ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF GRADUATE STUDIES

DEPARTMENT OF RADIOLOGY

COMPUTED TOMOGRAPHY IMAGING PATTERNS , ASSOCIATED RISK FACTORS AND PREVALENCE OF PNEUMONIA IN ESOPHAGEAL CANCER PATIENTS VISITING TASH FOR STAGING.

BY: ALEMU GETIE (MD, RADIOLOGY RESIDENT)

THESIS SUBMITTED TO DEPARTMENT OF RADIOLOGY, COLLEGE OF HEALTH SCIENCE, ADDIS ABABA UNIVERSITY IN PREPARATION FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR SPECIALTY CERTIFICATE IN RADIOLOGY

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THIS THESIS IS ACCEPTED IN ITS PRESENT FORM AS SATISFYING THESIS REQUIREMENT FOR THE POSTGRADUATE STUDY IN RADIOLOGY.

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LIST OF ABBREVIATIONS AND ACRONYMS

AAU……Addis Ababa university
CE……Cancer of esophagus
CT……Computed tomography
LAP……Lymphadenopathy
M……Metastasis
MRI.....Magnetic Resonance Imaging
N……No
PET-CT……Positron emission tomography-computed tomography
SCC .....squamous cell carcinoma
TASH……...Tikuranbessa specialized hospital
T……tumor

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ABSTRACT

Background: Esophageal cancer is the eighth most common cancer and the sixth most common cause of cancer relate death worldwide and the fifth most common cancer and attributes a significant number of cancer-related death in Ethiopia.

Objective:To asses Computed tomography imaging pattern, risk factors and prevalence of aspiration pneumonia in esophageal ca patients visiting radiology department TikurAnbesa Specialised Hospital for staging.

Method: Institutional based prospective cross-sectional study was conducted on 110 histological proven esophageal ca patients come to the radiology department of TikurAnbesa Specialised Hospital for staging.Sociodemographic data were collected by principal investigators using a semi-structured questionnaire with the full consent of the participant. The data was collected from the source population and entered and analyzed using SPSS version 25. Text, tables,and graphs were used to present descriptive data, and analysis was processed.

Result: Esophagus cancer was commonly seen in the age group between 51 to 60 years (37.3%) with the females (55.5%) more commonly affected than males (44.5%).

All patients predominantly presented with dysphagia and weight loss. Dirking or eating extremely hot drinks or meals, alcohol, and smoking was the associated risk factor.

The lower esophagus affected more commonly 47.3% compared to other parts. The wall thickness in the majority of the cases measured between 10-20mm (83.8%).

T4b N0M0 was the most common staging found in CT (56.7%)with non resectability of 78.18% .Twenty point seven percent of the cases presented with metastasis being lung is the commonest site of metastasis. Squamous cell carcinoma (81.8%) was the most common histopathological type presented. Of 110 patients 12 of them (10.9%) have pneumonia.

Conclusion: . Most patients are old age farmers from oromia prsented with 100% dysphagia and weight loss. The identified risk factor are dirking or eating extremely hot drinks or meals, alcohol, and smoking. The lower esophagus affected more commonly 47.3% compared to other parts with significant corraltion with histologic type and T4bN0M0 was the most common staging (56.7%) with 78.18% unresetablility at presentation.

About 22.7% of cases with metastasis being lung is the commonest site of metastasisand SCC (81.8%) was the most common histopathological type presented. Of 110 patients 12 of them (10.9%) have aspirational pneumonia

CHAPTER 1. INTRODUCTION

1.1. BACKGROUND

Esophagealcancer is one of the highly lethal disease that continues to have less than 10% five-year survival despite advances in multimodality therapy(1).

It is the 8th most common malignancy and the sixth most common cause of cancer-related deathsworldwide (2).

It is the third most common gastrointestinal malignancy and one of the 10 most prevalent cancers worldwide. Moreover, the death rate for esophageal cancer in men is increasing,particularly in the 5th-8th decades of life(3).

It is endemic in many parts of the world, particularly in developing countries like Asia, Southern, and Eastern Africa, and Northern France(1).

Esophageal cancer is comparatively more in men than in women and it occurs most commonly during the sixth and seventh decade of life. The disease becomes more common with advancing age; it is about 20 times more common in persons after attaining the age of 65 years(4).

Many studies have showed there are associated risk factors for esophageal cancer having strong association with different histology type smoking, being overweight, having gastroesophageal reflux, and consuming low amounts of fruits and vegetables,Barrett's esophagus for esophageal adenocarcinoma; and smoking, heavy alcohol use, and consuming small amounts of fruits and vegetables for esophageal squamous cell carcinoma (5,6).

There are two main types of esophageal cancers- squamous cell carcinomaand adenocarcinoma(4).

Jemal A et al, in a study the incidence of the subtypes has regional variations. The squamous cell subtypes have the largest worldwide incidence (approximately 90%), but the adenocarcinoma subtype is more prevalent in many geographical pockets of North America and Europe. In addition to it, some other areas having a high incidence of esophageal cancer are Iran, some parts of Africa, Italy, and China. In western countries, it accounts for heavy mortality(4,7).

Squamous cell carcinoma is higherin Africa than adenocarcinoma and these epidemiologic observations are important because of the potential contributions to the understanding of the risk factors and pathogenesis of esophageal cancer(1,8).

Over the past decades, computerized tomography has led to early detection of cancers and thereby decreasing the mortality rate. The introduction of a multidetector computerized tomography (MDCT) scanner is a boon to clinical imaging practice(3,4,9,10).

MDCT meant for diagnosing carcinoma esophagus is the most useful technique of radio imaging modality for staging and management. It also depicts the severity of esophageal cancer and detect distant metastasis so that helpful for clinicians to plan and devise an appropriate treatment(4,11, 12).

In the mid-nineties, positron emission tomography (PET) superseded other techniques for the staging of esophageal cancer. Now a day's joint venture of PET and CT scanners have been progressively replacing conventional PET for the exact evaluation in oncological patients. Employing both the techniques- PET as well as CT better results have been achieved to mark the requisite spots of this particular disease. Therefore, PET and CT both techniques are highly dependent on spotting and distinction. Combination of these two modalities have been rendering accurate and authentic findings, thus lead to a better diagnosis for treatment of cancer patient (16,17).

As with all other tumors, the outcome for patients with esophageal cancer is strongly associated with the stage at initial diagnosis. The current overall 5-year survival rate remains less than 20% for patients with esophageal carcinoma. However, patients with the localized disease currently have a 5-year survival rate of almost 40%. Complete resection of esophageal cancer and adjacent malignant lymph nodes is the only potentially curative treatment. Hence, accurate pretreatment staging is important in the initial evaluation and assessment of patients to determine appropriate stage-specific treatment options and avoid inappropriate attempts at curative surgery(7,8,3).

1.2. STATEMENT OF THE PROBLEM

Esophageal canceris the eighth most common cancer and the sixth most common cause of cancer relate death worldwide and the fifth most common cancer and attributes a significant number of cancer-related death in Ethiopia. More than 80 % of cases and deaths are in developing countries (8). Ethiopia is one of the developing countries and the incidence of esophageal cancer is increasing. Because TASH is the only oncologic center for the country almost all esophageal cancer patients are referred to TASH from many periphery health institutions. As a result, a significant amount of chest CT scanning and reporting is done for esophageal ca patients. They do have different CT imaging pattern, stage of disease as well as ancillary findings like associated soft tissue mass and lymph node involvement. Most patients come at late presentation and have associated pneumonia but there is no clear studied data about the prevalence and correlation with the stage of the disease. The outcome of esophageal ca is highly dependent on the stage of the disease at the presentation so pre-treatment staging is more than necessary for treatment and prognosis. So, there are different diagnostic modalities for staging like EUS, PET-CT, MRI, and MDCT. MDCT is the only available and currently utilized imaging modality in TASH for chest scanning and plays a key role in the diagnosis and staging of esophageal patients. So, this study will focus on the role of MDCT for assessing imaging patterns, location distribution staging, and prevalence of pneumonia for proper treatment plan using available limited resources.

1.2. RESEARCH RATIONALE

Many patients referred from money part of the country to TASH with advanced esophageal cancer .The outcome of esophageal ca is highly dependent on the stage of the disease at the presentation so pre treatment staging is more than necessary for treatment and prognosis . The aim of this study to determine CT imaging patterns like staging ,associated risk factors and the prevalence of pneumonia

1.3. SIGNIFICANCE OF THE STUDY

Esophageal canceris the eighth most common cancer and the sixth most common cause of cancer relate death worldwide and the fifth most common cancer and attributes a significant number of cancer-related death in Ethiopia. More than 80 % of cases and deaths are in developing countries (8). Ethiopia is one of the developing countries and the incidence of esophageal cancer is increasing. Because TASH is the only oncologic center for the country almost all esophageal cancer patients are referred to TASH from many periphery health institutions. As a result, a significant amount of chest CT scanning and reporting is done for esophageal ca patients. They do have different CT imaging pattern, stage of disease as well as ancillary findings like associated soft tissue mass and lymph node involvement. Most patients come at late presentation and have associated pneumonia but there is no clear studied data about the prevalence and correlation with the stage of the disease. The outcome of esophageal ca is highly dependent on the stage of the disease at the presentation so pre-treatment staging is more than necessary for treatment and prognosis. So, there are different diagnostic modalities for staging like EUS, PET-CT, MRI, and MDCT. MDCT is the only available and currently utilized imaging modality in TASH for chest scanning and plays a key role in the diagnosis and staging of esophageal patients. So, this study will focus on the role of MDCT for assessing imaging patterns, location distribution staging, and prevalence of pneumonia for proper treatment plan using available limited resources.

CHAPTER 2. LITERATURE REVIEW

Esophageal carcinoma is the eighth most common cancer and the sixth most common cause of cancer-relateddeaths worldwide with developing nations making upmore than 80% of total cases and death(2)and accounts for about 7% of all tumors arising from the hollow viscera(10). Itis also the fifth and eighth most common cause of cancer-related deaths in men and womenrespectively(18). There is a huge variation in incidence worldwide with greater than 100-fold differences observed between high incidence areas such as China and Iran, and low incidence areas such as Western Africa(19).
Another study showed worldwide incidence rates vary internationally by nearly 16-fold, with the highest rates found in Southern and Eastern Africa and Eastern Asia and lowest rates observed in Western and Middle Africa and Central America in both males and females(18).
Overall incidence rates are two-fold higher in less developed country compared with more-developed country , with the highest rates occurring in Asia (20).
Worldwide, a higher incidence of esophageal cancer is seen in men with an average 3–4fold increased rate for SCC and a 7–10fold increased rate for ADC compared to women(19).
Esophageal cancer is exclusively higher in the easternand southern African Sub-regions with adult males asa high-risk population(21,22).

Most studies have shown that advancing age is the mostpotent of all carcinogens.Carcinoma esophagus was commonly seen in the age group between 50 to 60 years (59.5%) with males (51.3%) more commonly affected than females (48.6%)(12). The study done in Ethiopia showed the mean age for women 50 years and 55yeasr for men(23). Another study showed peak age for prevalence is between 55year and 64years(4). Another study showed the peak age prevalence in the study wasbetween 41-60 yrs (11). The study from Ghana showed patients' age range was 27 to 87 years with a mean age of 57.8±11.7 years(1).
Incidence and mortality rates are 2 to 3fold higher in males than females(20). Unlike Europe and Asia esophageal ca , esophageal ca in Africa is younger ages like Western Kenya affects individuals below theage of 30(24).
A study was done in Ethiopia showed a hundred fifteen (55%) were females with a mean age of 50 years while 96 (45%) were males with a mean age of 55 years(23). Another study in Ethiopia showed more than half of the patients in the study (61.3%, n=87) were females and about (38.7%, n=55) were males(8).
There is a male preponderance among the patients 64% male and 36% female studied(11), 3 to 4 times more common among males than females(18)but some studies demonstrated female predominance 60% (4, 23,8). Another study done in Ghana152 patients with carcinoma of the esophagus was seen and of these, 122 (80.3%) were males and 30 (19.7%) were females(1).

Many studies showed alcohol and smoking are strongly associated risk factors for esophageal cancer(4, 24,23,8). Cigarette smoking, chat chewing, and alcohol consumption was reported by 5%, 3%, and 2% of the patients with esophageal cancer, respectively(23).
One study showed 125 five patients (82%) had a history of alcohol ingestion and smoking(1). Of the 16 cases of adenocarcinoma, 11 (68.8%) had no history of alcohol or smoking; of the 59 cases of squamous cell carcinoma, 6 (10.1%) had no history of alcohol or smoking(1).
In Western Kenya,alcohol drinkers had a 45% higher risk of developingEC than non-drinkers(24).

In Golestan, Iran, smoking is associated with a moderately increased risk of esophageal cancer, with a reported prevalence of ever having smoked in the general population of 11%, compared with 25% and 27% of those who developed ADC and SCC respectively reporting a smoking history(19).

Hot beverage consumption has been related to increased risk of SCC in South America, Iran, Japan and Singapore (19).
Anotherstudy conducted in nearby Tanzania showed astrong correlation between the drinking of hot milkytea (≥ 70°C) and EC (25). Similar results werefound in Northern Iran and Southern China,where individuals who drank tea at ≥ 70°C had8-fold increased risk of EC(26,27).
Most of the patients were Muslim farmers from rural Arsi and Bale regions of the country where consumption of hot wheat porridge is very common as a traditional staple diet(23). Consumption of very hottea and porridge is common in Kenya and has beensuspected as a risk factorfor EC(24).
In China, 65% of males and 63.5% of females from a high-risk population undergoing endoscopy had biopsy-proven chronic esophagitis(19).
Caustic injury causes intense inflammation and structuring and increases the risk of esophageal SCC approximately 1000-fold(19). Although several genetic abnormalities have been associated with esophageal cancer, these vary between high-risk populations and no single gene has been identified as pivotal in the pathogenesis of esophageal cancer(19).
Esophageal adenocarcinoma is strongly linked to gastroesophageal reflux disease (GORD), Barrett's esophagus and obesity (19,28,29).
Regional differences in alcohol consumption were greatest for men with Southern African men having the highest levels,whereas smoking prevalence was highest in Southern and Middle Africa in both genders (prevalence over 20%)(30).
In a case series of young EC (< 30 yrs of age) at the Tenwek Mission Hospital, Western Kenya, it was found that 45 out of 60 patients had a family history of cancer and 21 out of 60 had a family history of EC(24).
A hospital-based study was done in Ethiopia showed none of the patients reported a history of similar illness among their family members (23).

Many literatures showed that most of the patients predominantly presented with dysphasia(4,7,24,23,8,3). Ninety percent of % of the patients were referred to the center with sever progressive dysphagia and cachexia of more than six months after trying various acid suppressants and/or traditional herbs as they were unaware of the disease and possible risk factors(23).
Dysphasia is the most common symptom (100%) followed by weight loss(45%), abdominal pain (28%) and Chest pain (26%)(11).
Sixty-three percent of the patients studied had 1 - 4 months' history of progressive dysphagia while the duration was 5 - 10 months in the rest(1).
All patients had been reported with a complaint of dysphasia to both solids and liquids. There were (84%) patients with a complaint of weight loss and pain in the throat was reported in (68%) cases (56%) patients with a complaint of vomiting,(28%) patients with a complaint of blood-stained vomiting and only (20%) patients with a complaint of hoarseness(4).None of the patients reported a history of similar illness among their family members while vomiting was reported by 55 % of the patients who were wasted due to the malignancy as well as chronic malnutrition due to prolonged dysphasia(23).
Late presentation with a poor prognosis due to lack of awareness amongst patients and healthcare workers, pooraccess to health facilities and insufficient diagnostic facilitiesand youngpatients (< 30 years of age) at presentation are common in African patients like Kenya(24).
The prominent decline of H. pylori colonization,especially CagA-positive strains, may be responsible for partof the recent increase in esophageal adenocarcinoma rates inWestern countries(31).
Many studies demonstrated that the middle and lower third of the esophagus. The distribution of esophageal cancer by anatomical location was 5 (3.3%) in the upper third, 18(11.8%) in the middle third and 129 (84.9%) in the distal third(1).
Middle and distal third of the esophagus is more affected by esophageal cancer than upper third esophagus but a significant number of cases extends to GEJ and stomach(32).

The majority had mid-esophageal mass lesions followed by distal and proximal lesions, 45%, 34%, and 21% of the patients, respectively(23).
Another study showed the location of the esophageal cancer lesion lower and middle equally covers 40% and upper esophageal ca is consists of 20%. Length of esophageal lesions observed patients ranged from 4.6 to 6.5cm and only a few patients showed greater than 8.5cm lesions length. However, an equal number of patients in two categories each comprising of patients (24%) each were having the length of esophageal lesion ranging between 2.5-4.5cm and subsequently 6.6-8.5cm respectively(4).

Asia's esophageal cancer belt has been extensively researched, but little researchattention has been given to Africa's analogous high-incidence area. The latter affects a north-southcorridor in easterly lying African countries stretching from Ethiopia and Kenya down toSouth Africa(30).
Even though there is no well-studied population-representative data on the prevalence of cancer data in Ethiopia, hospital-based 14years cancer registration analysis done at TASH shows the cancer incidences linearly increasing and GI malignancy is 5th but no clear data about esophageal ca incidence. According to this study (33), gynecologic malignancy is the most common followed by breast ca.
Another hospital-based study was done in TASH in 2017 and esophageal cancer is the 5th most common cancer with a prevalence of 7%(8). According to this study(8)breast, ca is the most common followed by uterine ca. But the imaging pattern, location distribution stage of the diseases at presentation and prevalence of associated ancillary finding like pneumonia is
yet not studied in Ethiopia, which is the purpose of this study.

Many studies have shown that the majority of esophageal cancer is either Squamous cellcarcinoma or Adenocarcinoma. More than 90% of esophageal cancers are either squamous cell carcinomas (SCCs) or adenocarcinomas. Squamous cell carcinoma usually occurs in the middle or upper one-third of the esophagus. Smoking and alcohol consumption are the most important risk factors for squamous cell carcinomas (3).
Adenocarcinoma is most commonly found in the distal esophagus and esophagogastric junction and generally develops in association with Barrett syndrome columnarmetaplasia of the squamous epithelium of the esophagus that is related to gastroesophageal reflux disease. In the past few decades, the incidence of squamous cell carcinoma has been decreasing, whereas that of adenocarcinoma has been increasing(3,6).
Analyzing 75 patients from the 152 patients in whom histopathological information was available, 78.7% had squamous cell carcinoma and 21.3% had adenocarcinoma(1).
Another study showed histologically, 72 tumors (97.3%) were squamous cell carcinomas and two(2.7%) were adenocarcinomas(34).
More than 90% of these are SCCs or adenocarcinomas, approximately 85% of patients esophageal cancer with SCC are men, and the peak incidence is in the 7th decade. In contrast to SCC of the esophagus, esophageal adenocarcinoma is about five times more common in white men than in black men(7).
Squamous cell carcinoma accounts for 90% of EC cases in Kenya(24).
A hospital-based study done in Ethiopia showed most (88%) of the patients had esophageal SCC while the rest 12% had adenocarcinoma on histologic diagnosis(23).

Imaging is essential for detection, diagnosis, staging, and treatment planning and response assessment of esophageal neoplasms. So different diagnostic imaging modalities play a key role in the detection, staging, and post-treatment follow up of patients.

The main purpose of cross-sectional imaging studies in patients isnot a diagnosis. Even though it is currently possible to demonstrate verysmall lesions with dynamic multi-slice CT, almost all patients will have been submitted to endoscopy before reaching the radiology department(10).
Most imaging studies are performed in patients with known esophageal carcinoma. The purpose is to stage the disease as accurately as possible to determine which patients may be suitable candidates for surgical resection(10).
Accurate preoperative staging, particularly concerning the depth of mural invasion, mediastinal invasion, nodal involvement, and distant metastases and assessment of therapeutic response after neoadjuvanttherapy is crucial in determining the most suitable therapy and avoidinginappropriate attempts at curative surgery and patient prognosis are directly related to staging at the time of presentation(35,9,10).
Many diagnostic imaging modalities are used for multipurpose like detection of the esophageal lesions like barium studies and local invasion, lymph node involvement and distant metastases like endoscopic ultrasound, MRI, CT and PET-CT(35,9,3).
Each imaging modality has its advantagesand disadvantages; therefore, CT, endoscopic US, and PET should beconsidered complementary modalities for preoperative staging and therapeuticmonitoring of patients with esophageal cancer(3).
Despite the widespread application of endoscopy, bariumstudies remain the primary imaging techniques in suspected esophageal disorders, particularly in cases ofdysphagia. They are simple to perform, inexpensive andhave a high sensitivity. In the case of carcinoma of esophaguschanges seen in barium swallow is a mucosal irregularity,filling defects, shouldering, and luminal narrowing withproximal dilatation. In case of complete obstruction, thereis no evidence of the barium column running down theobstruction(11).
Esophageal cancer may present as polypoid, infiltrative, varicoid, or ulcerative lesions. Superficial spreading lesions show a nodular mucosal pattern without a well-defined mass(36).

Endoscopy is widespread and easily accessible, allowing definite diagnosisthrough direct biopsy(10).
Endoscopic US is considered to be the most accurate imaging modality currently available for primary tumor staging (T staging) in patients with esophageal cancer. The esophageal wall is visualized as five alternating layers of differing echogenicity, allowing accurate preoperative determination of the depth of tumor invasion thereby differentiate T1, T2, and T3 tumors(9).

Endoscopic US performed with high-frequencyUS probes has shown promisingresults in helping distinguish mucosal (T1*m*)from submucosal (T1*sm*) invasion, which iscritical to the identification of tumors that are amenable to local ablative therapy such asphotodynamic therapy or endoscopic mucosalresection (9,12,10).
A review of the literature shows variations in the accuracyof endoscopic US for T staging as follows: 75%–82% for T1, 64%–82% for T2, 89%–94% for T3, and 88%–100% for T4 disease(9).
The average accuracy of endoscopic US for T staging of oesophageal cancer is 84 %, endoscopic US has several limitations for use in T staging. The endoscopic US is an operator-dependent procedure, and different experience levels among investigators create interobserver variation(9, 36).
Peri-tumoraledematous changes may lead to over staging, while limited tumor penetration below the resolution of endoscopic US may lead to under staging (36).
In patients with stenotictumors in whom the endoscope cannot be passed through the lumen, it may be difficult to evaluate the entire tumor by using endoscopic US (36).In most comparative studies, the accuracy of CT for the assessment of the T stage is lower than that of endoscopic US(9,10,36).
The overall accuracy of endoscopic sonography for local staging is greater than CT and is reported to be between 85% and 90%(10).

Endoscopic US shows higher accuracy rates (72%–80%) for assessing lymph node metastases than does CT (46%–58%)(9) because the endoscopic US relies not only on the size criterion of a short-axis diameter greater than 1 cm but also on the internal echo characteristics of individual nodes. Round nodes, have a hypoechoic central echo pattern, and have sharply demarcated borders are more likely to represent malignancy. Although the accuracy of endoscopic US for predicting lymph node metastases has been reported as 100% if all four features of malignancy are present, only a small number of metastatic lymph nodes demonstrate all four features, especially in the paraesophageal region (9,37).
The endoscopic US has limited value for assessing distant metastases because of the small field of view(3).
Endoscopic US shows higher accuracy rates for assessing lymph node metastases than does CT because the endoscopic US relies not only on the size criterion but also on the internal echo characteristics of individual nodes(3).
EUS results have consistently shown more than 80% accuracycompared with surgical pathology for the depth of tumor invasion (T). Accuracy increased with the higher stage, and was 90% for T3 cancer(37).
Compared with other imaging modalities, endoscopic US better demonstrates the depth of invasion in the esophageal wall, allowing distinction between T1, T2, and T3 disease (tumor invasion of the mucosa or submucosa, muscularispropria, and adventitia, respectively) with an accuracy of 84% (7).
Endoscopic US is also better for evaluating regional lymph nodes, with a reported accuracy of 92% when combined with fine-needle aspiration. However, stenotictumors may not allow passage of the echoendoscope in up to 50% of patients(7,37).

MRI presents the same diagnostic capability as CT,although some reported sensitivity and specificity values of 100% and 84% respectively for MRI and 100% and 80% respectively for CT in the evaluation of the mediastinal invasion (11).
Sensitivity, specificity, and accuracy for resectability were 100%, 84%, and 87%, respectively, for MR and 1 00%, 80%, and 84%, respectively, for CT.
Thus, thestudy has shown that MR and CT have nearby the same accuracy for predicting resectability in patients with esophageal carcinoma(38,39).
Although not a primary modality for staging, MR imaging has been reported to be comparable to CT in determining various parameters of resectability, including mediastinal invasion, lymph node involvement, and distant metastases(7).

CT plays an important role in the staging of esophageal cancer, especially in evaluating mediastinal invasion and distant metastatic disease and may show complications, such as esophageal obstruction and tracheoesophageal fistula formation(7).
CT is recommended for initial imaging following confirmation of malignancyat pathologic analysis, primarily to rule out unresectable or distantmetastatic disease. With the advent of multidetector CT, the use of thin sections and multiplanar reformation allow more accurate staging ofesophageal cancer (9).
CT hasbeen the mainstay for staging esophageal cancer,the increasing use of endoscopic ultrasonography and positron emission tomography (PET)with 2-[fluorine 18]fluoro-2-deoxy-d-glucose(FDG) has improved the staging algorithm fornewly diagnosed esophageal cancer(9).
MDCT currently remains the most commonly used examination for known esophageal cancer patients staging. In preoperative esophageal cancer staging, MDCT gives information extent of local extension of the mass and detect distant metastases and lymphadenopathies rapidly and noninvasively, (7,12,32).

Computed tomography is a primary imaging modality for enabling the detection and characterization of lesions of the esophagus. It is an effective mode in determining the length, location, nature of characteristics lesions and in monitoring their alteration in size over time(4).CT of the cervical region, chest, and abdomen are employed to detect the presence of cancer in the esophageal wall, invasion into the tracheobronchial tree, aorta, or pericardium, and the presence of metastatic disease in lymph nodes, lung, liver, bones, or adrenal glands(4,13).

Normal esophageal wall thickness at CT is usually less than 3 mm when the esophagus is distended, and any thickness greater than 5 mm is considered abnormal(9).
The CT findings of carcinoma of the esophagus may include.
1.Intraluminal mass.
2.Esophageal wall thickening, often sufficient to cause a soft tissue mass.
3.An irregular or eccentric esophageal lumen
4.A dilated lumen, with or without a fluid level proximal to the obstructing tumor.
5.Obliteration of the fat plane between the tumor and adjacent structures
6.Perforation or sinus tract into the mediastinum or fistula with the tracheobronchial tree.
7.Lymphadenopathies in the mediastinum, supraclavicular region, and the abdomen.
8.Distant metastasis to liver, lung, or other distant organs(11).

General imaging findings of malignancy include stricture or mass with mucosal irregularity or ulceration at barium esophagography and evidence of tumor spread with infiltration of the periesophageal fat, lymphadenopathy, or distant metastases at cross-sectional imaging(7).
The most common type of wall attenuation was observed to be homogeneous in (64%) patients followed by heterogeneous in (36%) patients.The most common asymmetrical wall thickening was observed in the maximum number of patients (72%) and circumferential wall thickening was observed only in(28%) of patients (4).

There was the variable degree of esophageal wall thickening <10mm (10.8%), (10-20mm 83.8% and more than 20mm is 5.4% (12)The study also showed about 78.4% of the patients have proximal dilatation and 16.2% mediastinalInvolvement(12).
There was also the various site of lymph node involvement, abdominal nodes 24.3 %, neck nodes 5.4 %, mediastinalnodes 16.2% and 16.2% patients have metastasis with (86.5%)of squamouscellcarcinomahistopathological variant (12).
There was a variable degree of esophageal wall thickening <10mm (6%), (10-20mm 84% and more than 20mm is 10 %with about 75% of the patients have proximal dilatation and 13% mediastinal involvement(11).
The clinical staging of esophageal cancer is assessed with the TNM system. The depth of tumor invasion determines the primary tumor stage (T). Nodal status (N) is based on the number of locoregional cancer-positive lymph nodes. Distant metastases are subdivided into M0 (absence) and M1 (presence) (40).
CT, MR imaging, and EUS are the cross-sectionalimaging techniques that have been used for stagingesophageal cancer patients(41).
CT is considered the most accurate imaging tool for depicting local invasion to adjacent structures, which helps determine suitability for surgical resection. CT criteria for local invasion include loss of the fat planes between the tumor and adjacent structures in the mediastinum and displacement or indentation of adjacent mediastinalstructures (3, 14).

However, it frequently is impossible to delineate normal fat planes at CT, particularly in the mid esophageal area, in severely underweight patients and in patients who have undergone radiation therapy or surgery (14).T4a tumors are resectable cancers that invade adjacent structures such as the

pleura-peritoneum, pericardium, or diaphragm. T4b tumors are unresectable cancers that invade other adjacent structures such as the aorta, carotid vessels, azygos vein, trachea, left main bronchus, or vertebral body(3).
Pericardial invasion is suspected if CT images show obliteration of the fat plane between the esophageal mass and pericardium, pericardial thickening, pericardial effusion, or indentation of the heart with a concave deformity (8,9).
A tracheobronchial fistula or direct extension into the lumen is an unequivocal finding of airway invasion by the tumor.Tracheobronchial invasion is also suspected if there is a discrete indentation on the posterior wall or displacement of the trachea or bronchus by the tumor(8,9,14).
Aortic invasion is suggested if the contact area between the tumor and aorta is greater than 90° or if there is the obliteration of the triangular fat space between the esophagus, aorta, and spine adjacent to the primary tumorby esophageal cancer was reported to be 80%(41).
The reported sensitivity and specificity of CT for detecting mediastinal invasion in patients with esophageal cancer are 88%–100% and 85%–100%, respectively(9).
The reported accuracy of CT in detecting aortic invasion and tracheobronchial involvementis currently around 90%(14).
The individual layers of the esophageal wall cannot be delineated accurately with CT-scan and further CT cannot identify microscopic infiltration. Thus, CT is less accurate in differentiating between T1 andT2 disease(11).

Lymphadenopathy is diagnosed based on the short axis size criterion: 1cm is usually taken as the threshold of significance for mediastinal and upper abdominal nodes, and 0.6 cm forretro rural nodes, although clusters of smaller nodes are regarded as suspicious(12,42).
CT has approximately 80% accuracy in predicting abdominal lymph node involvement and is poorer at detecting perioesophageal lymph node involvement as this may be from the tumor mass. Unlike most cancers, distant lymphadenopathy in neoplasms of the upper and lower third of the esophagus contributes to the M stage of the tumor(12).
An enlarged lymph node on CT suggests nodal metastasis. The short axis of nodes is easily measured; intrathoracic and abdominal lymph nodes >1 cm are considered enlarged(40).
One study done in India showed the staging was maximum in T3 stage patients (56%) followed by (36%) patients with T1 and T2 staging and the least number (8%) patients accounted for T4 staging(4).
Five of the 13 (38%) early T1/T2 tumors were accurately identified by CT.CT correctly identified the T stage in 15 of the 16 (94%) advanced tumors (T3/4)(32).
T3N0Mx was the most common staging found in CT(56.7%) and 16.2% of cases presented with metastasis(12).
The reported accuracy of CT in diagnosing mediastinal invasion ranges from 59% to 82%(10,36).
Reported accuracy rates for T-staging by EUS range from 77% to 93% compared with 51–64% for CT-scan (43).

Infiltration of the adjacent structures was most commonly detected by the esophageal growth seen in lymph nodes with a maximum population of 23 (92%) of the patients. However, the least number only 2 (8%) patients accounted for mediastinal infiltration either into great vesselsbronchial/tracheobronchitis. But infiltration of the adjacent bones was found to be altogether nil (4).
Great vessel infiltration has been reported both in 2 cases (13.3%) of squamous cell carcinoma but no bronchus infiltration reported in both 2 cases (13.3%) with squamous cell carcinoma and patients with adenocarcinoma had been reported as nil (4).

CT is sensitive for the detection of distant metastases, most commonly involving the liver, lungs, and bones; however, CT is less sensitive for detecting nodal metastases, as involved lymph nodes often are not enlarged (7).
Distant metastases have been reported at initial presentation in 20%-30% of patients with esophageal cancer and are most commonly diagnosed in the liver, lungs, bones, adrenal glands, and, rarely, peritoneum and brain(2, 3).
No metastasis had been reported in patients with an ailment of adenocarcinoma prevailed in (40%) patients. However, only (13.3%) patients reported metastasis in patients suffering from squamous cell carcinoma.
Metastasis to distant organs has been reported only in the liver, the preferred largest organ to metastasize accounting for only (8%) number of patients(4).
a study showed 12 patients out of 100 showeddistant metastasis6 patients show metastasis to lung, 3patients to the liver, 2 patients in the brain, 2 patients to the bone, 1patient to peritoneal and 1 to suprarenal(11).
Liver metastasis was present in 40 (36.2%) and lung metastasis in 6 (5.4%) of the patients studied(1).
Approximately 18% ofpatients will have distant metastases, typically to abdominal lymph nodes (45%), liver (35%), lung (20%), supraclavicular nodes (18%), bone (9%), or adrenal glands (5%) (35).
The most common metastatic site was the cervical lymph nodes (56.8%), and the most common visceral metastatic organ was the lungs (18.9%) (34).

The AJCC, distant metastasis can be subdivided intoM1a and M1b. Each of these classifications is crucial in determining possible treatment options. M1a includesmetastasis to celiac and cervical lymph node groups.
This classification is associated with a better prognosiscompared to M1b. Patients classified as M1a oftentimescomplete a course of neoadjuvant therapy followed bysurgical resection. Patients with M1b include those with
distant site metastasis. This classification usually carries worse prognosis given that surgical resection with curativeintent is not indicated in these cases(2). The combination of CT-scan and ultrasound might be the best strategy for the detection of distant metastasis (supraclavicular nodes and abdominal metastasis) with reported sensitivity, specificity and accuracy rates of 83%, 81%, and 79%, respectively (43).
PET provides diagnostic information based on this increased FDG uptake and often demonstrates early-stage disease before any structural abnormality is evident. The sensitivity and specificity of FDG PET in the staging of local nodal disease were 60% and 100%, respectively(35). Although PET has been shown tohave a higher sensitivity than CT in the detection of primary esophageal cancer, it is of limitedvalue in assessing the T stage because it provides little information on the depth of tumor invasion(44).
One study showed that PET was able to detect distant metastasis 15% of the time in patients that were believed to only have primary esophageal cancer by other imaging modalities(2). FDG PET is more sensitive than CT for depicting nodal metastases in patients with squamous cell carcinoma of the esophagus(45). The sensitivity, specificity, and accuracy, respectively, of CT, have been reported to range from 8% to 75%, 60%to 99%, and 45% to 96%; those of FDG PET have been reported to range from 22% to 57%, 90% to 100%, and 37% to90%(45).
PET/CT is also superior to CT for detecting lymph node metastases and can depict metastases in normal-sized lymph nodes through the uptake of FDG (,43).
In a recent study comparing PET/CT and the endoscopic US, endoscopic US was superior to PET/CT for identifying local regional lymph node metastases (17).

PET/CT has the advantage of allowing total body coverage, and its primary role is to depict distant sites of metastatic disease (3,46).
Pooled sensitivity and specificity for the detectionoflocoregional metastases were 0.51 and 0.84, respectively. For the detection of distantmetastases, pooled sensitivity and specificity were 0.67 and 0.97, respectively(16).
Furthermore, PET/CTscan can depictmetastases in unusual and unexpected locations, including the brain, skeletal muscles,subcutaneous tissues, thyroid gland, and pancreas(14).
One of the major limitations of anatomic imaging with CT or MR imaging is the inability to distinguish postoperative scar from tumor recurrence at which FDG PET is extremely useful .
FDG PET is useful for further investigation of abnormalmasses seen at other imaging modalities and is a useful diagnostic tool in the follow-upof asymptomatic treated patients or evaluation of symptomatic patients with suspecteddisease recurrence . It also play a valuable role in the follow-up of patients who undergo chemotherapy and radiation therapy and early response treatment(35,14,47).
FDG-PET showed moderate sensitivity and specificity for the detection of locoregional metastases, and reasonable sensitivity and specificity in the detection of distant lymphatic and hematogenous metastases(48,16).

FDG-PET has also been utilized in determining nodal involvement in esophageal cancer. Assessment oflocal and regional lymph nodes for the uptake of FDG isdifficult to determine given the intense uptake of FDGby the primary esophageal tumor. However, PET is quiteuseful in detecting distant metastasis, including metastasisto the abdomen and cervical lymph nodes. Sensitivitieswere reported as high as 90% in distant lymph nodemetastasis(2).
The primary role of PET/CT in the detection of distant metastases. In up to 20% of patients, FDG PET prevents unnecessary surgery by demonstrating metastatic disease not found with conventional modalities(7).

Diagnostic sensitivity for the primary tumor was 83% for PET and 67% for CT; for local peritumoral lymph node metastasis, it was 37% for PET and 89% for EUS; and for distant metastasis, it was 47% for PET and 33% for CT. The diagnostic specificity for local lymph node metastasis was 100% with PET and 54% with EUS, and for distant metastasis, it was 89% for PET and 96% for CT. Accuracy for locoregional lymph node metastasis was 63% for PET, 66% for CT, and 75% for EUS, and for distant metastasis, it was 74% with PET and 74% with CT (49).

The prognosis depends primarily on the depth of invasion and the presence or absence of lymph node involvement. Independent of staging, esophageal adenocarcinoma has a better prognosis than SCC, with a 5-year survival rate after resection of 42% compared with 30% for SCC (7).
Radical esophageal resection alone remains the only established curative treatment of cancer of the esophagus(24).
Among the treatment modalities chemotherapy, radiation, surgery, and immunotherapy have been mentioned and the choice is dependent on the specific CA treatment protocol. Surgery has been promising in early-stage solid CA cases with adjuvant or neoadjuvant radiation therapy(8).

CHAPTER 3. OBJECTIVES

3.1. GENERAL OBJECTIVE

To assess CT imaging pattern, associated risk factors, and prevalence of pneumonia in esophageal cancer patients coming for staging radiology department unit using MDCT –Scan

3.2. SPECIFIC OBJECTIVES

To evaluate various CT scan findings in carcinomaesophagus.

To asses correlated risk factors

To stageesophageal cancer using worldwide accepted new 8th TNMstaging system

To correlate histology with location and risk factors

To assess the prevalence of aspiration pneumonia

CHAPTER 4. MATERIALS AND METHODS

4.1. STUDY AREA

The study was conducted at the TASH Radiology departmentfrom July 2018 to June 2019 G.C

4.2. STUDY DESIGN AND PERIOD

Facility-based prospective crossectionalstudy of allendoscopy and orhistopathology confirmed esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia.

4.3 SOURCE AND STUDY POPULATION

4.3. 1.SOURCE POPULATION

All patient who wassent for chest CT-scanat the time of the data collection period

4.3.2. STUDY POPULATION

patients who have all endoscopy and or histopathology confirmed esophageal cancer sent for the staging of esophageal ca in the TASH-radiology department.

4.5. STUDY UNIT

Each selected endoscopy and or histopathology confirmed esophageal cancer sent for the staging of esophageal ca in the TASH-radiology department.

4.6. INCLUSION AND EXCLUSION CRITERIA

4.6.1. INCLUSION CRITERIA

All esophageal cancer patients confirmed by endoscopy and or histopathology.

4.6.2. EXCLUSION CRITERIA

Noncontrast chest CT

Patient sent for tumor recurrence, response assessment or post-operative scanning

Patient with CT scan which did not include all anatomical coarse of the esophagus

4.7. SAMPLING TECHNIQUE

4.7.1. SAMPLE SIZE DETERMINATION

Non-probability sampling technique was used and all patients with endoscopy and histopathology confirmed esophageal cancer sent for the staging of esophageal ca during the study period were included.so110 esophageal cancer patients were sampled accordingly and participated the study.

4.7.2. SAMPLING METHOD

Non probablity convienent sampling methond

4.8. DATA COLLECTION PROCEDURES

4.8.1. DATA COLLECTION INSTRUMENT AND TECHNIQUES

Study tools

- GE machine with 64 slice MDCT was used for scanning.
- since there is no automatic injector manual injector is our option.
- contrast media.
- A semi-structured questionnaire was used and demographic and clinical data were collected directly from the patient and other data like histological type and endoscopic findings were recorded from the chart.

study protocols

As all other patients history was taken for history for contrastallergy and Cr.levelwas checked as TASH upper limit level for contrast.

all examination was done by 64 MDCT with contrast administration according to their weight.

CT protocol :

- ✓ 50ml for chest and 100ml for the abdomen of IV iodinated contrast was injected through manual injectors.
- ✓ MDCT is commenced at 25-30 second(chest) and 70sec (abdomen) post injection .
- ✓ *Sections are acquired at 2.5mm and reformatted at 5mm for multi-planar viewing.*

4.8.2. DATA COLLECTION

- The data was collected by the principal investigator and radiology resident collogues working in the radiology department.
- PACS images were reviewed to retrieve reports with esophageal ca during the study period.
- Structured questioner was used to collect necessary information.
- Medical record of the patients were reviewed.

4.9. STUDY VARIABLES

4.9.1. DEPENDENT VARIABLES

The dependent variable of the study was CT-scan findings such as location distribution, length of involvement of esophagus, staging, and prevalence of aspiration pneumonia of patients scan for esophageal ca staging.

4.9.2. INDEPENDENT VARIABLE

The independent variables of the study were age and sex of the patients.

4.10. DATA PROCESSING AND ANALYSIS

The data was checked for clarity and completeness then analyzed using IBM SPSS statistics software version 25 .
The data were processed by using descriptive analysis, including frequency distribution, cross-tabulation and summary measures to see the relation between the dependent variable and independent variables. Finally, the results are presented in text, charts, graphs, and tables.

4.11. ETHICAL CONSIDERATION

Data collection started after getting permission from the ethical review committee of the department of radiology at Ababa University.
Data collection was done by the investigator and information is confidential.
On the data retrieval form, anonymity was assured by omitting all parts including names and personal documents.

4.12. OPERATIONAL DEFINITIONS

Cervical esophagus; begins at the level of the lower border of the cricoid cartilage and ends at the thoracic inlet (suprasternal notch).
Upper esophagus; from the sternal notch and inferiorly by the azygos arch.
Middle esophagus; from the level of the azygos arch to the level of the inferior pulmonary vein
Lower esophagus;from the level of the inferior pulmonary vein to the lower esophageal sphincter

4.13.LIMITATION OF THE STUDY

Some of the risk factors has no objective measurement like extremely hot drink and alcohol ingestion which didn't separate alcoholic content
There is no comparison between the intra operative staging and radiological staging

CHAPTER 5. RESULT

5.1.1. Socio-demographic and socio-economic characteristics of respondents

A total of the 110 esophageal ca patients were involved in the study; none respondent rate was 0%.

Table 1; Sociodemographic characteristics of the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019

	variable	Frequency	Valid Percent
Address	Rular	80	72.7
	Urban	30	27.3
Exact residence	Arsi	32	29.1
	Bale	10	9.1
	Silte	4	3.6
	Gurage	4	3.6
	North Shewa	3	2.7
	Gojam	3	2.7
	Gonder	1	.9
	Adama	4	3.6
	Shashemene	4	3.6
	Welkite	2	1.8
	Addis Ababa	3	2.7
	Harerge	2	1.8
	Segen	1	.9
	Welega	6	5.5
	Kembata	2	1.8
	Harer	1	.9
	Jijiga	1	.9
	Hawassa	4	3.6
	Others	23	20.9
	Total	110	100.0
Sex distribution	Female	61	55.5
	Male	49	44.5
Ethnic group	Oromo	80	72.7
	Amhara	8	7.3
	Tigray	1	.9
	Gurage	4	3.6
	Others	17	15.5

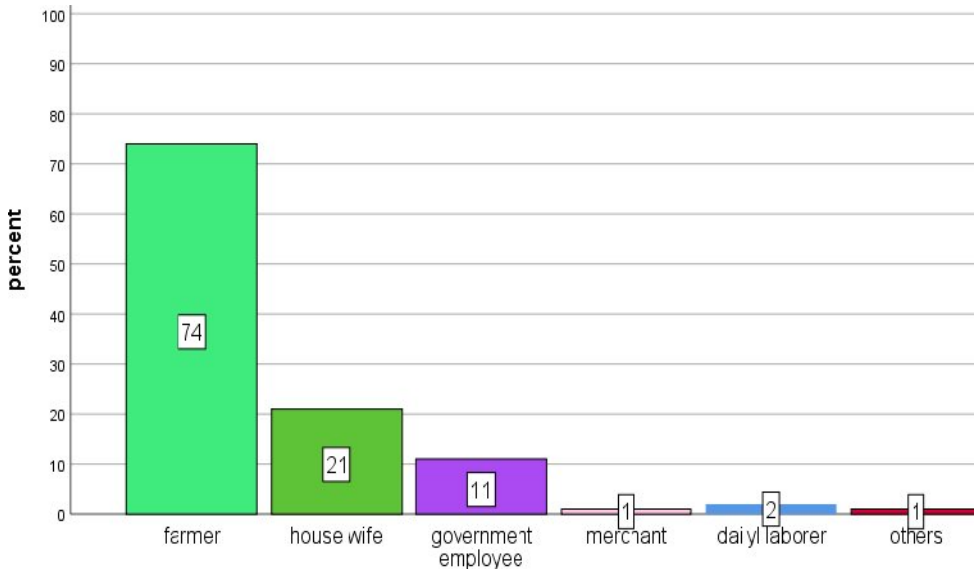

Figure 1.Occupational distribution of the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019

The majority of the respondents belonged to the Oromo ethnic group (72.7%), and from the rulararea(72.7%) specifically Arsi and bale . Regarding the occupational background, the majority were farmers (67.3%) and minorities were merchants(0.9%). Out of the total number of respondents,110 (37.3%) were in the age group 51 to 60 years as is presented in the next figure.

Table 2;age distribution of the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019.

Agerange	Frequency	Percent	Age range	Frequency	Percent
Less 30	5	4.5	**56-60**	**22**	**20**
31-35	6	5.4	61-65	10	9
36-40	8	7.3	66-70	8	7.3
41-45	14	12.7	71-75	2	1.8
46-50	15	13.6	76-80	4	3.6
51-55	16	14.5			

Among 110 respondents only 10(9.1%) had a history of cigarette smoking; all of them less than half-packet per day.

Only 10.9% had frequent alcohol consumption and 13.6% has symptoms of GERD before the onset of the current symptoms.

The majority of the responders (62.7%) have a history of taking an extremely hot drink and are from Bale(9%) and Arsi (28.2%).

All respondents are presented with symptom and weight loss and dysphasia are the symptoms that all of them complaining as described by the following graph.

Table 3 ; symptom distribution of the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019.

Symptoms	Frequency	Percent
Dysphasia and weight loss	56	50.9
Vomiting , dysphasia and weight loss	35	31.8
Chest pain , dysphasia and weight loss	18	16.4
Cough ,dysphasia and weight loss	1	.9
	110	100

The majority of the histology type is SCC as seen by the following pie chart.

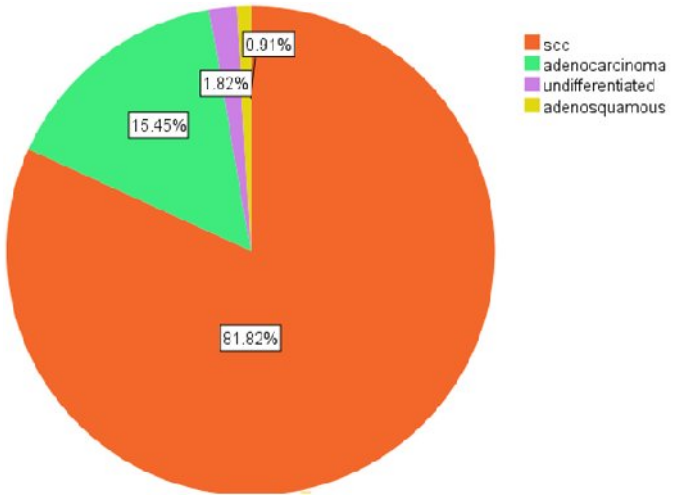

Figure 2;Histological distribution of the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019

Regarding the location, majorly loweresophagus is involved with a 33% GEJ extension.

Table 4;Esophageal ca location distribution of the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019

Location	Frequency	Percent
Middleand lower	27	24.5
Lower	52	47.3
Middle	15	13.6
Upper and middle	6	5.5
Cervical And Upper	3	2.7
Upper	5	4.5
Cervical	2	1.8

Most of the CT findings are asymmetrical wall thickening (68.2 %) with mean length 7.7cm and mean wall thickness of 16.7mm.Thirty percent of the respondents have proximal esophageal dilatation with a mean dilatation diameter of 19.2mm %.

Table 5;CT findings of esophageal ca of the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019

CT imaging finding	Freq	%	Variable	Length in cm	Wall thickness in mm	Esophageal Dilatation mm 31/110=28.2
asymmetric wall thickening with luminal narrowing	75	68.2	Mean	7.7	16.65	19.2
circumferential wall thickening	29	26.4	Minimum	2.5	6	6
enhancing soft tissue mass with narrowing	6	5.5	Maximum	18	40	34

More than 85 % of the cases have mediastinal involvement by the mass as demonstrated by the following figure .

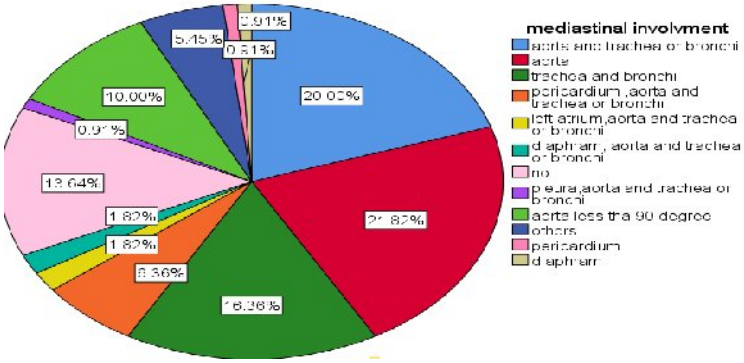

Figure 3; Mediastinal involvement by esophageal ca in the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019

More than 50 % of the cases have lymph node involvement being the mediastinum is common site as demonstrated by the following figure .

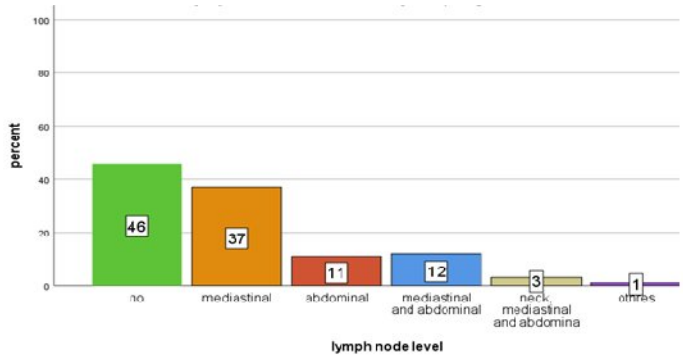

Figure 4;lymph node involvement by esophageal ca in the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019.

Among 110 respondents25(22.7%) have distant metastases with the lung is the commonest site and distant lymph node is the least common site of metastases.

Table 6;Metastases of esophageal ca in the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019.

Site	Frequency	Percent
liver	9	36.0
lung	11	44.0
lung and bone	1	4.0
liver and bone	1	4.0
liver and lung	2	8.0
live and lymph node	1	4.0
Total	25	100.0

About 9.1% of patients who have aspiration pneumonia with right middle lobe is the common site.

Table 7; Lung lobe distribution of pneumonia in esophageal ca in the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019.

Lung lobe	Frequency	Percent
RML	1	8.3
RLL	1	8.3
RML and lingula	4	33.3
LLL	1	8.3
RUL and LUL	2	16.6
RLL and LLL	3	15
Total	12/110=10.9	100

Most of the patients are as stage T4b, N0 and M0 at presentation as described by the following table.

Table 8; TNM staging esophageal ca in the study participants that CT imaging pattern ,associated risk factors and prevalence of pneumonia of esophageal cancer patients scanned for staging in the Department of Radiology, TASH, Addis Ababa, Ethiopia 2019.

T stage			N staging			M staging		
	Frequ	%		Freq	%		Frequ	%
T4b	77	70	N2	30	27.3	M0	84	76.4
T4a	20	18.2	N0	47	42.7	M1	26	23.6
T 3	13	11.8	N3	13	11.8			
			N1	20	18.2			
Total	110	100		110	100		110	100
Unresectability								
T3M0=12		T3M1=1		13		T3M1+T4aM+T4b 1+8+77=86/110 = 78.18 unresectable		
T4aM0=12		T4aM1=8		20				
T4bM0= 60		T4bM1= 17		77				

CHAPTER 6.DISCUSSION

Esophageal cancer is a one of the highly lethal disease that continues to have less than 10% five-year survival despite advances in multimodality therapy(1).
Esophageal cancer is the eighth most common cancer and the sixth most common cause of cancer relate death worldwide and the fifth most common cancer and attributes a significant number of cancer-related death in Ethiopia.

The majority of the respondents belonged to the Oromo ethnic group (72.7%), and from rular area(72.7%) specifically Arsi and Bale where extremely hot drinks and meals are routine . Regarding the occupational background, the majority were farmers (67.3%) and minorities were merchants(0.9%). Out of the total number of respondents, 110 (20%) were in the age group 56 to 60 years and slightly female predominance with 55.5% which is consistent with the study done in Ethiopia showed mean age for women 50 years and 55yeasr for men(8,23).There are 5 out of 110 responders below the age of 30 with a minimum of 22years which is consistent with a study done in Kenya below the age of 30 years but Europian and Asian esophageal ca is older (24).
There is female predominance in our study with 55.5 % to 45.5% which comparable two previous studies in Ethiopia (8,23) unlike European and Asian esophageal ca at which male is much higher than female(1,4,11,18).This discrepancy could be the well studied risk factors are smoking and alcohol consumption which is much more taken by males but in our study even though there is no well studied risk factors possible explanation is in the endemic area extremely hot drinks and meals are equally consumed by females and males .

Many studies have shown there are associated risk factors for esophageal cancer has a strong association with smoking, being overweight, having gastroesophageal reflux, consuming low amounts of fruits and vegetables, Barrett's esophagus, heavy alcohol use and extremely hot drinks (5,6).

This study has shown the CT imaging feature of esophageal ca and correlated factors. Among 110 respondents only 10(9.1%) had a history of cigarette smoking; all of them less than half-packet per day. About 10.9% had frequent alcohol consumption and13.6% has symptoms of GERD before the onset of the current symptoms. So this study has shown more respondents have a higher rate of smoking and frequent alcohol consumption than a study done in 2014 Ethiopia 5% and 2% respectively (23). This could be the result of the increment in smoking in the general population. But the alcohol consumption still lowers comparing with the study done at Western Kenya (45%) and Ghana (82%) respectively (24,1) and smokers are less than the other study(25%) in Iran (19). Among 10 smokers 9(90%) have SCC and 11of 12 frequent alcohol consumers have SCC. Of the 17 cases of adenocarcinoma, 16 (94%) had no history of alcohol or smoking; of the 90 cases of squamous cell carcinoma, only 9 (0.1%) had a history of alcohol or smoking.This study is consistent with other studies that alcohol and smoking are not a major risk factor of adenocarcinoma but smoking and alcohol consumption is not a major correlated risk factor for SCC in our study(1). This discrepancy could be a result of the majority of the responders had a history of smoking and alcohol consumption even though the histology type is 90/110 (81.8%).

Many studies have shown hot beverage consumption has been related to increased risk of SCC in South America, Iran, Japan and Singapore (19).
The majority of our responders (62.7%) have a history of taking an extremely hot drink and wheat porridge Muslim farmers from Bale(9%) and Arsi (28.2%) .

This study is consistent with the study done in Ethiopian in 2014(23)and other studies Tanzania(25), Kenya (24), China (19).
The etiology of esophageal adenocarcinoma is strongly linked to gastro-esophageal reflux disease (GERD), Barrett's esophagus and obesity(19,28,29).
But all of our participants cannot call their weight before the symptoms started and 13.6% have GERD symptoms that started before the current symptoms started and repeatedly treated.But GERD has no statically significance with adenocarcinoma with P >0.05.
This study showed none of the patients reported a history of similar illness among their family members which consistent withhospital-based study was done in Ethiopia at 2014(23) but was found that 45 out of 60 patients had a family history of cancer and 21 out of 60 had a family history of EC(24).

Many pieces of the literature showed that most of the patients predominantly presented with dysphasia(4,7,24,23,8,3).

All respondents were referred from other health facilities after they presented with symptoms and weight loss and progressive dysphasia(100%) of average 7.5 months with a minimum of 1month and maximum of 24 months after trying various acid suppressants and unspecified medications. This study finding is consistent with money studies (1,4,11,23) and most of our participants have an advance stage that corresponds with the symptoms.

All of the respondents have a combination of symptoms beside of the weight loss and dysphasia, vomiting, chest pain and cough with a prevalence of 31.8 %, 16.4 and .9% respectively like other study findings (1,4,11,23)but none of them complains abdominal pain or hoarseness unlike other studies (24).Like a study was done in Kenya, a late presentation with a poor prognosis due to lack of awareness amongst patients and healthcare workers, poor access to health facilities and insufficient diagnostic facilities and young patients (< 30 years of age) at presentation (24).

The majority of the histology type is SCC (81.8%) and 15.45 % is adenocarcinoma but there were undifferentiated(1.82) and adenosquamous(9) histologic types in our study. This study is consistent with other studies being the SCC is the commonest histological type followed by adenocarcinoma (1,7,23,34) but in our study adenocarcinoma is slightly increased compared with previous images which are supported some studies (3,6). Among 17 adenocarcinomas 14 of found lower esophagus location with stastically significant correlation with P=0.02 and 10 of 17 are female . The only 1out of 17 of adenocarcinoma has history smoking and 9/90 of SCC has a history of smoking which is not stastically significant with P>0.05.

Out of 17 adenocarcinoma patients, only 2 have a history of GERD symptoms before the current symptoms started. out of 90 cases of SCC, about 56(62.2%) respondents have a history of frequent alcohol consumption .

The majority had lower esophageal mass lesion followed by both middle and lower and middle only lesions, in 47.3%, 24.5%, and 13.6 % of the patients, respectively with 33% GEJ extension.Only 5 out of 110 cases are cervical esophagus location with 3 of them have an upper esophageal extension. The upper esophageal involvement is14 cases out of 110 with middle and cervical extension 6 and 3out of 110 total cases.

The study is compatible with other studies, (84.9%) in the distal third (1,32)but one study done in Ethiopia showed the commonest is location is mid esophagus(45%)(23) probably the research was done using endoscopy imaging alone.
The length of esophageal lesions observed in our respondents ranged from 2.5 to 18 cm(only one patient)which is longer than the other studies could be late presentation of our patients with mean length 7.7cm.Thirty percent of the respondents have proximal esophageal dilatation with mean dilatation diameter of 19.2mm.
Asymmetric wall thickening with luminal narrowing is the common CT findings of esophageal ca (68.2%) and circumferential wall thickening and enhancing soft tissue mass with narrowing with a frequency of 26.4%and 5.5%respectively. Our CT findings of the esophageal lesion areconsistent with other studies, asymmetrical wall thickening (72%) and circumferential wall thickening were (28%) of patients (4).And also CT findings are comparable endoscopic findings 68/110 fireable mass ,23/110 circumferential wall thickening and 19/110 fungating mass. Out of 110case 21 has barium swallow and 18/21 has filling defect with narrowing and shouldering.
There was a variable degree of esophageal wall thickening ranging from 6 to 40mm with a mean of 16.65mm. our study is comparable with other studies 10-20mm of 78.4%(12).

The study also showed about 33% of the respondents have proximal dilatation ranging from 6mm to 34mm with a mean of 19.24mm. Among patients present with esophageal dilatation 81.8% are lower and middle esophagus in location. Proximal esophageal dilatation has significant stasticall correlation with SSC with P value of 0.01.

The clinical staging of esophageal cancer is assessed with the TNM system. The depth of tumor invasion determines the primary tumor stage (T). Nodal status (N) is based on the number of locoregional cancer-positive lymph nodes. Distant metastases are subdivided into M0 (absence) and M1 (presence) (40).
CT is considered the most accurate imaging tool for depicting local invasion to adjacent structures, which helps determine suitability for surgical resection.
CT criteria for local invasion include loss of the fat planes between the tumor and adjacent structures in the mediastinum and displacement or indentation of adjacent mediastinal structures (3, 14). Mediastinal structures can be involved by direct extension so this study showed the commonest mediastinal structure involved is aorta about 87% of cases, followed by a variable degree of trachea and bronchi, rarely involved structures rare pericardium, left atrium, pleura, diaphragm, and others. Only 13.6% of the patients have no mediastinum involvement. There is a significant relationship between location and mediastinal involvement, lower and middle esophageal have a tendency to involve mediastinal structure. Least number only 2 (8%) patients accounted for mediastinal infiltration either into great vessels, bronchi /tracheobronchus (4). This discrepancy is possible because of our cases are presented with advanced stages like T3/T4.

About 70% of the respondents are stage T4b followed by T4a and T3 are 18.2%and 11.8% respectively. None of them have stage T1 or T2 in our collection .In other studies the T staging is lower than our cases. One study done is in Indian showed most of the cases are staged as T3(56 %) and least wasT4 8% (4).Another study showed 15 out of 16 cases showed advanced T staging T3/T4 (32).
Lymphadenopathy is diagnosed based on the short axis size criterion: 1cm is usually taken as the threshold of significance for mediastinal and upper abdominal nodes, and 0.6 cm for retrocrural nodes, although clusters of smaller nodes are regarded as suspicious(12,42).
In our study, about 41.8% of the case have no lymph node involvement, among the involved lymph nodes mediastinal 37/110, both mediastinum and abdominal (12/110) and abdominal(10/110) in decreased

frequency. Rarely neck lymph nodes are involved(2.7%). So our finding is comparable with others which were N0 the most common staging found in CT(56.7%) (12).
CT is sensitive for the detection of distant metastases, most commonly involving the liver, lungs, and bones; however, CT is less sensitive for detecting nodal metastases, as involved lymph nodes often are not enlarged (7).

Among 110 respondents 25 (22.7%) have distant metastases with the lung is the commonest site(44%) followed by liver (36%) and the distant lymph node is the least common site of metastases(4%). There was one case having both liver and bone metastases and the other case both lung and bone metastases .our finding is similar to other studies. Distant metastases have been reported at initial presentation in 20%-30% of patients with esophageal cancer and are most commonly diagnosed in the liver, lungs, bones, adrenal glands, and, rarely, peritoneum and brain(2, 3). Other study showed liver is commonest followed by lung metastases 36.2% and 5.4% respectively (1). so in our study, the commonest staging is T4bN0m0 comparable with others.

About 10.9% of patients who have pneumonia with right middle lobe is the common site followed by a lingularlobe. There is no specific research is done on prevalenceofpneoumonoa

CHAPTER 7.CONCLUSION AND RECOMMENDATION

7.1. CONCLUSION

- ✓ Most patients are 56-60years farmers from oromia with female predominance
- ✓ All patients presented with dysphagia and weight loss.
- ✓ Dirking or eating extremely hot drinks or meals, alcohol, and smoking was the associated risk factor.
- ✓ The lower esophagus affected more commonly 47.3% compared to other parts.
- ✓ The wall thickness in the majority of the cases measured between 10-20mm (83.8%).
- ✓ T4bN0M0 was the most common staging (56.7%) with 78.18% unresetable at presentation.
- ✓ About 22.7% of cases with metastasis being lung is the commonest site of metastasis.
- ✓ SCC (81.8%) was the most common histopathological type presented.
- ✓ Of 110 patients 12 of them (10.9%) have aspirational pneumonia.

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7.2. RECOMMENDATION

- ✓ Create disease awareness in the community levelespecially at the burden area
- ✓ Alert health professionals about the disease so early diagnosed to be made at local health facility .
- ✓ Avoid identified risk factors
- ✓ Further study should be done why most of patients are come with advanced disease
- ✓ Further study should be done to compare radiological staging and intraoperative staging

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Annexes

Annex I. Dummy tables

Table 9;Sociodemographic characteristics of the study participants that CT imaging pattern of esophageal cancer patients scanned for staging in the Department of Radiology, TASH , Addis Ababa, Ethiopia

	variable	Frequency	Valid Percent
Address	Rular	80	72.7
	Urban	30	27.3
Exact residence	Arsi	32	29.1
	Bale	10	9.1
	Silte	4	3.6
	Gurage	4	3.6
	North Shewa	3	2.7
	Gojam	3	2.7
	Gonder	1	.9
	Adama	4	3.6
	Shashemene	4	3.6
	Welkite	2	1.8
	Addis Ababa	3	2.7
	Harerge	2	1.8
	Segen	1	.9
	Welega	6	5.5
	Kembata	2	1.8
	Harer	1	.9
	Jijiga	1	.9
	Hawassa	4	3.6
	Others	23	20.9
	Total	110	100.0
Sex distribution	Female	61	55.5
	Male	49	44.5
Ethnic group	Oromo	80	72.7
	Amhara	8	7.3
	Tigray	1	.9
	Gurage	4	3.6
	Others	17	15.5

Annex II- CONSENT FORM

I am requested to participate in the study by being informed of the objective of the study, whichis to know the CT imaging patterns, correlated risk factors andprevalence of pneumonia among esophageal ca patients .

Because I believe that the results of this study have importance to be used as a guide for the prevention and/or good treatment outcome of esophageal ca in TASH and the country as whole, I have agreed voluntarily to provide the necessary information answering all the questions included on the questionnaire; without requesting any costs from the researcher.

Signature of participant: _____ date _____

ANNEX III- QUESTIONNAIRE

Esphageal CT imaging pattern Questionnaire 2011

NAME_____ MOBILE NO_____ CT NUMBER:_____			
PART ONE: SOCIO DEMOGRAPHIC CHARACTERSTICS			
No	**Questions and filters**	**Coding categories**	remark
101	Address of the respondent	Rural. 1 Urban. 2 where exactly _____	
102	Age	_____ years	
103	Sex	Male. 1 female. 2	
104	*Ethnic group:*	1) Oromo 2) Amhara 3) Tigre 4) Gurage5) Other specify	
Part II risk factor assessments			
201	Weight before symptom started	_____kg or not known	
202	Height	_____-cm	
	BMI	To be calculated;_____	
203	Smoking	Yes. 1 NO. 2 , if yes packet per day ;___	
204	Alcohol consumption	1 frequent 2 infrequent 3 no consumptions	
205	occupation	1. Government employee. 2. Farmer. 3. House wife. 4. House maid. 5. Merchant 6. Daily laborer. 7. Others(specify)._____	
206	History of other tumors	1- yes 2- NO 3- if yes how long and where _____	
207	Family HX of cancer	1- Yes 2.. No If yes specify_____	
209	History of GERD	1- yes 2- NO 3- if yes duration _____	
210	History of thoracic radiation	1- Yes 2. No, if yes how many _____	
111	Do you use extremely hot drinks?	1-yes 2-No If yes how frequent? 1.always 2. frequent3. infrequent	
Part III : clinical information			

301	Which of the following health problem or symptoms helps you to seek health institutions ? Duration of Symptom you faced _____months	1. Dysphasia 2. weight loss 3. abdominal pain 4. chest pain 5. vomiting 6. cough 7. neck swelling 8. 8.others if any specify :
302	Which of the following best describes the events which led to your diagnosis of cancer?	1. had either of the above mentioned symptoms and visited health institution 2. investigated by doctor for another problem during which he cancer was discovered 3. Other (please describe):
303	Mode of presentation	1. elective 2. emergency
304	Did you visited other health facility for same condition?	1- yes 2-No If yes duration _____
305	Type of pre CT imaging investigation	1. Barium swallow 2. CT scan of abdomen MRI 3. Ultrasound 4. CXR 5. endoscopy
306	Histology type	Specify _____
PART IV: Imaging information		
401	Location of the lesion	1. Cervical esophagus 2. Upper esophagus 3. Middle esophagus 4. Lower esophagus
402	Length of involvement	_____ _____cm
403	CT scan imaging features :	1. Enhancing soft tissue mass with luminal narrowing 2. focal wall thickening with luminal narrowing 3. asymmetric nodular wall thickening with luminal narrowing / eccentric wall thickening 4. annular / semi annular 5. calcified mass 6. others
404	Wall thickening	In mm_____
405	Proximal dilation	1. yes 2. No If yes how many in mm _____
406	Mediastinum involvement	1.Tracheal or bronchial involvement 2.Aortic invasion 3.Amputation of vessel 4.Pericardial effusion 5.Pleural involvement 6. others specify

407	Lymph node involvement	1.neck lymph node 2. mediastinal lymph node 3. abdominal lymph node 4. others specify _____
408	Metastases	1. yes ,,,,2. No If yes specify site _____
409	Aspiration pneumonia	1. yes,,,2.No If yes specify which lung and the lobe involved?_____
410	Complications	1. perforation 2. abscess formation 3. fistula 4. hemorrhage 5. others specify _____
411	Clinical staging	1. T_____ 2. N_____ 3. M_____
412	Treatment option	1. primary surgery , 2. chemo radiotherapy followed by surgery 3. chemo radiotherapy only

Number of questionnaire_____
Date _____
Location of participant_____
Name of interviewer_____

, College of Health Science, Department of Radiology

ANNEX V: DECLARATION

I, the undersigned, declare that this paper is my original work and has not been presented for postgraduate study in this or another university and that all sources used for this paper have been fully acknowledged.

Name: Alemu Getie (MD, Radiology Resident)

Signature: _____

Date:_____

Place: Addis Ababa University, College of Health Science, Department of Radiology

This thesis has been submitted with our approval as University advisors

1. Dr. Azmera Gissla MD, (Cardiothoracic radiologist, Assistant prof. of radiology)

   Signature:_____

   Date:_____

   Place: Addis Ababa University, College of Health Science, Department of Radiology

   2. Amir Alwan,(MD, Cardiothoracic radiologist, Assistant prof. of radiology)

   Signature: .....

   Date:.....

   Place: Addis Ababa University, College of Health Science, Department of Radiology