Low Dose Computed Tomography in Lung Cancer Diagnosis

Student Researcher: Jocelyn King Faculty Advisor: Dr. Elaine Halesey, Ed.D., R.T. (R)(QM)(ARRT)

MISERICORDIA UNIVERSITY

Introduction

- "*Computed Tomography (CT)* is the process of creating a cross-sectional tomographic plane of any part of the body" (Wright & Johnson, 2019, p. 206)
- CT scans are created by an x-ray tube rotating around the patient
- Low-dose CT is the use of a reduced tube current during a scan
- "Low-dose chest CT is usually used in children, for screening of patient (I.e., lung cancer screening), or if multiple follow-up examinations will be necessary in a given patient" (Webb et al., 2020, p. 5)

CT Scanner

(Johns Hopkins Medicine, 2024) [Image]

Lung Cancer Statistics

- "Lung cancer is the second most common form of cancer is the U.S. and the leading cause of cancer-related deaths" (Rulli & Matthews, 2020, p. 25)
- About 80% of Lung Cancer is caused by smoking, followed by radon gas, then secondhand smoke exposure (Kratzer et al., 2024)
- Lung cancer is typically diagnosed in people at the age of 65 years or older
- Smoking is the leading cause of lung cancer for both men and women (Rulli & Matthews, 2020)
- Men are more likely to smoke compared to women and consist of about 54% (men) of new lung cancer diagnosis and 44% for women (Rulli & Matthews, 2020)
- Chance of lung cancer increases with age
- Asthma and pneumonia increase the risk of lung cancer
- African American men are more likely to die from lung caner than Caucasian men
- Although more men smoke, women are at a greater risk for developing lung cancer

Risks, Signs and Symptoms of Lung Cancer

- Environmental hazards such as air pollution, coal fires, smoke inhalation, pesticides, and asbestos are risks of lung cancer
- E-cigarettes, social smoking and vaping are risks of lung cancer
- Weight-loss, haemoptysis, and fatigue are considered signs of late-stage lung cancer
- Symptoms of lung cancer get mistaken for lung co-morbidities such as chronic obstructive pulmonary disease (COPD)
- Early symptoms consist of a persistent cough and shortness of breath
- Patients with lung cancer are asymptomatic for months before seeking medical care

(Sabb et al., 2020)

Low Dose Computed Tomography

- "Low-dose computed tomography (LDCT) lung cancer screening is a noncontrast, noninvasive diagnostic imaging procedure used to detect noncalcified nodules suspicious for lung malignancy" (Hirsch, 2022, p. 65)
- LDCT scans used for patients with increased possibility for developing lung cancer
- Only type of screening performed to reduce lung cancer mortality (Hirsch, 2022)
- LDCT shows small tumors that are unable to be seen on traditional x-rays
- Preferred imaging of choice for detection of lung cancer

Cancer within the lung
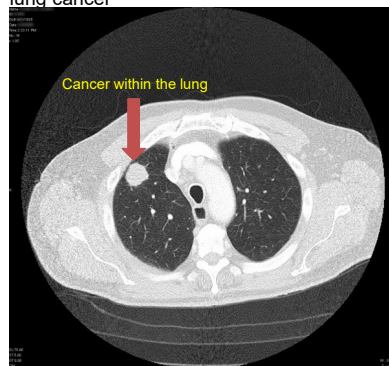
(Changuris, 2014) [CT image]

Low Dose Scans vs. Routine Scans

- LDCT reduces the dose to the patient
- Lower doses are used to image the lungs while maintaining image quality due to high contrast between air in the lungs and the nodules
- LDCT produces about 1.5 mSv a scan compared to 7 mSv for a routine chest CT scan

TABLE 1.2
Radiation Dose for Chest CT Protocols

	Radiation Dose (mSv)
Normal yearly background radiation	2.5–3.2
Chest radiograph (single view)	0.05
Routine chest CT (300 mA)	5–7
Routine chest CT (modulated tube current approximately 100–150 mA)	1.5–2
High-resolution CT with volumetric imaging (supine, expiratory; modulated tube current of approximately 100–150 mA)	1.5–2
High-resolution CT with spaced axial images (supine, prone, expiratory)	1
Low-dose volumetric CT (40 mA)	<0.5–1

The chart shows the different dosages between a normal and low-dose chest CT (Webb et al., 2020, p. 5)

- Lungs do not attenuate as much radiation as bones, soft tissue and muscles, which will result in less radiation used
- LDCT images appear the same but depending on patient habitus the image may look more mottled/grainer than a routine CT scans
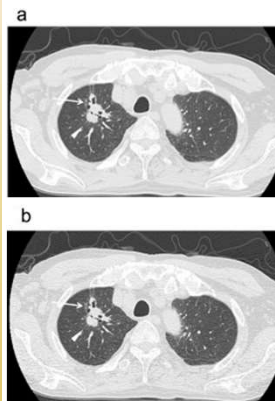
a

b

Image a is an example of a routine chest CT. Image b is a low-dose CT scan. The images are very similar to one another which emphasizes that there is not a huge difference in image quality between the two scans.
(Kubo et al., 2016)
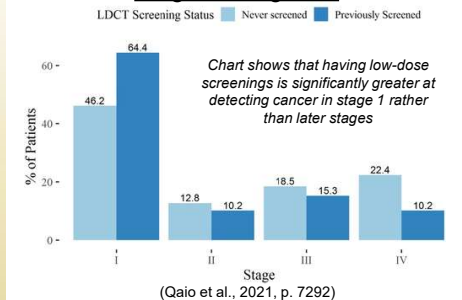
Risks vs. Benefits of LDCT in Lung Cancer Diagnosis

Risks

- LDCT may over diagnose tumors that are typically asymptomatic
- False positives due to overdiagnosis
- Overdiagnosis leads to anxiety to the patient
- Treatment when unnecessary may lead to death

Benefits

- LDCT aids in early detection of lung cancer
- Start treatment at an earlier stage
- Mortality rates decreased with the use of LDCT screenings
- Lower dose to the patient

Stage at Diagnosis

LDCT Screening Status ▪ Never screened ▪ Previously Screened

Chart shows that having low-dose screenings is significantly greater at detecting cancer in stage 1 rather than later stages

% of Patients — Stage I: 46.2, 64.4; Stage II: 12.8, 10.2; Stage III: 18.5, 15.3; Stage IV: 22.4, 10.2

(Qaio et al., 2021, p. 7292)

Conclusion

- Lung cancer is the leading cause of deaths in the U.S., and people who are at high risk for developing lung cancer should have screening. Individuals who are current or previous smokers are at a high risk for developing lung cancer. LDCT scans are the suggested imaging choice for the diagnosis of lung cancer. LDCT has lower radiation doses while still obtaining good image quality.
- Physicians believe the benefits of LDCT outweigh the risks. With biannual or annual screenings, diagnosis of lung cancer is at an earlier stage, reducing mortality rate. Individuals with high risks should consider LDCT screenings given the favorable results.