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ROLE OF CT SCAN IN STAGING OF CARCINOMA OF ESOPHAGUS – A STUDY OF 100 CASES

Radiology

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ABSTRACT

Introduction: CT has become a useful diagnostic modality in the evaluation of the stage of oesophageal carcinoma and an integral part of surgical planning. Present study describes various finding of oesophageal carcinoma on CT to aid in its diagnosis and staging.

Aim and objectives: The aim of our study is to evaluate and describe the various CT findings of carcinoma oesophagus to evaluate diagnostic accuracy of CT for carcinoma oesophagus and comparision of CT findings with histopathological findings to stage the disease using worldwide accepted criteria of TNM staging system.

Materials and Methods: After ethical clearance, a prospective study was carried out in the Gujarat Cancer and Research In statute, Ahmedabad, from August 2015 to November 2017. After obtaining consent, 100 patients presenting with clinical symptoms and signs pertaining to carcinoma of oesophagus were studied. Oral and IV contrast was used. Three dimensional reconstructions were done and various CT findings of oesophageal cancer studied. The diagnosis and staging confirmed by post-operative histopathology.

Results: Carcinoma oesophagus was commonly seen in age group between 51 to 60 years (34%) with males (72%) more commonly affected than females (28%). All patients predominantly presented with dysphagia. The middle 1/3rd of oesophagus affected more commonly compare to other parts. The wall thickness in majority of the cases measured between 10-20mm (62%). T3N1M0 was the most common staging found in CT (30%). 16% cases presented with metastasis. Squamous cell carcinoma (84%) was the most common histopathological type presented. 54 patients got operated out of 100 and CT staging was compared with the postoperative histopathological staging. The accuracy of CT-scan for 'T' stage were 83.33 %, in 'N' stage 81.48 % and in 'M' stage being 99 %.

Conclusion: CT-scan is excellent in the diagnosis of distant metastasis and lymphadenopathies. Thus, evaluation of various CT findings and preoperative staging of carcinoma oesophagus will help to decide management of these patients. Hence, CT plays an important role in detecting and staging carcinoma oesophagus.

KEYWORDS

Dysphagia, oesophageal carcinoma, multidetector CT.

INTRODUCTION

Oesophageal carcinoma is the leading cause of death from cancers. Most of the oesophageal carcinomas are either squamous cell carcinomas or adeno-carcinomas. Its late presentation and early extramural disease spread lead to poor long term prognosis with a 5 year survival rate of less than 10%. There are various subtypes in oesophageal carcinoma. Primarily squamous cell carcinoma (approx. 60-65%) Adenocarcinoma (approx. 35-40% of all esophageal cancer worldwide) and other rare subtypes are small cell carcinoma, spindle cell, lymphoma, leiomyosarcoma, malignant melanoma and others. Smoking and drinking combine to increase the risk 25 to 100 fold, male are more likely to develop carcinoma of esophagus than female, it is notorious for biological behaviour, it infiltrates locally involving adjacent lymph modes and metastasis widely by hematogenous spread.

Squamous cells line the entire esophagus, so SCC can occur in any part of the esophagus, but it often arises in the upper half. Adenocarcinoma typically develops in specialized intestinal metaplasia (Barrett metaplasia) that develops as a result of gastro esophageal reflux disease (GERD); thus, adenocarcinoma typically arises in the lower half of the distal esophagus and often involves the esophago-gastric junction.

Imaging techniques including Barium oesophagography and CT scan are powerful tools in detection, diagnosis and assessing the stage of oesophageal carcinoma. The disease is diagnosed by biopsy done by an endoscopy.

Barium swallow is the primary investigation for oesophageal carcinoma, it is a valuable diagnostic test for evaluating structural and functional abnormalities but many a times it's not sufficient to reach at final diagnosis.

The use of CT scanning has empowered the modern surgeon to treat patients more effectively, facilitating reduced morbidity and complications.

The introduction of CT and the wider use of it in the last 15 years have further contributed to the physician's ability to appreciate nuances of carcinoma and accurate disease correlation.

CT has become a useful diagnostic modality in the evaluation of the stage of oesophageal carcinoma and an integral part of surgical planning. It is also used to create Intra-operative road maps and the radiological examination of choice in evaluating the oesophageal Carcinoma.

Material and Methods

After ethical clearance, prospective study of the role of CT scan in staging of carcinoma of esophagus was conducted from August 2015 to November 2017 at Gujarat Cancer and Research institute, Ahmedabad. Study group comprised patients of Gujarat and some other state (Rajasthan, Madhya Pradesh) who came to our CT center, located in premises of our institute. All patients with oesophageal malignancy were included in my study. Consent was taken prior to conducting the investigations in all patients.

100 adult patients who have symptoms and signs pertaining to carcinoma of esophagus were included in the study. All patients were followed up with their histopathological diagnosis. CT findings were confirmed by biopsy report, postoperative study or follow-up CT scan. Oral and IV contrast were used for the study. Comparison was performed for probable histo-pathological diagnosis on the basis of radiological imaging appearances and final histo-pathological diagnosis.

Criteria for diagnosis of lesion are age of the patients, site of involvement, wall thickness, length of the involved segment, homogeneous or heterogeneous enhancement and other findings like soft tissue mass, lymph nodal and distant metastases.
All patients were randomly selected for study.

Selection of patients:
Inclusion criteria:

- Only those patients who are willing to participate in study will be

included.
- Patients referred to the radiology department for barium swallow and/or CT scan investigations for oesophageal malignancy will be included in this study.
- Already diagnosed cases of oesophageal carcinoma which need follow up radiological investigations and are referred to our radiology department will be included in study.
- Patients coming for plain barium swallow and CT scan for diseases other than upper GI tract carcinoma or gastric carcinoma, and are accidentally found to have oesophageal carcinoma will be included in this study. .

Exclusion criteria:
- Patients presenting to radiology department having oesophageal carcinoma past and are cured completely will be excluded from the study.
- Patients not willing to participate in the study.
- Patients having allergy from contrast material used in CT scan

RESULTS

TABLE-1: DEMOGRAPHIC PROFILE

DEMOGRAPHIC PROFILE			
SR.NO	AGE GROUP	NO. OF CASES	PERCENTAGE
1	30-40 YR	10	10%
2	41-50 YR	28	28%
3	51-60 YR	34	34%
4	61-70 YR	24	24%
5	71-80 YR	4	4%
6	> 81 YR	0	0%
		100	100%

Patients of age group between 30 to 80 years were included. The peak age prevalence in the study was between 51-60 yrs. Out of 100 patients 72% male and 28% female was affected. There is a significant male preponderance among the patients studied.

TABLE-2: INCIDENCE OF HISTOLOGICAL CELL TYPES

HISTOLOGICAL CELL TYPE			
SR.NO	TYPES	NO. OF CASES	PERCENTAGE
1	SQUAMOUS CELL CARCINOMA	84	84%
2	ADENO CARCINOMA	16	16%
3	LYMPHOMA	0	0%
4	SMALL CELL CARCINOMA	0	0%
5	SPINDLE CELL CARCINOMA	0	0%
6	LEIOMYOSARCOMA	0	0%
7	MALIGNANT MELANOMA	0	0%
		100	100%

This shows a preponderance of squamous cell type of carcinoma esophagus over other types.

TABLE 3: INCIDENCE OF CHIEF COMPLAINTS

CLINICAL SYMPTOMS			
SR.NO	SYMPTOMS PRESENTATIONS	NO. OF CASES	PERCENTAGE
1	DYSPHAGIA	100	100%
2	WEIGHT LOSS	48	48%
3	ABDOMINAL PAIN	21	21%
4	CHEST PAIN	25	25%
5	VOMITING	21	21%
6	REGURGITATION	9	9%
7	COUGH	3	3%
8	NECK SWELLING	4	4%
9	OTHER	5	5%

As seen in above table in the study, Dysphasia (100%) is the most common symptom followed by weight loss (48%), abdominal pain (21%) and Chest pain (25%).

Table-4: Different Sites of Carcinoma Oesophagus

ESOPHAGEAL INVOLVMENT						
SR. NO	SITE OF INVOLVMENT	TOTAL NO.OF CASES	MALE	FEMALE	SCC	ADENO
1	UPPER	7	6 (85.71%)	1 (14.28%)	6 (85.71%)	1 (14.28%)
2	MIDDLE	33	25 (75.75%)	8 (24.24%)	32 (96.96%)	1 (3.03%)
3	LOWER	20	16 (80%)	4 (20%)	18 (90%)	2 (10%)
4	LOWER+GEJ +STOMACH	19	12 (63.15%)	7 (36.84%)	7 (36.84%)	12 (63.15%)
5	MIDDLE+LOWER	17	11 (64.71%)	6 (35.29%)	17 (100%)	0 (0%)
6	UPPER+MIDDLE	4	2 (50%)	2 (50%)	4 (100%)	0 (0%)
		100	72 (72%)	28 (28%)	84 (84%)	16(16%)

From the above table it is evident that the middle and lower third of esophagus is more affected by carcinoma esophagus than upper third esophagus.

TABLE-5: CECT FINDINGS

CECT FINDING				
SR. NO	CECT FINDING		NO OF CASES	PERCENTAGE
1	WALL THICKNESS	< 10 MM	18	18%
		10-20 MM	62	62%
		>20 MM	20	20%
2	PROXIMAL DILATATION		74	74%
3	MEDIASTINAL INVOLVMENT		28	28%
4	ABDOMINAL NODES		18	18%
5	MEDIASTINAL NODES		31	31%
6	NECK NODES		7	7%
7	METASTASIS		16	16%

From above table it is evident that, oesophageal wall thickness of less than 10mm is seen in 18 patients, between 10-20 mm in 62 patients and more than 20mm in 20 patients. In present study, proximal dilatation present in mostly in oesophageal region.

TABLE-6 (A): STAGING OF OESOPHAGEAL MALIGNANCY

CT STAGING			
SR.NO	CT STAGING	NO. OF CASES	PERCENTAGE
1	T1 N0 M0	1	1%
2	T2 N0 M0	2	2%
3	T3 N0 M0	7	7%
4	T2 N1 M0	11	11%
5	T3 N1 M0	30	30%
6	T1-4 N1-3 M1	26	26%
		23	23%

From above table it is evident that T3N1M0 CT staging is the most frequently found CT staging for carcinoma of esophagus.

TABLE 6(B): STAGING OF OESOPHAGEAL MALIGNANCY

FINAL STAGING OF OESOPHAGEAL MALIGNANCY			
SR.NO	**STAGING**	**CASES**	**PERCENTAGE**
1	I	1	1%
2	II	20	20%
3	III	56	56%
4	IV	23	23%
		100	100%

TABLE-7: CT STAGING V/S PATHOLOGICAL STAGING T STAGE:

CT VS PATHOLOGICAL "T" STAGE			
NO OF PATIENT'S OPERATED	IDENTICAL "T" STAGE	DIFFERENT "T" STAGE	ACCURACY
54	45	9	83.33%

In our study out of 100 patients 54 patients' undergone operative intervention, so we were able to know operative and pathological staging for T stage of 54 patients

CT scan cannot reliably delineate the individual layers of the esophageal wall and thus cannot differentiate T1 from T2 neoplasm. Microscopic infiltration of the periesophageal fat (T3) can be present but not evident on CT scan. When macroscopic invasion of mediastinal fat is present, CT scan demonstrates abnormal soft tissue density that is often ill defined. All though tumor infiltration in to the periesophageal fat (T3) adversely affects prognosis, en bloc resection of tumor as an attempted cure is not precluded. Tumor infiltration in to an adjacent structure (T4) is critical for patient management; direct invasion of aorta and tracheobronchial tree precludes surgical resection.

Out of operated 54 patients 45 patients had identical CT T stage with pathological and operative T stage showing accuracy of CT scan of around 83.33 % in our study.

N STAGE:

CT VS PATHOLOGICAL "N" STAGE			
NO OF PATIENT'S OPERATED	IDENTICAL "N" STAGE	DIFFERENT "N" STAGE	ACCURACY
54	44	10	81.48%

In our CT scan series lymph nodes with short axis measurements greater than 1 cm was considered as a predictor of metastatic adenopathies.

Out of 54 patients operated lymph node stations were confirmed operatively and lymph nodes along with resected mass was sent for pathological confirmation. Out of 54 patients 44 patients had same lymph node metastasis as diagnosed on CT scan showing that CT scan accuracy for N stage around is 81.48%. Large lymph nodes may also results from inflammatory disease leading to false positive results of CT scan. Microscopic invasion of normal size lymph nodes, also a common manifestation of esophageal carcinoma, is another factor limiting CT scan accuracy.

M STAGE:

CT VS PATHOLOGICAL "M" STAGE			
NO OF PATIENTS	IDENTICAL "M" STAGE	DIFFERENT "M" STAGE	ACCURACY
100	99	1	99%

In our study out of 100 patients, 99% accuracy for M stage was seen. CT scan is a superb modality for detecting metastatic diseases to the liver, adrenal glands and lung.

TABLE-8: INCIDENCE OF DISTANT METASTASIS

INCIDENCE OF DISTANT METASTASIS			
SR.NO	DISTANT METASTASIS	NO. OF CASES	PERCENTAGE
1	LIVER METASTASIS	8	8%
2	LUNG METASTASIS	3	3%
3	BONE METASTASIS	2	2%
4	SUPRARENAL METASTASIS	2	2%
5	BRAIN METASTASIS	1	1%
		16	16%

Out of 100 patients who underwent CT scan for carcinoma oesophagus in our study, 16 patients showed distant metastasis. 3 patients shows metastasis to lung, 6 patients to liver, 1 patient in brain, 2 patients to bone, and 2 to supra renal.

DISCUSSION

Oesophageal carcinoma is the eighth most common cancer and the sixth most common cause of cancer related deaths worldwide with developing nations making up more than 80% of total cases and deaths.[1] While many other types of cancer are expected to decrease in incidence over the next 10 years by 2025 the prevalence of esophageal cancer is expected to increase by 140%.[2] The esophagus is lined by squamous epithelium and therefore the prevalent histology of esophageal tumors is squamous cell carcinoma in most geographical pockets of the world.[3]

Oesophagus is a muscular tube extending from C6 vertebra, cricoid cartilage level to T11 vertebra measuring ~ 25-30 cm in length and then penetrates the diaphragm to join the cardia of stomach at GEJ. It has an inner circular and an outer longitudinal muscle coat with predominately striated muscle in the upper third of the oesophagus and predominantly smooth muscle in the lower two thirds, with the transition occurring at the level of the aortic knuckle. The mucosa of the oesophagus is lined by stratified squamous epithelium which changes to columnar epithelium along an irregular horizontal Z line in the region of the gastro-oesophageal junction. Lymphatics from the upper oesophagus drains to cervical nodes, the mid oesophagus to preaortic nodes and the lower oesophagus drains to coeliac and left gastric nodes.

Oesophagus carcinomas have following histopathological types like, squamous cell carcinoma, adenocarcinoma, and other rare subtypes are small cell carcinoma, spindle cell, lymphoma, leiomyosarcoma, malignant melanoma and others.

Incidence rates of SCC of the esophagus have been reported as high as 100 cases per 100000 annually in an area referred to as the "Asian esophageal cancer belt" and this region extends from northeast China to the Middle East.[4]

Presentation of carcinoma oesophagus varies from dysphasia, odynophagia, weight loss to other symptoms related to distant metastasis. Formation of fistula between the esophagus and the tracheobronchial tree increases the risk of pneumonia and presents as coughing, fever or symptoms related to aspiration.

With no anatomical barrier, the primary tumor is able to extend rapidly into the adjacent structures of the neck and thorax including the thyroid gland, trachea, larynx, lung, pericardium, aorta and diaphragm.[5]

Diagnostic tool of carcinoma oesophagus is esophagoscopy and biopsy. For surgical intervention, size and extent of the tumour are very important. Localized tumors are treated with surgery. Larger mass are inoperable and hence are treated with either radiotherapy, chemotherapy or a combination of both. In fewer cases chemo and radiotherapy can make these tumors operable. So prognosis depends on the size, extent and associated other conditions, but is generally poor.

Despite many advances in diagnosis and treatment, the 5-year survival rate for all patients diagnosed with esophageal cancer ranges from 15% to 20%.[6]

CT findings

Generally the following criteria are regarded for diagnosing and staging esophageal cancer on CT:

- The esophageal wall is considered thickened when its width was greater than or equal to 5 mm. The depth of invasion of esophageal cancer can be inferred to be greatest in the direction of the ulcer the contact area between the tumor and aorta. Early periesophageal invasion by the tumor may appear on CT scans as strand like areas of soft-tissue attenuation that produce a feathery appearance within the periesophageal fat plane.
- Tracheal or bronchial involvement is considered certain when an intraluminal mass or a thickened wall was present, on when tumoral extension was seen between the trachea and the aortic arch between the left main bronchus and the descending aorta. Tracheal invasion is also indicated by CT images showing tumor displacing or indenting the trachea.
- Aortic invasion is diagnosed if the area of contact between the esophagus and the aorta creates an arc of greater than 90º. If the arc is less than 45º, aortic invasion is considered to be absent; an arc between 45º and 90º is considered indeterminate; (some authors apply similar criteria regarding the trachea).
- Amputation of vessel lumen or lack of opacification are signs of tumoral spread to the pulmonary veins;
- Pericardial effusion is synonymous with pericardial tumoral infiltration;
- Pleural involvement is judged to be present when pleural thickening adjacent to the tumor or pleural effusion is present. However in the opinion of some authors, local invasion of the pleura or of the diaphragmatic crura does not significantly influence surgical management.
- Lymph nodes greater than 6mm in diameter in upper and lower mediastinal compartments and lymph nodes greater than 10mm in diameter in subcarinal and celiac regions are considered to contain metastases.
- Metastatic disease most commonly involves distant nodal stations

(celiac nodes in squamous cell carcinoma, for example), the liver, adrenal glands and bone. Thoraco-abdominal imaging is well established as the standard scan for staging esophageal carcinoma.

CT is currently the most commonly used method for preoperative staging of carcinoma oesophagus as it is able to give information regarding the local extension of the mass and to detect distant metastases and lymphadenopathies very rapidly and importantly noninvasively, with overall diagnostic accuracy values of 59-82%. Computed tomography (CT) has become an indispensable tool for evaluating the oesophagus in both the outpatient and emergency room settings.[7] The sensitivity and specificity of CT to detect mediastinal invasion ranges between 85%-100%.[8]

MDCT is much useful for staging carcinoma oesophagus because it is the most valuable and vulnerable advanced technique for formulation of actual line of incidence and further treatment to be meted out at the appropriate time and in an appropriate manner.[9]

Adjuvant chemotherapy and radiotherapy is the choice of treatment of locally advanced esophageal cancer. Preoperative chemotherapy and combined preoperative chemo radiotherapy are also standards of treatment based on recent clinical trials.

Surgical techniques are:

- The Ivor Lewis, a thoraco-abdominal approach
- The trans-hiatal, involving the abdomen and neck while avoiding the thoracic incision
- The trans-abdominal, used particularly for cancers of the lower gastro esophageal junction; and
- The thoracoscopic / laparoscopic, a minimally invasive approach.

SUMMARY

The main purpose of this study in patients with known oesophageal carcinoma is to stage the disease as accurately as possible to determine the further line of management.

CT scan is the most valuable and preferential technique for planning operational strategy revealed as CT images are very clear and distinct with high density resolution in human tissue and it is highly sensitive for detecting nodes and distant metastasis however it cannot reliably delineate the individual layers of the wall and thus cannot differentiate T1 from T2 neoplasms.

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