Radiology Section

The Role of MDCT in Oesophageal Cancer

L. SUMITHRA, KR. VIJAY KUMAR, BR. NAGARAJ

ABSTRACT

Introduction: MDCT plays an important role in detecting various finding of locally advanced carcinoma oesophagus and metastasis, which helps the surgeons to decide the line of management. Present study describes various finding of oesophageal carcinoma on CT to aid in its diagnosis and staging.

Aim: The aim of our study is to evaluate and describe the various Multi Detector Computed Tomography findings of carcinoma oesophagus to aid in its diagnosis and staging.

Materials and Methods: After ethical clearance, a prospective study was carried out in the Department of Radiodiagnosis, BMC & RI, Bangalore from October 2014 to September 2015. After obtaining consent, 37 patients presenting with clinical symptoms and signs pertaining to carcinoma of oesophagus, who underwent prior endoscopic biopsy, were studied with Multi Detector CT scanner (Siemens somatom emotion- 6 slice CT) using thin sections. 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 50 to 60 years (59.5%) with males (51.3%) more commonly affected than females (48.6%). All patients predominantly presented with dysphagia. Alcohol and smoking was the associated risk factor. The lower 1/3rd of oesophagus affected more commonly compare to other parts. The wall thickness in majority of the cases measured between 10-20mm (83.8%). T3N0Mx was the most common staging found in CT (56.7%).16.2% cases presented with metastasis. Squamous cell carcinoma (86.5%) was the most common histopathological type presented. Twenty six patients got operated out of 37 and CT staging was compared with the post operative histopathological staging. The sensitivity of CT-scan for 'T' stage were 73.0%, in 'N' stage 80.7% and in 'M' stage being 100%.

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.

INTRODUCTION

Carcinoma of oesophagus remains most lethal and third most prevalent gastrointestinal malignancy in the world, because of its late presentation and early extramural disease spread, which results in poor long term prognosis with a 5year survival rate of less than 10% [1,2]. Early oesophageal cancer has shown a good 5-year survival rate of 57%–78% [3]. The prognosis is poor in locally advanced disease and worse in cases with distant metastasis [4]. Squamous cell carcinomas (SCCs) and adenocarcinomas are the most common oesophageal cancers [5].

Risk factors for squamous cell carcinoma of the oesophagus include tobacco, alcohol [6]. The risk factors for development of adenocarcinoma include reflux esophagitis and resultant Barrett's oesophagus, due to the chronic irritation of the mucosal lining and dietary factors [7]. Prior irradiation is also considered probable risk factor for developing carcinoma oesophagus [8]. Imaging studies play a key role in the Detection of local invasion and metastasis in patients with carcinoma oesophagus. Thus, helping surgeons to triage the

patients and choose the line of management. The usefulness and limitations of computed tomography is also discussed.

AIMS

To evaluate and describe the various CT-scan findings in carcinoma oesophagus to aid in its diagnosis and staging.

MATERIALS AND METHODS

A prospective study of detecting and describing various MDCT findings in carcinoma of oesophagus was carried out in the Department of Radiodiagnosis, BMC & RI, Bangalore from October 2014 to September 2015. After obtaining consent, 37 patients presenting with clinical symptoms and signs pertaining to carcinoma of oesophagus, who underwent prior endoscopic biopsy, were studied with Multi Detector CT scanner (Siemens somatom emotion- 6 slice CT) using thin sections. Oral and IV contrast was used. Three dimensional reconstructions were done and various CT-scan findings in carcinoma oesophagus studied. The diagnosis and staging confirmed by post operative histopathology. Ethical clearance was obtained from the institute.

The diagnosing criteria used included age and gender of the patients and various CT findings like, site of involvement, degree and pattern of wall thickening, length of the involved segment, type of enhancement and associated findings of local invasion like peri-lesional soft tissue mass, lymph nodal and distant metastases.

RESULT

Patients of age group between 28 to 75 years were included in the study. The peak age prevalence in the study was between 50-60 years accounting for 59.5%. Out of 37 patients 51.3% male and 48.6% female were affected. There is a male preponderance among the patients studied. All patients predominantly presented with dysphagia. Alcohol and smoking was the associated risk factor.The lower 1/3rd of oesophagus affected more commonly compare to other parts. The wall thickness in majority of the cases measured

CECT Findings	Number of Cases	Percent of Cases
Wall thickening <10mm	04	10.8%
10-20mm	31	83.8%
>20mm	02	5.4%
Proximal Dilatation	29	78.4%
Mediastinal Involvement	06	16.2%
Abdominal Nodes	09	24.3%
Neck Nodes	02	5.4%
Mediastinal Nodes	06	16.2%
Metastasis	06	16.2%
[Table/Fig-1]: CECT findings		

between 10-20mm (83.8%) among all CT criterias of carcinoma oesophagus as shown in [Table/Fig-1]. T3N0Mx was the most common staging found in CT(56.7%) and 16.2% cases presented with metastasis.

Out of 37 patients who underwent CT-scan for carcinoma oesophagus in our study, 6 patients showed distant metastasis. Two patients shows metastasis to lung, 2

| Types	No. of Cases	Percentage (%)
Squamous Cell Carcinoma	32	86.5%
Adeno Carcinoma	04	10.8%
Lymphoma	01	2.7%
Small Cell Carcinoma	00	00
Spindle Cell Carcinoma	00	00
Leiomyosarcoma	00	00
Malignant Melanoma	00	00
[Table/Fig-2]: Histological cell type of carcinoma oesophagus		

No. of Patient's Operated	Identical 'T' stage	Different 'T' stage	Accuracy
26	19	7	73.0%
[Table/Fig-3]: CT v/s pathological 'T'-Stage.			

No. of Patient's Operated	Identical 'T' stage	Different 'T' stage	Accuracy
26	21	5	80.7%
[Table/Fig-4]: CT v/s pathological 'N'-Stage			
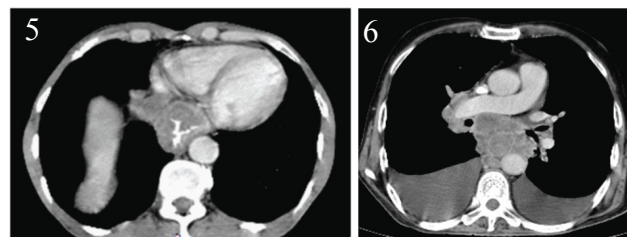
[Table/Fig-5]: Contrast enhanced axial image of CT-scan thorax shows there is homogenous enhancing wall thickening of middle third oesophagus.
[Table/Fig-6]: Contrast enhanced axial image of CT-scan thorax shows there mediastinal lmph node involvement and bilateral pleural effusion.
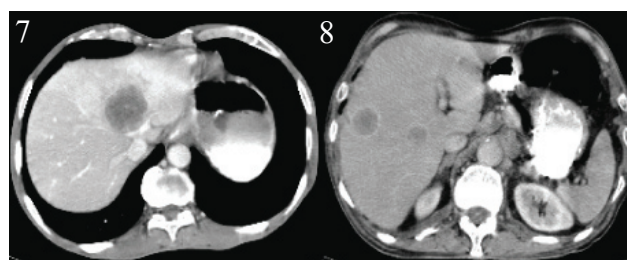
[Table/Fig-7,8]: Contrast enhanced axial images of CT-scan abdominal cuts shows few well defined mildly enhancing lesions in liver suggestive of metastasis.

patients to liver, 2 patients adrenal gland, squamous cell carcinoma was the most common histopathological variant (86.5%) as shown in [Table/Fig-2].

In the present study, 26 out of 37 patients underwent surgery and identical CT 'T'-stage found in 19 patients (73.0%), identical CT 'N'-stage in 21 patients (80.7%), as shown in [Table/Fig-3,4] when compared to post operativehistopathology.The sensitivity of CT-scan to identify M stage was 100%.

DISCUSSION

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 [1].

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 [9].

CT Protocol and Anatomy

The CT examination should extend from the lung apices to the bottom of the liver (extending to cover the cervical region for upper third tumours). This provides an overview of the tumour, its anatomical relationships, lymph nodes and major metastatasis within the field of view. CT acquisitions with a collimation of 5mm should be performed through the chest in an arterial dominated vascular phase upper abdomen in the portal venous dominated phase. The stomach should be distended so as to determine the extent of gastric involvement in lower third tumours. Water is ideal as a contrast agent.

The oesophagus can be divided into four anatomical segments for staging purposes. The cervical oesophagus extends from the cricoids cartilage to the sternoclavicular joint. The upper thoracic oesophagus extends from the thoracic inlet to the carina (approximately 24cm from the upper incisor teeth). The middle and lower thirds of the thoracic oesophagus are the proximal and distal halves of the part of the oesophagus that lies between the carina and the gastro-oesophageal junction [9].

Staging of Oesophageal Cancer

The clinical staging of oesophageal cancer is assessed with the TNM system as developed by the American Joint Committee on Cancer (AJCC); with no consideration of the histologic types of oesophageal cancer [10]. Primarily tumour is staged depending upon the depth of tumour invasion (T). Nodal status (N) is based on the presence (N1) or absence (N0) of involvement of loco regional lymph nodes.

Cervical or celiac axis lymph nodes metastases are considered as subdivision of M1a of distant metastases with M1b indicating metastases to distant sites [11].

Computed Tomography- Normal thickness of oesophageal wall measures less than 3 mm in distended status [12]; wall thickness greater than 5 mm is abnormal [13]. Asymmetrical oesophageal wall thickening is a primary but non-specific CT finding of oesophageal cancer [Table/Fig-5] [11].

In CT preservation of fat planes between the oesophageal cancer and adjacent mediastinal structures excludes T4 disease [Table/Fig-5] [14].

Lymphadenopathy [Table/Fig-6] is diagnosed on the basis of 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.

CT has approximately 80% accuracy in predicting abdominal lymph node involvement and is poorer at detecting peri-oesophageal lymph node involvement as this may be indistinguishable from the tumour mass. Unlike most cancers, distant lymphadenopathy in neoplasms of upper and lower third of oesophagus contributes to the M stage of the tumour.

The liver is the commonest extranodal site for metastases at the time of presentation,accounting for 35% of patients, followed by lungs 20%, bone 2%, adrenal 2% and brain 2%. CT provides a good means of surveying metastasis [Table/Fig-7,8]. Liver metastases are typically hypovascular and best demonstrated on portal venous phase [9].

For M staging MDCT is considered as standard modality in most situations and is superior to MR in depicting mediastinal, hilar, pulmonary, pericardial, pleural, omental, mesenteric and peritoneal disease [15].

Site of Involvement

The most common site involved in adenocarcinoma is lower third of oesophagus, which may extend in to gastro oesophageal junction and stomach, with middle third being next and proximal oesophagus to be affected last [6,8].

LIMITATIONS

The individual layers of oesophageal wall cannot be delineated accurately with CT-scan and further CT cannot identify microscopic infiltration. Thus, CT is less accurate in differentiating between T1 and T2 disease. Small metastases

in the left lobe of the liver that are too small to detect with CT can be missed.

In this present study, 26 patients out of 37 patients underwent surgery and identical CT 'T' stage found in 19 patients (73.0%), identical CT 'N' stage in 21 patients (80.7%) when compared to post-operative histopathology. The sensitivity of CT-scan to identify M stage was 100%. The result obtained for sensitivity of CT scan in diagnosing 'T'staging is 73.0%, which is less compared to the result obtained in study done by Kavita U Vaishnav et al., which shows 77.94% sensitivity of CT-scan for 'T'-staging. Whereas, results of CT sensitivity for 'N' and 'M' staging are 80.7% and 100% respectively, compared to 79.4% and 99% for 'N' stage and 'M' stage respectively in their study.

CONCLUSION

CT, despite of its limitations in assessing T and N stages, has become the most commonly used modality in the initial staging of newly diagnosed oesophageal cancer and in preoperative oesophageal cancer staging because it gives information regarding the local extension of the mass and to detect distant metastases and lymphadenopathies rapidly and non invasively, with overall diagnostic accuracy values of 59-82%.

Thus, evaluation and detection of various CT findings to aid in the diagnosis and preoperative staging of carcinoma oesophagus will help in the management of these patients.

REFERENCES

[1] Vaishnav KU , Vaishnav UG, Patel SB, Bhatt CJ, Shah DS et al. Role of CT-Scan in staging of carcinoma of oesophagus – a study of 100 cases. *Gujarat Medical Journal*. 2014;69(1):87-92.

[2] Stewart BW, Kleihues P. World cancer report. 2003;3:123-29. https://www.iarc.fr/en/publications/pdfs-online/wcr/2003/WorldCancerReport.pdf

[3] Kobori O, Kirihara Y, Kosaka N, Hara T. Positron emission tomography of oesophageal carcinoma using 11 C-choline and 18 F-fluorodeoxyglucose. *Cancer*. 1999;86:1638–48.

[4] Block MI, Patterson GA, Sundaresan RS, et al. Improvement in staging of oesophageal cancer with the addition of positron emission tomography. *Ann Thorac Surg*. 1997;64:770–77.

[5] Daly JM, Fry WA, Little AG et al. Esophageal cancer: results of an American College of Surgeons patient care evaluation study. *J Am Coll Surg*. 2000; 190:562–72.

[6] Blot WJ, McLaughlin JK: The changing epidemiology of oesophageal cancer. *Semin Oncol*. 1999; 26:02-08.

[7] Lagergren J, Bergstrom R, Lindgren A, Nyren O. Symptomatic gastroesophageal reflux as a risk factor for esophageal adenocarcinoma. *N Engl J Med*. 1999;340: 825–31.

[8] Devesa SS, Blot WJ, Fraumeni JF. Changing patterns in the incidence of esophageal and gastric carcinoma in the United States. *Cancer.*1998; 10:2049-53.

[9] A. H. A. Chapman with contributions from John A. Spencer, J. Ashley Guthrie and Philip J. A. Robinson, David Sutton Text book of Radiology and Imaging, Volume 1, Seventh Edition, 2003.

[10] Green F, Fritz A, Balch C, et al. Oesophagus. In: Greene F, Fritz A, Balch C, et al, eds. AJCC cancer staging handbook part III: digestive system 9—oesophagus. 6th ed. New York, NY: Springer- Verlag, 2002.

[11] Kim TJ, Kim HY, Lee KW, Kim MS. Multimodality assessment of esophageal cancer: preoperative staging and monitoring of response to therapy. *Radio Graphics*. 2009; 29:403–21.

[12] Noh HM, Fishman EK, Forastiere AA, Bliss DF, Calhoun PS. CT of the oesophagus: spectrum of disease with emphasis on esophageal carcinoma. *Radio Graphics*. 1995;15:1113–34.

[13] Desai RK, Tagliabue JR, Wegryn SA, Einstein DM. CT evaluation of wall thickening in the alimentary tract. *Radio Graphics*. 1991;11:771–83.

[14] Rice TW. Clinical staging of esophageal carcinoma. CT, EUS, and PET. *Chest Surg Clin N Am*. 2000; 10:471–85.

[15] Gore RM, Mehta UK, Berlin JW, Rao V and Newmark GM. Upper gastrointestinal tumours: diagnosis and staging. *Cancer Imaging*. 2006:6, 213–17.

AUTHOR(S):
1. Dr. L. Sumithra
2. Dr. KR. Vijay Kumar
3. Dr. BR. Nagaraj

PARTICULARS OF CONTRIBUTORS:
1. Postgraduate Student, Department of Radiodiagnosis, Bangalore Medical College and Research Institute, Bangalore, India.
2. Associate Professor, Department of Radiodiagnosis, Bangalore Medical College and Research Institute, Bangalore, India.
3. Professor and Hod, Department of Radiodiagnosis, Bangalore Medical College and Research Institute, Bangalore, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. L. Sumithra,
Department of Radiodiagnosis, Bangalore Medical College and Research Institute, Bangalore-560002, India.
E-mail: Pradeepnaik.l@gmail.com