Radiation Dose

- 3.6 milliSieverts (mSv) per year background dose
 - Higher in Denver
- 0.1 mSv on a flight from New York to London
- CXR approximately 0.1 mSv
- Mammogram 0.7 mSv
- IVP 3 mSv
- CT abdomen/pelvis 10 mSv
- Barium Enema 10-15 mSv

- “Standard” CT Chest = 7 mSv
- Chest CT at SMMC with ASIR = 3.5 mSv
- Screening CT Chest with ASIR <1 mSv
 - Similar dose to mammography

- Lifetime increased risk of developing cancer from a screening CT chest in 50 y/o = 0.005%
 - 200x more likely of dying in an MVA
 - About equivalent to risk of fatal lightning strike
- Overall lifetime risk of developing cancer=50%
 - Three CT screenings increase risk 0.015% for total of 50.015%
 - 3 screenings decrease lung CA mortality by 20%

Lung Nodules

- Benign and Malignant Characteristics

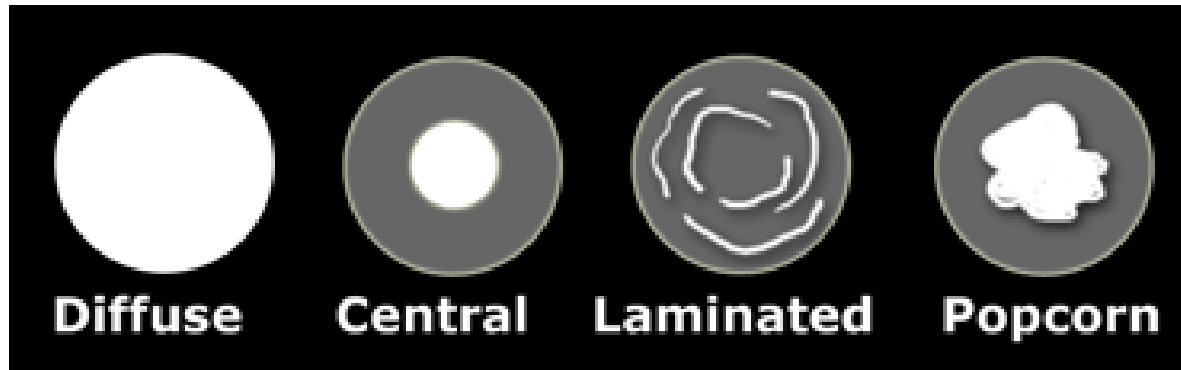
Benign Characteristics

- size

- Size at initial detection
 - Small nodules very common
 - Statistically, all nodules $\leq 6\text{mm}$ have less than 1% chance of malignancy.
 - Basis of recommending 1 year follow-up screening CT for small nodules.

Benign Characteristics

- calcification



- “Likelihood ratio” of 0.01
- Odds of CA= prior odds x 0.01

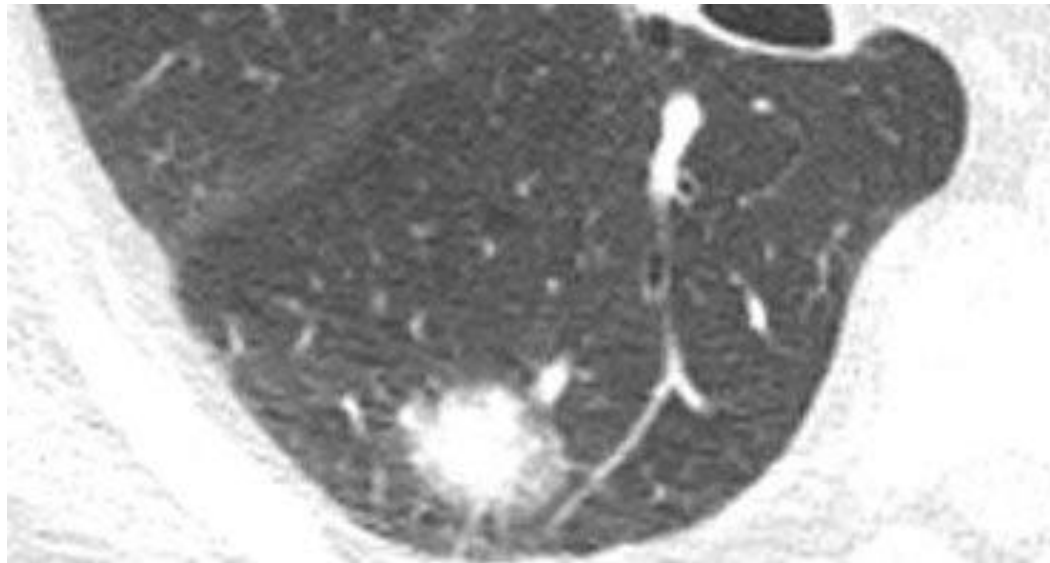
Lung Nodules

“Intermediate” Characteristics



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- Ground glass/semisolid nodules
 - Partly solid lesions are 3-4 times more likely to be cancerous than solid nodules



Lung Nodules

“Intermediate” Characteristics



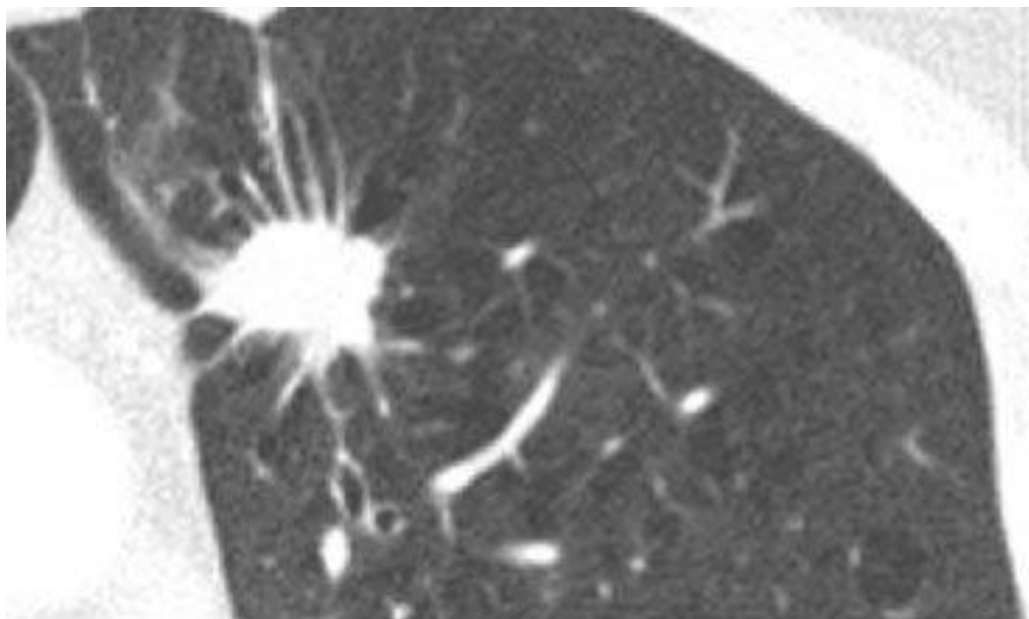
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- Other characteristics
 - Location
 - Upper/middle lobe 2 times more likely CA than lower lobe
 - Cavitation
 - >16 mm thickness of cavity wall is 50 times more likely CA than if <5 mm

Lung Nodules

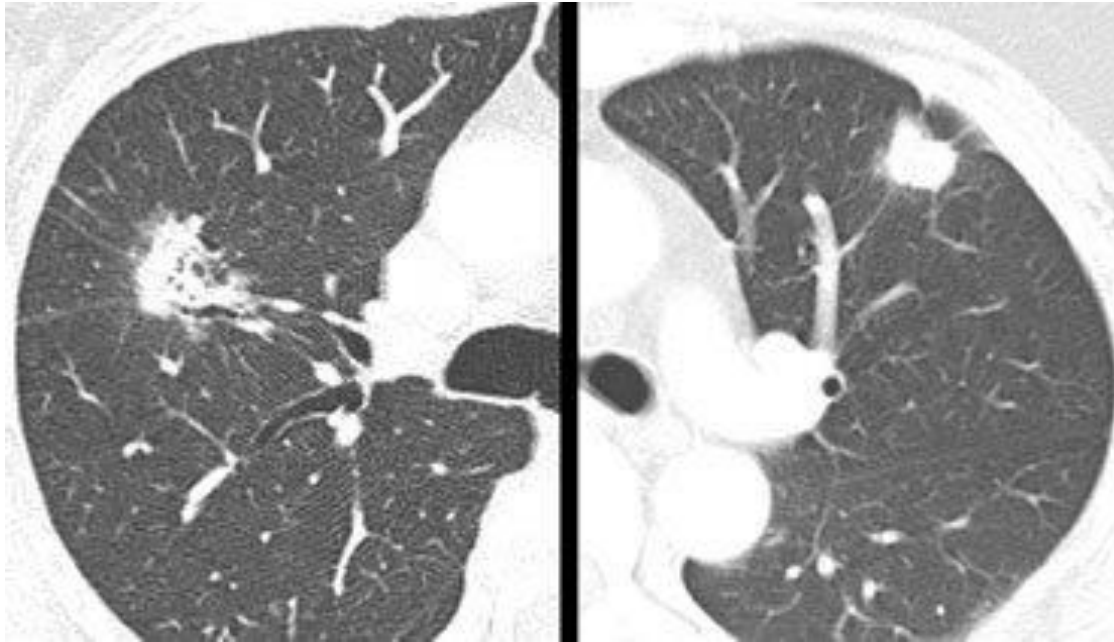
“Suspicious” Characteristics

- Margins
 - Spiculated or “corona radiata sign” is nearly 10 times more likely to represent CA than lobulated



Nodule Characteristics

Which is malignant?



- Left: bronchograms, homogeneous, 2 month double time
 - Right : spiculated, semisolid, 6 month double time
- Left is adeno CA - Right is fungal infection

Small Lung Nodules

Why follow them by CT?

- Stability of nodules is a characteristic highly associated with benignity.
 - Likelihood ratio of 0.01
 - Very helpful with nodules $\leq 8\text{mm}$ as most of these are benign even without knowing the growth rate
 - Basis of screening CT and follow-up recommendations

Small Lung Nodules

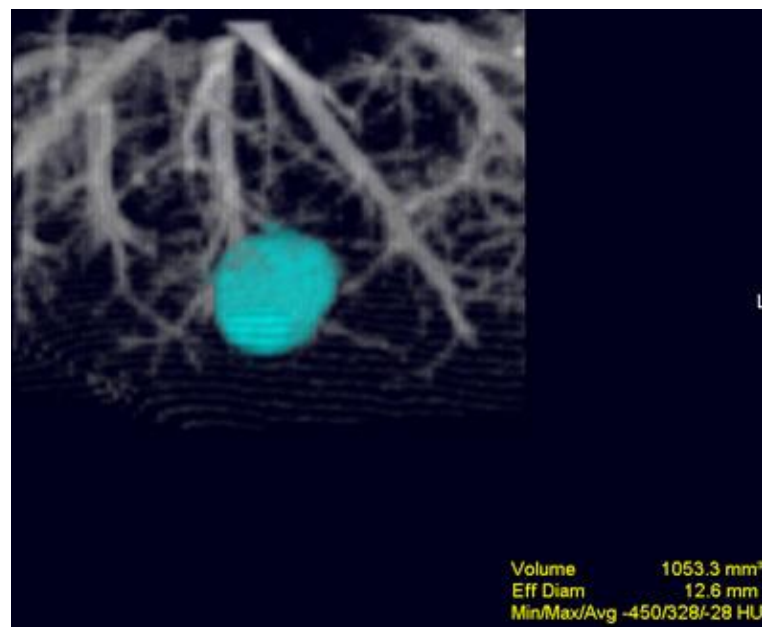
Why follow them by CT?

- Average doubling time for solid cancerous nodules is 6 months.
- Average for semisolid/ground glass approximately 2 years.
- Generally accepted “benign growth rate”:
 - 2 years for solid and 3-4 years for semisolid nodules

Lung Nodules

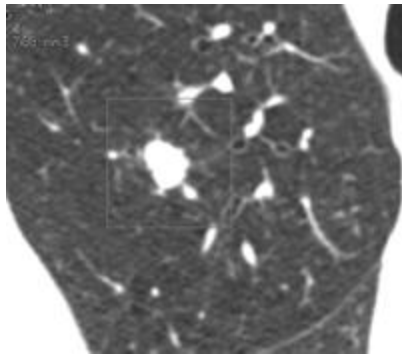
How do we measure change?

- Volume measurement most accurate.
 - Can be followed from Scan to scan
 - Can be computer calculated – very reproducible
 - Automated software – consistent measurement

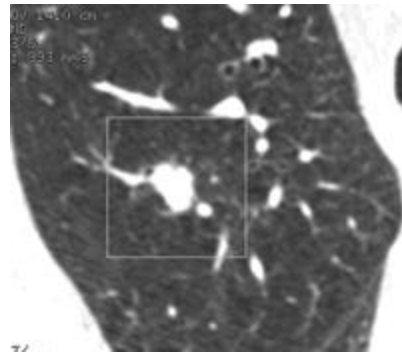


Volume measurement

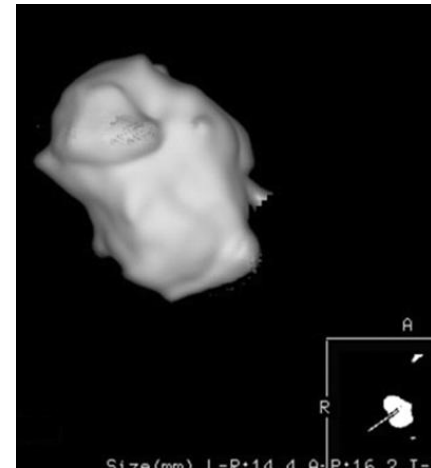
- Very sensitive to change in morphology and growth



Initial CT



3 months later



Larger Nodules > 8mm

Why not follow them?

- Relatively likelihood of CA substantially increases with size > 1 cm
- Relative stage of CA at presentation increased
- Availability of other tests
 - PET/CT, contrast enhanced CT, biopsy

Larger Lung Nodules

- additional tests

- For nodules $> 8\text{mm}$, PET/CT has high sensitivity and reasonable specificity.
 - Some overlap between benign and malignant active processes
 - Great negative predictive value. Malignant Likelihood Ratio of 0.06 for SUV < 2.5

Lung Nodules

- additional tests

- Contrast enhanced CT
 - Good negative predictive value. Likelihood ratio of CA = 0.04 for enhancement <15
- Limitations
 - Nodules need to be relatively spherical
 - They need to be homogeneous without necrosis, fat or calcification
 - No motion or scanner artifact
- PET probably more valuable

Lung Nodules

- additional tests

- Biopsy
 - Percutaneous CT guided
 - Bronchoscopic
 - surgical



Screening CT Paradigm

- Annual low dose CT screen in high risk patients
 - > 55 years old, 30 pack year smoking history, quit less than 15 years ago.
- Nodules ≤ 6 mm or benign characteristics
 - Annual low dose screening.
- Nodules between 6 -8 mm
 - Interval CT chest 3 – 6 months.
 - Computerized volume calculation for consistency.
 - Possible intervention for growth; expanded scan interval for stability.
- Nodules > 8 mm
 - Further workup / intervention may be required.