

STAGING OF GASTRIC CARCINOMA WITH MULTI DETECTOR CT

Thesis
Submitted for partial fulfilment
of M.Sc. degree in radiodiagnosis
By

Youstina Gerges Shokry Ibrahim
M.B.,B.Ch.
Faculty of medicine
Cairo University

Supervised by

Prof. Dr. Hani Ahmad Sami

Professor of Radiodiagnosis
Faculty of medicine
Cairo University

Prof. Dr. Samira Abdalah Mahmoud Salem

Professor of Pathology
Faculty of medicine
Cairo University

Dr. Maryse Youssef Awadallah

Lecturer of Radiodiagnosis
Faculty of medicine
Cairo University

Faculty of medicine
Cairo University
2013

Acknowledgement

First and foremost, thanks are due to God the most beneficent and merciful.

It was an honour to work under the supervision of eminent professors in the field of radiology.

*I am so grateful and most appreciative to the efforts of **Professor Dr. Hani Ahmad Sami** (Professor of Radiodiagnosis, Faculty of Medicine, Kasr El Aini Hospital, Cairo University). No words can express what I owe him for his endless patience and continuous advice and support.*

*My profound thanks to **Professor Dr. Samira Abdalah Mahmoud** (Professor of Pathology, Faculty of Medicine, Cairo University) for her interest, sincere guidance and support.*

*I wish to express my thanks to **Dr. Maryse Youssef Awadallah** (Lecturer of Radiodiagnosis, Faculty of Medicine, Kasr El Aini Hospital, Cairo University) for her kind assistance, support, encouragement and personal guidance.*

*I also wish to express my thanks to **Professor Dr. Ikram Hamed Mahmoud** (Head of Radiology Department, National Cancer Institute, Cairo University) for his kind assistance and cooperation.*

*I am deeply grateful to **Professor Dr. Ahmad Mohamad Shokry** (Professor of Radiodiagnosis, National Cancer Institute, Cairo University) for his constructive cooperation and motivation.*

I am greatly indebted to Dr. Yehya Labib (Lecturer of Radiodiagnosis, National Cancer Institute, Cairo University) for his cooperation and assistance.

Finally, I am deeply thankful and indebted to my beloved family especially my mother and my aunt for their kind support and love which allowed the completion of this work.

Abstract

Multi-detector CT (MDCT) is a powerful tool for non-invasive evaluation of gastric cancer. MDCT not only detect primary tumors but also provide comprehensive staging, with accurate assessment of the neoplastic mass, regional and distant lymphadenopathy, and distant metastasis. Current MDCT with multiplanar reconstruction (MPR) images increased the accuracy of staging of gastric cancer. Thus, MDCT with MPR provides a useful diagnostic method for the pre-operative evaluation of patients with known gastric cancer.

Keywords: multidetector CT - gastric - lymphadenopathy - metastasis - multiplanar reconstruction

List of Abbreviations

AGC	Advanced Gastric Carcinoma
AJCC	American Joint Committee on Cancer
3D	Three dimensional
2D	Two dimensional
EGC	Early Gastric Carcinoma
EUS	Endoscopic Ultrasound
Fig	Figure
H&E stain	Hematoxylin and eosin stain
HU	Hounsfield unit
LN	Lymph Nodes
MDCT	Multi Detector Computed Tomography
MPR	Multi Planar Reconstruction
PET/CT	Positron Emission Tomography-Computed Tomography
WHO	World Health Organization

List of Figures

Figure	Title	Page
Figure 1	Outline of stomach, showing its anatomical parts.	4
Figure 2	A dissection to show the structures of the stomach bed.	7
Figure 3	Blood supply of the stomach .	8
Figure 4	Lymph node stations surrounding the stomach.	10
Figure 5	Physiological lymphatic drainage of the stomach.	12
Figure 6	Diagram showing the gastroesophageal junction.	16
Figure 7	Drawing of the anatomy of the greater and lesser omenta.	17
Figure 8	Axial MIP image from CT angiographic data demonstrates early branching of the celiac artery (CA).	17
Figure 9 (A,B)	A: Gastric wall as three layer structure on CT B: Photomicrograph shows layers of the stomach	18
Figure 10	Layers of the stomach by EUS.	19
Figure 11	Parts of the stomach in axial CT cuts.	20
Figure 12 (A-F)	Relations of the stomach by CT.	21-23
Figure 13 (A-F)	Lymph nodes draining the stomach .	25,26
Figure 14	Gross picture of early gastric carcinoma.	30
Figure 15	Tubular adenocarcinoma H&E Stain.	34
Figure 16	Gastric signet ring cell carcinoma H&E stain.	34
Figure 17	Poorly cohesive carcinoma H&E stain.	34
Figure 18	Poor to moderately differentiated adenocarcinoma of the stomach H&E stain	34

Figure 19	Schematic representation of pathologic staging of gastric carcinoma.	37
Figure 20 (A,B)	Ulceroinfiltrative gastric lesion by upper GI endoscopy and EUS	45
Figure 21 (A,B)	T1b gastric carcinoma	52
Figure 22	T2 gastric carcinoma	52
Figure 23 (A,B,C)	T3 gastric carcinoma	53
Figure 24 (A,B)	T3 gastric carcinoma	54
Figure 25 (A,B)	T3 N2 Mo gastric carcinoma	54
Figure 26 (A-D)	Advanced gastric carcinoma with peritoneal seeding.	55
Figure 27	Chart of the gender of patients included in the study.	70
Figure 28	Chart of the main complaint of patients in the study.	71
Figure 29	Chart of the endoscopic shapes of the gastric lesion in the study.	72
Figure 30	Chart of the pathological grades of gastric adenocarcinoma in the study.	72
Figure 31	Chart of the site of the gastric lesion by MDCT in the study.	73
Figure 32	Chart of the frequency of each T stage with MDCT(according to <i>Chamadol et al., 2008</i> , staging system) in the study.	74
Figure 33	Chart of the frequency of each T stage with MDCT (according to <i>Lee et al., 2012</i> , staging system) in the study.	76
Figure 34	Chart showing comparison between 2008 and 2012 staging systems regarding T staging in the study.	77

Figure 35	Chart of the frequency of each N stage with MDCT (according to <i>Chamadol et al., 2008</i> , staging system) in the study.	79
Figure 36	Chart of the frequency of each N stage with MDCT (according to <i>Lee et al., 2012</i> , staging system) in the study.	81
Figure 37	Chart showing comparison between 2008 and 2012 staging systems regarding N staging.	82
Figure 38	Frequency of each M stage with MDCT (according to <i>Chamadol et al., 2008</i> , staging system) in the study.	84
Figure 39	Frequency of each M stage with MDCT (according to <i>Lee et al., 2012</i> , staging system) in the study.	84
Figure 40 (A,B,C)	MDCT images of antral gastric carcinoma stage T2 N0 M0.	88
Figure 41(A-E)	MDCT images of antral gastric carcinoma stage T3 N2 M0.	90
Figure 42 (A-E)	MDCT images of diffuse gastric carcinoma stage T4a N3a M1.	92
Figure 43 (A-E)	MDCT images of gastric carcinoma at the gastro-esophageal junction stage T4a N2 M0.	94
Figure 44 (A-E)	MDCT images of gastric carcinoma at the gastro-esophageal junction stage T4a N2 M0.	96
Figure 45 (A-D)	MDCT images of diffuse gastric carcinoma stage T3 N3a M1.	98
Figure 46 (A-E)	MDCT images of antral and lesser curvature gastric carcinoma stage T4b N3a M1.	100
Figure 47 (A-F)	MDCT images of antral and lesser curvature gastric carcinoma stage T4b N3a M0.	102
Figure 48 (A-E)	MDCT images of greater curvature gastric carcinoma stage T4a N3a M0.	104

Figure 49 (A-E)	MDCT images of lesser curvature gastric carcinoma stage T4a N2 M1.	106
Figure 50 (A-E)	MDCT images of pyloric and lesser curvature gastric carcinoma stage T4a N2 M1.	108

List of Tables

Figure	Title	Page
Table 1	Other extra-perigastric lymph node stations.	11
Table 2	Morphologic classification of EGC.	30
Table 3	Gastric adenocarcinoma classification systems.	35
Table 4	Pathological staging of gastric carcinoma using TNM system .	38
Table 5	Clinical stages of gastric cancer .	57
Table 6	Gender of patients included in the study.	70
Table 7	The main complaint of patients in the study.	71
Table 8	The endoscopic shapes of the gastric lesion in the study.	71
Table 9	The pathological grade of gastric adenocarcinoma in the study.	72
Table 10	The site of the gastric lesion by MDCT in the study.	73
Table 11	Frequency of each T stage with MDCT(according to <i>Chamadol et al., 2008</i> , staging system) in the study.	74
Table 12	Comparison between T staging by MDCT (according to <i>Chamadol et al., 2008</i>) and pathology.	75
Table 13	Frequency of each T stage with MDCT (according to <i>Lee et al., 2012</i> , staging system) in the study.	75
Table 14	Comparison between T staging by MDCT (according to <i>Lee et al., 2012</i> , staging system) and pathology.	76
Table 15	Comparison between 2008 and 2012 staging systems regarding T staging in the study.	77
Table 16	Comparison of evidence of serosal with/without adjacent organs invasion between MDCT and pathology.	77

Table 17	Sensitivity, specificity and accuracy of MDCT in evaluating serosal involvement with/ without adjacent organ invasion in the study.	78
Table 18	Frequency of each N stage with MDCT (according to Chamadol et al.,2008,staging system)	79
Table 19	Comparison between N staging by MDCT (according to <i>Chamadol et al., 2008</i> , staging system) and pathology.	79
Table 20	Frequency of each N stage with MDCT (according to <i>Lee et al., 2012</i> , staging system) in the study.	80
Table 21	Comparison between N staging by MDCT (according to <i>Lee et al., 2012</i> , staging system) and pathology.	81
Table 22	Comparison between 2008 and 2012 staging systems regarding N staging.	82
Table 23	Comparison between all pathologic lymph nodes detected by MDCT and pathology.	82
Table 24	Sensitivity, specificity and accuracy of MDCT in detection of metastatic LNs in the study.	83
Table 25	Frequency of each M stage with MDCT (according to <i>Chamadol et al., 2008</i> , staging system)in the study.	83
Table 26	Frequency of each M stage with MDCT (according to <i>Lee et al., 2012</i> , staging system) in the study.	84
Table 27	Therapeutic plan according to the clinical stage.	85

Table of Contents

<u>Contents</u>	<u>Page</u>
• Introduction.....	1
• Aim of work.....	3
• Review of Literature.....	4-62
A. Anatomy of the stomach.....	4-8
B. Lymphatic drainage of the stomach.....	9-13
C. Radiological anatomy of the stomach by MDCT...	14-26
D. Pathology of gastric carcinoma.....	27-38
E. Protocol of MDCT examination of the stomach....	39-45
F. Staging of gastric carcinoma with MDCT.....	46-55
G. Clinical stages of gastric carcinoma and treatment options according to stage.....	56-62
• Patients and methods.....	63-69
• Results.....	70-86
• Case presentation.....	87-108
• Discussion.....	109-116
• Summary and Conclusion	117,118
• References.....	119-130
• Arabic summary	

INTRODUCTION

Radiology plays an essential role in the diagnosis, staging and surveillance of oncology patients. CT is the most commonly utilized imaging modality in the work up of these patients (*Moron et al., 2007*).

Gastric cancer is the 4th most common cancer and the 2nd leading cause of cancer-related deaths worldwide after lung cancer (the first common deadly cancer) (*Kamangar et al., 2006*). Despite a steady decline in the incidence rate over the last few decades, the absolute incidence has risen due to the aging of the worldwide population (*Parkin et al., 2005*). The incidence of gastric cancer is particularly common in eastern Asia (*Moore et al., 2010*).

Chronic inflammation (especially chronic *Helicobacter pylori* infection), exposure to diverse carcinogens, and genetic susceptibility are among factors associated with an increased risk of gastric cancer (*Han and Lauwers, 2010*).

The tumor-node metastasis (TNM) staging system is one of the most commonly used staging systems. The TNM system is well known to effectively predict the prognosis of gastric cancer patients (*Lee et al., 2012*).

In the past, double-contrast barium examination and upper gastrointestinal endoscopy were used for the assessment of gastric cancer. Currently, the standard imaging methods for gastric cancer are endoscopic ultrasonography (EUS), computed tomography (CT), magnetic resonance imaging (MRI), and diagnostic laparoscopy. Each modality has strengths and weaknesses in diagnosing and staging disease for treatment planning (*Byrne et al., 2002*).

Introduction and Aim of work

CT has been used for pre-operative staging work ups, including assessment of liver metastases and distant spread after endoscopic evaluation. Current multi-detector row CT with thin collimation provides isotropic imaging, which allows marked improvement of imaging resolution, especially in multi-planar reconstruction (MPR) images. Some studies have reported that MDCT with MPR images increases the accuracy of T staging in patients with gastric cancer (*Kim AY, et al. 2005; Chen et al., 2007*). Thus, MDCT with MPR images are used as a routine protocol for gastric cancer staging (*Lee et al., 2012*).

This study mainly discusses the pre-therapeutic staging of gastric carcinoma based on TNM staging system with MDCT, including MPR images, and a brief review of the current management of gastric cancer.

AIM OF THE WORK

The aim of this work is to evaluate the role of multidetector CT with MPR images in the staging of gastric carcinoma.