



HSHS
St. John's
Cancer Center



2 0 1 7 A N N U A L R E P O R T

DIRECTORY

For more information about cancer services and programs at HSHS St. John's Hospital, call **(217) 544-6464**. Extensions are below.

St. John's Cancer Services can also be reached by calling (217) 525-5640 or by visiting www.st-johns.org.

Extension numbers

Director of Oncology Services.....	44013
Melissa Wade	
Medical Oncology	55640
Radiation Therapy	55666
Day Hospital/Infusion Unit.....	45395
Oncology Unit Nurse Manager.....	47501
Shauna Campo, RN	
Chief Nursing Officer.....	44572
Allison Paul, DNP, RN, NEA-RC	
Nurse Navigator	45591
Diana Weyhenmeyer, RN, MA, OCN, MSN	
Cancer Registry	
Angela George, MS, CTR.....	44692
The Mammography Center.....	535-3795
Social Work Services.....	45095
Spiritual Care.....	55675

CANCER COMMITTEE

HSHS St. John's Cancer Committee monitors the cancer program and recommends changes on various aspects of the expanding program. Representatives from all medical specialties are involved in the treatment and care of St. John's cancer patients.

2017 Cancer Committee Members

- Sabha Ganai, MD, Ph.D - Cancer Liaison Physician
- Hui Zhang, MD and Rajesh Banderudrappagari, MD
- Committee Chairs and Medical Oncologists
- Samuel Au, Ph.D, MD - Radiation Oncologist
- Onsi Kamel, MD - Pathologist
- Simon Bekker, MD, Kiran Sekhar, MD and Shawn Mayer, MD
- Radiologists
- Tamra Davidson, R.Ph - Pharmacist
- Melissa Wade, MBA - Executive Director of Cancer Services
- Diana Weyhenmeyer, RN, MA, OCN, MSN
- Community Outreach Coordinator/Nurse Navigator
- Shauna Campo, RN - Oncology Nurse Manager
- Kathy Chepulis, RHIT - Quality and Risk Management
- Trisha Gebhardt, RN and Ann Derrick, RN
- Palliative Care Nurse Coordinator
- Angela George, MS, CTR - Cancer Registrar
- Faith Grab - Social Work/Case Management
- Nancy Young, RN, BSN, OCN - Nurse Educator
- Patricia Fank (SIU) and Michelle Gates (SIU)
- Psycho-Oncology
- Deborah Durham - Dietitian
- Linda Schultz - American Cancer Society
- Dan Groepper, CGC (SIU) - Genetic Counselor
- Meckenzie Husske and Shyla McCarthy
- Rehabilitation Services
- Research/Clinical Research - Mark Sanders

WELCOME TO HSHS ST. JOHN'S HOSPITAL



Melissa Wade, MBA

Director, Oncology Services
HSHS St. John's Hospital
Cancer Center

Many people get diagnosed with cancer every year and HSHS St. John's Hospital has powerful oncology resources in place to prevent and fight cancer. St. John's Hospital is a recognized cancer center accredited by the American College of Surgeons Commission on Cancer. The Cancer Center continues to grow to better serve the people of central Illinois.

This past year, St. John's increased access to low dose CT screening for lung cancer, added numerous colleagues to meet the needs of the department and, along with other community groups, offered numerous prevention and screening programs to the community. St. John's also continues to participate in the Relay for Life, Komen Foundation's Race for the Cure and Making Strides for Breast Cancer Walk.

We would like to thank the physicians, nurses and support staff who provide a high quality, patient-centered care in a safe environment. Thank you to the physician partners and leaders for their continued support to the oncology program, and most importantly, thank you to our patients and their families for allowing us the honor and privilege of caring for you and your family members.





Sabha Ganai, MD, PhD

Assistant Professor of Surgery
 SIU School of Medicine
 Chair, Cancer Committee
 CoC Cancer Liaison Physician
 Vice-Chair, Surgery
 HSHS St. John's Hospital

CANCER LIAISON PHYSICIAN REPORT: A BREATH OF RELIEF

HSHS St. John's Hospital is a Commission on Cancer (CoC) Academic Comprehensive Cancer Center and is committed to delivering excellent multidisciplinary cancer care to residents of Springfield and surrounding counties in central and southern Illinois. We seek to provide our cancer patients with not only the most innovative therapies and strategies in oncologic care, but also several important quality improvement initiatives for surveillance and cancer therapy through participation in the American College of Surgeons National Cancer Database (NCDB).

The HSHS St. John's Cancer Registry collects and monitors data on all patients diagnosed and treated at St. John's. This data is used as part of the NCDB Cancer Quality Improvement Program and demonstrates that St. John's has achieved excellent performance in numerous benchmarks for cancer quality when compared against other facilities in the State of Illinois and all CoC programs in the region and nation. Among patients who received part of their cancer care at St. John's, including diagnosis, only 14.3% received their treatment elsewhere, reflecting the comprehensive breadth of oncology care available to our patients.

Over the last five years of available data from the National Cancer Database (2010 through 2014), 4397 cancer patients were diagnosed and/or treated at St. John's

Hospital, with 50.4% male gender. The stage distribution is seen in Figure 1, with a majority of patients being diagnosed with early stage disease. The top five primary cancer sites diagnosed and/or treated at St. John's in 2014 were breast, lung, prostate, kidney/renal pelvis and uterine cancer, in descending order (Figure 2). Cancers of the breast, lung, kidney/renal pelvis, uterine and colon were the top five primary cancer sites for women initially diagnosed between January 2010 and December 2014 (Figure 3). Overall, St. John's manages a greater proportion of lung cancer and kidney cancer cases in comparison to national averages for women. In men, cancers of the lung, prostate, kidney/renal pelvis, bladder and colon were the top five primary sites at St. John's between 2010-2014 (Figure 4). Overall, St. John's manages a greater proportion of lung, kidney and bladder cancer, but less colorectal and prostate cancers, compared to national averages for men.

Lung cancer is the second most commonly diagnosed cancer for both men and women in the United States, affecting an estimate of 222,500 people in the U.S. and 8,600 new cases in Illinois in 2017 [1]. Unfortunately, lung cancer is the number one cause of cancer mortality, with an estimate of 155,870 patients nationally and 6,470 people in Illinois dying from the disease in 2017 [1]. This is particularly disturbing because lung cancer can be

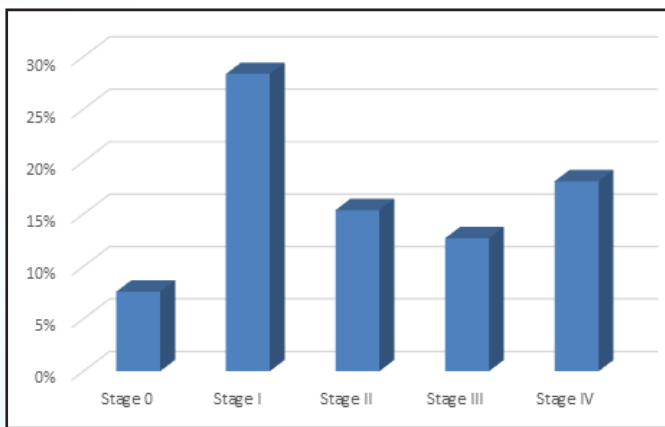


Figure 1: Stage Distribution of All Cancer Patients Diagnosed and/or Treated at St. John's Hospital (1/2010 - 12/2014)

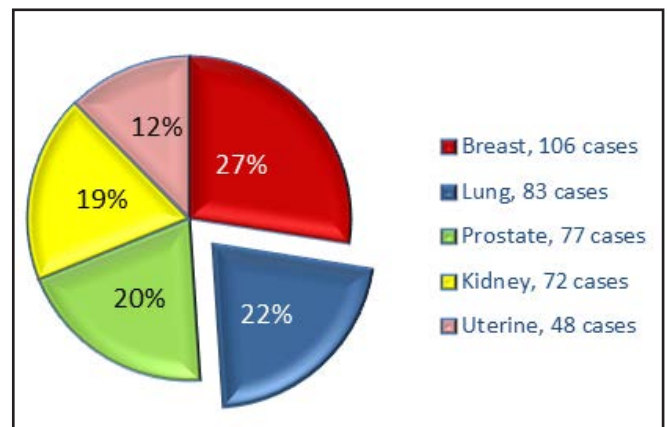


Figure 2: Incidence of the Five Most Common Cancer Types Diagnosed and/or Treated at St. John's in 2014

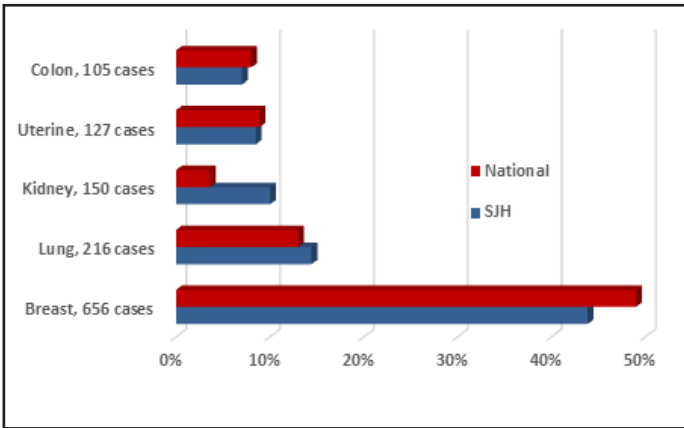


Figure 3: 2010-2014 Percentage Incidence Female Cases: Comparison of top 5 primary sites in females at St. John's with national data

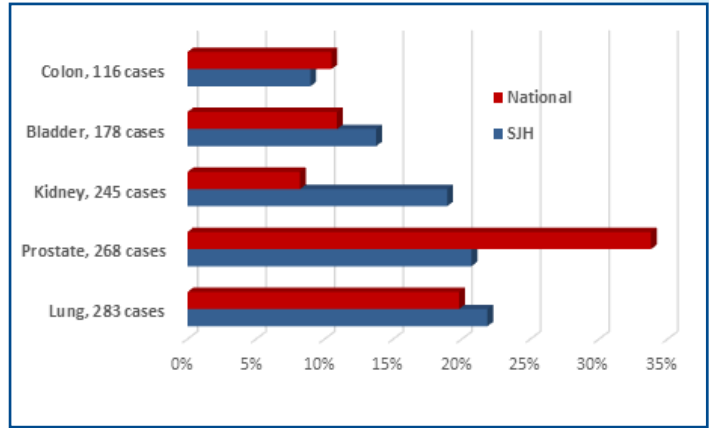


Figure 4: 2010-2014 Percentage Incidence Male Cases: Comparison of top 5 primary sites in males at St. John's with national data

prevented by limiting exposure to tobacco and harmful by-products of smoking. Cigarette smoking is the leading cause of preventable disease and death in the U.S., accounting for one out of every five deaths nationally [2]. Our Oncology Nurse Navigator Diana Weyenmeyer discusses cancer primary prevention via smoking cessation efforts for our community in this annual report. In addition, Dr. Reedy, from HSHS pulmonology, and Dr. Zata, one of our radiologists, discusses our new lung cancer secondary prevention program using low-dose CT screening.

The good news is that clinicians at HSHS St. John's Hospital are making an active effort to provide optimal care to our communities. Dr. Thomas, one of our thoracic surgeons, discusses minimally-invasive techniques to lung cancer surgery. Optimal cancer management is done in teams in a multidisciplinary

plinary fashion. Dr. Zhang, from HSHS medical oncology, discusses an overview of lung cancer etiology and management. Dr. Au, from HSHS radiation oncology, discusses the role of standard radiation therapy, as well as stereotactic body radiotherapy (SBRT) in the management of lung cancer. Among patients with non-small cell lung cancer managed at St. John's, 57% travelled between 25-100 miles to establish care, and 6% travelled over 100 miles, which is over twice the national average of patients dealing with similar driving distances. This is reflective of its important role as a regional cancer center.

From January 2010 to December 2014, a total of 499 non small cell lung cancers (NSCLC; 81%), 89 small cell lung cancers (SCLC; 14%), and 30 other lung cancers (5%) were diagnosed at St. John's, with 43% of incident cases in women and 57% in men. The age

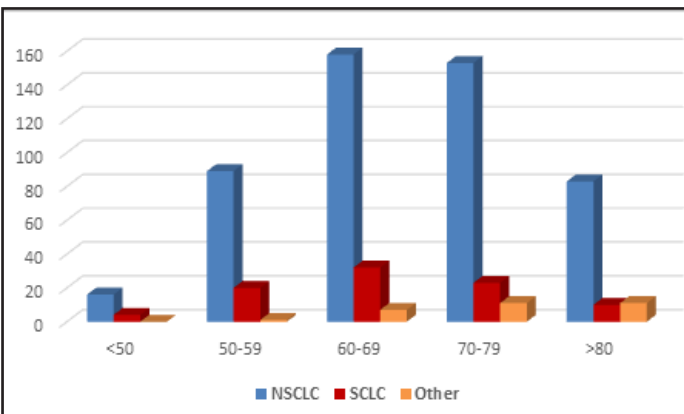


Figure 5: Histogram of age distributions by site for non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC) diagnosed and/or treated between 1/2010 and 12/2014 at St. John's.

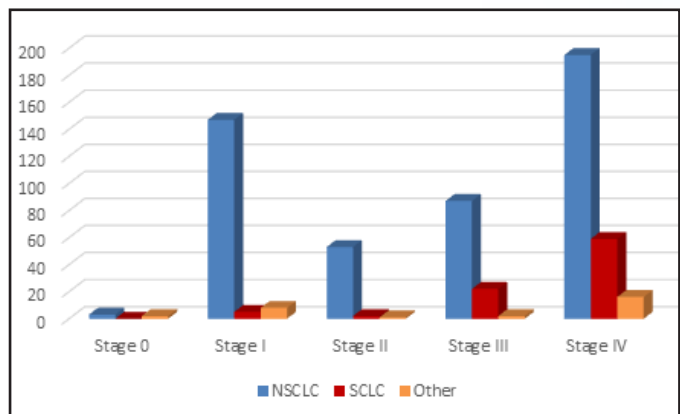
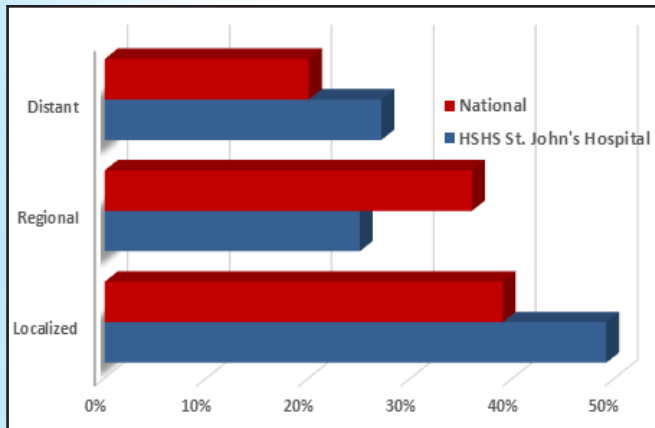


Figure 6: Histogram of stage distributions by site for non-small cell lung cancer (NSCLC) and small cell lung cancer (SCLC) diagnosed and/or treated between 1/2010 and 12/2014 at St. John's.

Figure 7:
2009-2013 Percentage Incidence
of Lung Cancer Cases by Extent of
Disease at Diagnosis: Comparison of
St. John's cases with known stage with
national data (Siegel et al., 2017)



distribution demonstrated a peak in patients in their sixties for NSCLC and SCLC, while other lung cancers occurred in later years (Figure 5). The stage distribution of patients presenting at St. John's with SCLC showed a greater proportion of late stage disease in comparison to those with NSCLC, which was bimodally distributed in either early or late stages (Figure 6).

When comparing lung cancer incidence with national numbers, we have higher proportion of localized disease (Stages I-II), and take care of a smaller proportion of patients presenting with regional disease (Stage

III) and distant, metastatic disease (Stage IV; Figure 7). This has important survival implications, where the U.S. 5-year survival is 55% for localized (Stages I-II), 28% for regional disease (Stage III), and only 4% for distant disease (Stage IV), even with the best therapies. [1] Ideally, by promoting tobacco control and low-dose CT screening practices in our communities, we can further decrease the proportion of late stage diagnosis of lung cancer, and thus improve cancer outcomes through prevention and early detection.

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Diana Weyhenmeyer
RN, MSN, MA, OCN
Oncology Nurse Navigator
HSHS St. John's Hospital

LUNG CANCER SCREENING PROGRAM

The lung cancer screening program was developed in 2014 and the first screening was done March 27, 2014. As of October 31, 2017, 374 screenings have been performed. Nine cancers have been found and treated. Forty-one have required additional scans and follow up. One biopsy was normal when it was done.

We have a lung cancer screening core group that meets and monitors processes and problem solves quarterly. Rules and regulations have changed since the program was developed. Medicare and insurances are now covering the service for the patients that qualify.

Qualifications include:

- Over 30-pack years of smoking
- Between ages 55 and 77
- Current smoker or stopped in the last 15 years
- Asymptomatic of lung cancer
- Shared decision making visit
- Smoking-cessation education
- NPI number of physician

These are all documented in the electronic health record order that is faxed to me, and I schedule the scan. I meet with every patient, and we discuss smoking cessation if they are smoking and

what worked for them if they have stopped smoking. Smoking cessation information is offered to everyone. For those who have quit, I've picked up some tips to help others and pass them along. The majority of people who have been successful have told me they stopped cold turkey once they made up their mind to stop. According to the American Cancer Society (ACS), the cold-turkey strategy works well for people who smoke less than 10 cigarettes a day. The ACS recommends the 4 D's to fight smoking urges:

- Delay for 10 minutes.
- Deep breathe. Close your eyes, slowly breathe in through your nose and out through your mouth. Picture your lungs filling with fresh, clean air.
- Drink water slowly sip by sip.
- Do something else. Some activities trigger cravings. Get up and move around.

Several physicians have guided this program, and I am grateful for their help. Medicare began covering this program in 2016 as a routine preventive screening. Insurance has covered it in some cases.

I have enjoyed developing this program and watching it change and grow over the years.



Jeremiah Reedy, MD
Pulmonary Medicine,
Sleep Medicine
HSHS Medical Group

UPDATE ON LUNG CANCER SCREENING

Lung cancer remains the most common cancer worldwide. In the United States it is estimated this year there will be 224,390 new cases and 158,080 deaths from lung cancer. It is a leading cause of cancer deaths in both men and women, killing more individuals than colon, breast and prostate cancer combined.

Despite advances in treatment, the overall 5-year survival rate for all lung cancers is approximately 16%. This is because clinical outcomes are related to the stage of cancer at the time of diagnosis, and 75% of patients with lung cancer present with locally advanced or metastatic disease not amenable to curative treatment.

The most powerful intervention to decrease the burden of lung cancer is smoking cessation. In the United States the rates of lung cancer incidents and death are declining in men and women reflecting trends in smoking rates. Screening for lung cancer in high risk patients using low-dose computed tomography (LDCT) has also been shown

to decrease the risk of death. The National Lung Screening Trial showed that LDCT decreased the risk of death in lung cancer by 20% when compared to single view chest radiography. The United States Center for Medicare and Medicaid Services recommends coverage for lung cancer screening services for high risk individuals enrolled in a screening program.

HSHS St. John's Hospital has been doing lung cancer screening since 2014. The key components of the program include: (1) High risk individuals, defined as current or former smokers age 55 to 77 years with at least 30-pack years who are current smokers or quit within 15 years; (2) There must be a written order from a licensed provider documenting a shared decision making visit; (3) Scanning center eligibility is restricted to centers with radiologist experienced in reading LDCT studies; (4) Centers are required to collect and submit demographic and engine data to a Center for Medicare and Medicaid Services approved registry.



Vincent J. Zata, MD
Cardiothoracic Imaging
Central Illinois Radiological
Associates
HSHS St. John's Hospital

LUNG CANCER SCREENING

Lung cancer is the most common non-skin cancer affecting both men and women, accounting for an estimated 222,500 new cases in 2017. Lung cancer also is the leading cause of death from cancer in men and women, accounting an estimated 155,870 deaths in 2017, which is approximately 26% of all cancer deaths in the United States. This equates to approximately 427 lung cancer deaths per day.

When lung cancer is diagnosed after symptoms occur, lung cancer is typically advanced, resulting in a dismal 5-year survival rate of 17.4%. This illustrates the need for detecting lung cancer in the early stages. Although lung cancer is one of the top four deadliest cancers and is curable when detected at an early stage, routine screening for lung cancer has not been performed until recently.

In 2011, the National Lung Screening Trial (NLST) was the first randomized control trial to demonstrate that screening can reduce lung cancer specific mortality. The U.S. Preventive Services Task Force (USPST) issued a high grade recommendation for screening in December 2013. And finally in February 2015, Centers for Medicare and Medicaid Services (CMS) granted lung can-

cer screening coverage for millions of high-risk Americans with no insurance co-payment.

Fueled by these developments, the number of lung cancer screening programs will continue to increase, and millions of Americans are expected to enroll in the next 3-5 years.

High-quality lung cancer screening and treatment centers should ascertain the smoking status and smoking history of their patients ages 55 to 77 years and should initiate a discussion about lung cancer screening with those patients who have at least a 30-pack per year smoking history, currently smoke or have quit within the past 15 years and are in relatively good health. Core elements of this discussion should include the benefits, uncertainties and harms associated with screening for lung cancer with low-dose CT (LDCT). Adults who choose to be screened should follow the protocol of annual LDCT screening. Chest x-ray should not be used for cancer screening.

Smoking-cessation counseling constitutes a high priority for clinical attention among patients who are currently smoking. Current smokers should be informed of their continuing risk of

lung cancer and referred to smoking-cessation programs and interventions. Screening should not be viewed as an alternative to smoking cessation.

Clinicians should not discuss LDCT lung cancer screening with patients who do not meet the recommended criteria. If lung cancer screening is requested, then these patients should be informed that, at this time, there is too much uncertainty regarding the balance of benefits and harms for individuals at younger ages, less life-time exposure to tobacco smoke or with sufficiently severe lung damage to require oxygen (or other health-related NLST exclusion criteria), and thus screening is not recommended. Where risk seems to approximate or exceed the NLST eligibility criteria in one category but not another, clinicians will need to use their best judgment in deciding whether to engage the patient in a discussion about screening.

Each patient must receive a written order for LDCT during a lung cancer screening counseling and shared decision-making visit, which must be provided by a physician or qualified non-physician practitioner. The counseling and shared decision-making visit must include the following elements: (1) determination of eligibility; (2) shared decision making using one or more decision aids that describe benefits and harms of screening, follow-up diagnostic testing, over-diagnosis, false-positive rate and total radiation exposure; (3) the importance of annual screening, the impact of comorbidities and the ability or willingness to undergo diagnostic tests and therapy; and (4) the importance of smoking cessation or maintaining smoking cessation if the patient already has quit.

For subsequent screening examinations, the written order for LDCT lung cancer screening may be furnished during any appropriate visit with a physician or qualified

non-physician practitioner without repeating the shared decision-making process. Written orders must contain the following information: (1) date of birth; (2) actual pack-year smoking history (number of pack-years); (3) current smoking status and, for former smokers, the number of years since quitting smoking; (4) a statement that the beneficiary is asymptomatic (no signs or symptoms of lung cancer); and (5) National Provider Identifier of the ordering practitioner.

Radiologist qualifications include: (1) board certification or board eligibility with the American Board of Radiology or equivalent organization, (2) documented training in diagnostic radiology and radiation safety, (3) involvement in the supervision and interpretation of at least 300 chest CT acquisitions in the past 3 years, and (4) documented participation in continuing medical education in accordance with current American College of Radiology standards.

Radiology imaging facilities that provide LDCT lung cancer screening will need to: (1) meet dose and technical standards related to the LDCT examination; (2) use a standardized lung nodule identification, classification, and reporting system; (3) make smoking-cessation interventions available to current smokers; and (4) collect and submit data to a CMS-approved registry for each LDCT lung cancer screening performed. The CMS has specified minimum data elements that will be collected to measure adherence to quality-assurance standards and for program evaluation.

In conclusion, HSHS St. John's Hospital is a high quality lung cancer screening and treatment center that adheres to the guidelines as described above. The hospital has extensive expertise in lung cancer screening. Patients have access to a multi-disciplinary team skilled in the evaluation,

diagnosis and treatment of abnormal lung lesions. Referring doctors, pulmonologists, thoracic surgeons, radiologists, pathologists, oncologists, radiation oncologists and other practitioners work closely with patient navigators to coordinate care and optimize treatment.

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LUNG CANCER SCREENING

Lung cancer continues to remain one of the dominant cancers in the United States. In 2015 there was approximately 215,000 new cases of lung cancer with approximately 158,000 deaths as a result. The best results for long term survival is an anatomic surgical resection (i.e lobectomy) for early stage cancers (Stages I, II, IIIA).

The gold standard for surgical treatment has been lobectomy, which often involves a large single incision (10 to 15 cm) and spreading of the ribs (open thoracotomy). VATS surgery has allowed surgeons to complete the same operation with the same oncologic outcomes as open thoracotomy through 3 to 4 small incisions, without spreading the ribs, and the largest incision being 3 to 5cm. This has numerous advantages over traditional open thoracotomy:

- Decrease post-operative pain
- Equal disease-free and overall survival

- Lower cost
- Shorter hospital stay
- Shorter chest tube duration
- Decreased post-operative complications
- Greater chance of independent home discharge
- Lower morbidity and 30 day mortality.

VATS Lobectomy has quickly become the gold standard surgical treatment of early stage lung cancers. HSHS St. John's Hospital has the ability to offer VATS lobectomy by collaborating with SIU Medicine Thoracic Surgery. SIU Medicine Thoracic Surgery are the only surgeons in central and southern Illinois offering VATS lobectomy, in addition to other minimally invasive thoracic oncologic surgeries, to our patients. The highest quality thoracic oncologic care can be obtained at St. John's Hospital.



Michael J. Thomas, MD
Assistant Professor
Department of Surgery
SIU School of Medicine

LUNG CANCER

Lung cancer is a malignant disease originating in the airways or pulmonary tissue. Pathologically, there are two categories of lung cancer: non small cell lung cancer (NSCLC) and small cell lung cancer (SCLC). The NSCLC are further divided into subtypes of adenocarcinoma, squamous cell carcinoma, large cell carcinoma and neuroendocrine carcinoma. NSCLC and SLLC account for 95% of lung cancer. Cancers with sarcomatoid or sarcomatous characters, and cancers of salivary gland type are extremely rare primary lung malignancies (1).

According to WHO report in 2014, there were 1.8 million patients in the world diagnosed with lung cancer. In 2012, 1.6 million died (2). Lung cancer is the second most common cancer in men, and it has become the number two most common cancer in women since 1993 (3). In the United States in 2016, lung cancer occurred in about 225,000 patients and caused over 160,000 deaths. Currently, lung cancer is the leading cause of cancer death in both men and women in the

United States (4). There is a slight decrease in the incidence of lung cancer among men in the United States after 1985.

Etiology

A number of environmental and lifestyle factors have been associated with the development of lung cancer. Cigarette smoking, including cigar smoking, is the most important factor, which is estimated to account for approximately 90 percent of all lung cancers (5). The risk of lung cancer among cigarette smokers increases with the number of cigarettes smoked and the duration of smoking history. The risk of lung cancer increases more than 100 times compared to those who do not smoke. Approximately 25% of lung cancer cases among people who never smoked are caused by exposure to environmental tobacco smoke or pollution. The risk of lung cancer decreases with smoking cessation, but is still higher than in the nonsmoking population until 10 to 15 years of abstinence. Environmental toxins, radon,



Hui Zhang, MD
Medical Oncologist
HSHS Medical Group

radiation, alcohol, host genetic factors and, recent studies report, immune function may account for different susceptibilities to lung cancer (5).

There is no role for beta-carotene, vitamin A or any of their derivatives for the chemoprevention of lung cancer. In contrast, several reports demonstrated that beta-carotene supplementation was associated with an increased risk of lung cancer in patients with a history of heavy smoking (6).

Biology

In the past 10 years, molecular study demonstrated many extra- and intracellular signaling pathways are involved in the development of lung cancer. The epidermal growth factor receptor (EGFR) is a very important player. In addition, anaplastic lymphoma kinase (ALK) gene rearrangement, KRAS, ROS1 PD-1 mutations are important factors in the regulation of cell differentiation, proliferation, angiogenesis, metastasis and cell apoptosis. Based on findings, several generations of molecular target agents or biological medications have been developed and used in the world. The medications have achieved significant improvement for the treatment of lung cancer in the past decade, and shed a light for future treatment (7).

Clinical presentation

Most patients have advanced disease at clinical presentation because they do not visit a physician's office until they have symptoms, but some cases are discovered incidentally during a visit for another medical issue. Typical symptoms associated with lung cancer are cough, increased production of sputum and worsening shortness of breath. Other common symptoms including fatigue, weight loss without clear reason, anorexia and low grade fever. Some of patients may have chest pain, hemoptysis, bone pain or pleural effusion. Less frequently, patients present with paraneoplastic syndrome with low sodium, headaches, dizziness, pericardial tamponade, unsteady gait or focal weakness. Some patients with obstruction of the superior vena cava (SVC) cause symptoms that commonly include a sensation of fullness

in the head and dyspnea. Cough, pain and dysphagia are less frequent. Physical findings include dilated neck veins, a prominent venous pattern on the chest and facial edema. The SVC syndrome is more common in patients with SCLC than NSCLC. Lung cancers arising in the superior sulcus cause a characteristic Pancoast syndrome manifested by pain (usually in the shoulder and less commonly in the forearm, scapula and fingers).

Screening

The diagnosis of lung cancer is primarily based upon evaluation of individuals with symptoms. Recently, single-arm observational studies have shown that a large percentage of lung cancers detected by computed tomography (CT) screening are early stage tumors, which have a favorable prognosis. These findings led to the randomized National Lung Screening Trial that compared CT screening with chest x-ray (8). This trial demonstrated a 20 percent decrease in lung cancer mortality in heavy smokers who were screened annually for three years and is the only trial to show benefit in mortality reduction. Based on studies above, the Center for Medicare and Medicaid Services (CMS) has agreed to cover the cost of CT screening in approved programs for those age 55 to 77 who have no symptoms of lung cancer, have a 30 pack-year smoking history and, if they have quit, have done so within 15 years (9).

Prognostic factors

Prognostic factors predict a patient's outcome, regardless of treatment. Age and histologic subtype are not independent prognostic factors. The advanced disease, poor clinical performance, significant weight loss and male sex are poor prognosis factors. Any lung cancer, no matter of NSCLC or SCLC, with distant metastasis in another organ, or in a contralateral lung, or tumor with pleural nodules or malignant pleural effusion, is considered stage IV lung cancer and incurable except for extremely rare cases.

The principle of treatment

The treatment of NSCLC and SCLC is based on disease stage, patient perfor-

mance status, comorbid conditions and relevant social factors. The treatment for NSCLC is different from SCLC. The disease stage is based on tumor size, location, lymph node involvement and any distance metastasis.

If feasible, surgical resection is the principle treatment for stage I and II NSCLC. The lobectomy is the suggested procedure, even for patients with small or peripheral lesions, because wedge resections have been shown to be associated with increased local recurrence and decreased survival (10). For patients with stage I or II of NSCLC who cannot receive surgery due to a clinical condition such as poor lung function, treatment options are radiation therapy with or without chemotherapy.

Optimal treatment of "nonbulky" stage IIIA NSCLC is evolving but involves both systemic chemotherapy and local therapy such as surgery and/or radiation.

For patients with stage IIIB or stage IIIA NSCLC with multiple nodes involved, the concurrent systemic chemotherapy with radiation will result in the best overall survival rate. However, more toxicities or side effects of treatment may be experienced.

For patients with stage IV NSCLC, systemic chemotherapy and target therapy improve overall survival rate, enhance quality of life and reduce symptoms. Target therapy such as EGFR inhibitor is suggested in first line therapy for patients with certain EGFR mutations.

Other management options include supportive care and keeping the patient comfortable, especially for patients with advanced diseases, multiple comorbidities and poor clinical performance.

The stage system of small cell lung cancer (SCLC) is different from NSCLC. SCLC is classified into limited or extensive stage because of small cell lung cancer potentially metastasize quickly to brain, liver, bone and CNS. Only a small percentage of a limited stage of selected SCLC is feasible for surgery. The majority of patients with SCLC are treated with chemotherapy and/or radiation therapy. SCLC is especially sensitive to chemoradiation therapy, but resistance can develop later (11).

The prognosis

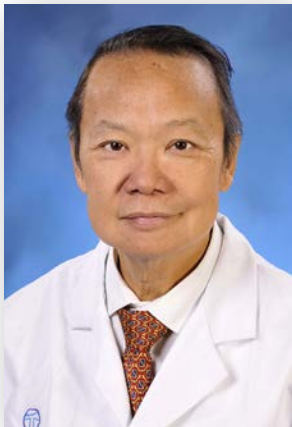
Epidemiology and End Results (SEER) database showed the survival of patients with NSCLC decreased progressively with more advanced disease from a median of 59 months for patients with stage Ia disease to four months for those with stage IV NSCLC. Poor performance status, poor appetite and weight loss have been associated with shortened survival [10-15]. Some studies suggested that African Americans have a worse prognosis even after correcting for stage and treatment. A multivariate analysis indicated that performance status and weight loss account for these results.

The most important prognostic factor in patients with SCLC is the extent of disease. For patients with limited stage disease, median survivals range from 15 to 20 months, and the reported five-year survival rate is 10

to 13 percent. In contrast, for patients with extended stage disease, the median survival is 8 to 13 months, and the five-year survival rate is 1 to 2 percent.

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Samuel P. Au, MD, PhD
Radiation Oncologist
HSHS Medical Group

RADIATION THERAPY AND LUNG CANCERS

Radiation therapy has always played an important role in the treatment and management of lung cancers. In the last ten years, the adoption of advanced on-board three-dimensional (3D) imaging technology into the treatment machine has made image guided therapy routine. This offers highly precise alignment and delivery of radiation beams to tumor targets deep inside the body, with minimal effects onto the neighboring normal tissues. Typically after a patient is immobilized on the treatment table, a 3D image of the patient is obtained with the on-board cone-beam CT scanner showing the tumor mass and position of the patient; then the patient position would be adjusted in all 6-dimensional ways (3 translational and 3 rotational) to achieve the best alignments with the treatment beams. Radiation would then be delivered to the tumor mass deep inside the body with high precision and minimal uncertainty. This optimizes the delivered dose to the intended target while maximally sparing exposure to the neighboring normal organs and tissues, thereby minimizing the treatment side-effects.

It is this highly precise delivery of radiation that makes stereotactic body radiotherapy (SBRT) a routine treatment option of tumor lesions situated throughout the body, including intracranial tumors, head-and-neck cancers, lung

cancers, or tumors in the abdomen or pelvis. The treatment course typically consists of one to five daily 30-minute sessions of intense, highly focused radiation to the tumor targets, compared to the conventional approach of typically five to six weeks therapy. Very often, for small lesions, only one session is necessary; in which case the SBRT is called stereotactic radiosurgery (SRS).

Often tumors in the lung or upper abdomen would move during the respiration cycle. Real-time tracking of their positions or sufficient margins of the treatment beams have to be considered to account for their motion during treatments.

With the advancement of computer technology, the design of various treatment beams, their sizes, shapes, orientations and intensities across the beams can be optimized with the “artificial intelligence” approach. It starts out with the patient undergoing a CT scan whereby 3-dimensional digital image of the patient’s full body will be obtained. After the clinician defines the tumor targets on the scans for irradiating, dosing scheme and criteria of minimizing exposure to the neighboring normal organs, computer optimization will be performed to arrive at the best treatment plan in terms of the energy of the radiation beams, their geometry, intensities, sizes and shapes to give the best coverage of the tumor

targets while minimizing the exposure to the neighboring organs. The optimized treatment plan will then be implemented onto the treatment machine with the treatment fully computer programmed and automatic.

Early stage lung cancers

Most lung cancers are already locally advanced when diagnosed. The diagnosis often starts out with some symptoms which brought the patient to seek medical care. In most cases, the prognosis of a locally advanced lung cancer is poor or guarded. Early stage lung cancers usually are asymptomatic and often found incidentally because of other medical reasons. These cases are highly curable and have good prognosis with treatments. They often start out with a small lung nodule. Lung screening using low-dose CT scans for patients of high risk of lung cancers was proven to be beneficial and can significantly reduce lung cancer mortality. Since the start of lung screening, more lung cancers are detected at their early stage.

The standard of care for early lung cancers, in the form of nodules, is thoracotomy with lobectomy or wide wedge resection. Very often these patients are chronic smokers, elderly or with significant comorbidities that they are not candidates for surgery. Nowadays, more and more, these early

stage lung cancers can be treated with SBRT, a completely non-invasive 5-day course of radiation therapy. It yields excellent control-rate comparable to lobectomy, and with few mild treatment-related side-effects.

Locally advanced stage lung cancers

Locally advanced stage lung cancers are usually treated with radiation therapy and systemic therapy consisting of combinations of chemotherapy, targeted therapy or immunotherapy. Radiation therapy would target all tumor-involved areas or areas at risk of tumor clinical involvement. In selected cases, surgery is also performed. Often the systemic therapy and radiation are given concurrently, i.e. over the same time period, if patients can tolerate the treatments concurrently. Otherwise they are treated sequentially. The order of systemic radiation and surgery in applicable cases are tailored to individual patient medical condition and overall performance status.

Advanced stage lung cancers

The signs and symptoms of patient suffering from lung cancers depend on the location of the tumor, its locoregional spread and metastases. Lung cancer is also associated with paraneoplastic syndromes more frequently than other tumors. As the tumor

engages with the airway, it causes dyspnea and hemoptysis. Often it grows to obstruct the distal airways resulting in atelectasis and pneumonia. Tumors involving the pleura or chestwall can cause effusion and severe chest pain. With apical tumor, the classic Pancoast syndrome and Horner's syndrome may become manifest. The tumor may invade the phrenic nerve or recurrent laryngeal nerve causing diaphragmatic paralysis or hoarseness. Another common symptom is Superior Vena Cava syndrome from bulky tumor or mediastinal lymphadenopathy encroaching onto the vena cava vessel. Subcarinal nodal involvement can produce partial or complete esophageal obstruction resulting in dysphagia or even tracheoesophageal fistula. Lung cancer can metastasize distally to virtually any organ but commonly to the skeleton, adrenal glands, brain and liver.

Localized radiation can palliate or alleviate many of the symptoms for many of the cases. With image guidance, radiation can be precise with little side-effects. Symptoms from the tumor mass and its infiltrations can be improved with a one to two week brief course of intense treatments. Brain oligometastases, with one to four lesions, would benefit from a course of SBRT or stereotactic radiosurgery (SRS).



800 E. Carpenter Street | Springfield, IL 62769
st-johns.org | (217) 544-6464