Role of CT Virtual Colonoscopy in Diagnosis of Colo-Rectal Neoplasms

Thesis

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By

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Eman Ahmed Fouad Darwish

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List of Abbreviations

Abb.	Meaning
2D	Two dimensional
3D	Three dimensional
AJCC	American Joint Commission on Cancer
AJR	American Journal of Roentegenology
CAD	Computer aided diagnosis
CT	Computed tomography
CTC	Computed tomographic colonography
FAP	Familial adenomatous polyposis
Fig.	Figure
GIT	Gastrointestinal tract
ICV	Ileo-caecal valve
IV	Intravenous
KV	Kilovolt
mA	Milliampere
MALT	Mucosal associated lymphoid tissue
mg	Milligram
MIP	Maximum intensity projection
mm	Millimeter
MSCT	Multislice computed tomography
msec	Millisecond
NEJM	New England Journal of Medicine
PJ	PeutzJeghers
RSNA	Radiology Society of North America
Sec.	Second
SSD	Surface shaded display
TNM	Tumor Node Metastasis
VC	Virtual colonoscopy
VR	Volume rendered
WHO	World Health Organization

Introduction

Colorectal carcinoma is among the leading causes of malignancy related deaths in the world. Because of the natural history of the progression from colorectal polyp to carcinoma, with most frank colo-rectal cancers arising from pre-existing polyps, early and prompt diagnosis can have a significant effect on patient mortality ***(Silva et al., 2005)***. Not only will detection and removal of precursor adenomas result in a decrease in the incidence of colorectal cancer, frank colo-rectal neoplasia has a great potential for cure when detected at an early stage. According to the American cancer society the 5-year survival rate for patients with colorectal cancer is 83%-90% if disease is confined to the bowel wall and less than 10% if there are distant metastases; thus, prompt detection and treatment are critical ***(Silva et al., 2006)***.

There is a continued search for method of early detection of colorectal neoplasms that is cost-effective, safe, and acceptable to patients. Current methods used to detect colorectal polyps and colonic cancer include sigmoidoscopy, colonoscopy, and double-contrast barium enema examination. The effectiveness of each modality remains controversial, and each method has inherent limitations. For instance, flexible sigmoidoscopy allows examination of only the distal 60 cm of the colon, which limits evaluation to the descending colon, sigmoid, and rectum; inherently, lesions are missed in subjects who have colonic neoplasms located proximal to the splenic flexure, while evaluations of double-contrast barium enema examination for the detection of colorectal cancer have found sensitivities of 71%–95% sometimes reported being as low as 50%–75% in some studies ***(Yee et al., 2001)***.

Though colonoscopy is currently considered the reference standard for the detection of colorectal neoplasia it has various potential limitations. First, up to 10% of colonoscopic examinations are technically difficult even for experienced colonoscopists. In addition to poor bowel preparation, an experienced colonoscopist may be unable to complete the colonoscopy and intubate the cecal pole for a variety of reasons (redundant colon; colonic spasm; marked diverticulosis; obstructing masses or strictures; and angulation or fixation of colonic loops, most commonly due to previous pelvic surgery). Second, it does not allow evaluation of the liver and other organs outside the colon. Third, it has a blind area, as a colonoscope passes in only one direction. For example, the opposite side of a colonic fold cannot be evaluated exactly. Finally, it is invasive and uncomfortable ***(Chung et al., 2005)***.

Therefore, in search for a rapid, less invasive, accurate, and well-tolerated technique which can image the entire colon and reliably identify colonic neoplasms, computed tomographic

(CT) colonography, or “virtual colonoscopy,” has evolved quickly. CT colonography refers to a CT examination of the fully prepared and air-distended colon. Volumetric CT data in the entire colon are acquired with only a few seconds to minutes of scanning and with a total of 15 minutes or less of examination time. By combining these data with advanced imaging software, the colon is examined at an off-line workstation by using the combination of two-dimensional (2D) and 3D images ***(Johnson and Dachman, 2000)***.

Theoretically, potential advantages of CTC include visualisation of colonic anatomy from both an endoluminal perspective as well as in multiple cross-sections, elimination of "blind spots" behind colonic folds as the entire colon is almost always evaluated, the display of the proximal colon that is inaccessible at colonoscopy because of obstructing colonic lesions or because of incomplete endoscopic examinations and the assessment of extracolonic abdominal and pelvic organs which provides radiologists with an opportunity to discover other potentially life-threatening, asymptomatic conditions ***(Johnson and Dachman, 2000)***.

Aim of the Work

The aim of this study is to assess the role of CT colonography (virtual colonoscopy) as a non-invasive imaging technique in detection and diagnosis of colorectal neoplasia using conventional colonoscopy and/or operative findings as a reference standard, as well as highlighting its advantages and possible pitfalls.

Chapter (1):

Anatomy of the Colon

The large intestine begins at the end of the ileum in the lower right quadrant of the abdomen. From there, it leads superiorly on the right side to a point just below the liver; it then crosses to the left, descends into the pelvis, and terminates at the anus ***(Van De Graff,2001).***

It tends to form a border around the loops of the small intestine which are located centrally within the abdomen ***(Borley,2005)***.

The large intestine is structurally divided into the caecum, colon, rectum, and anal canal.***(Fig.1)*** Its caliber is greatest near the caecum and gradually diminishes to the level of mid-rectum. It enlarges in the lower third of the rectum to form the rectal ampulla, above the anal canal***(Borley,2005).***

A specialized portion of the mesesntery, the mesocolon, supports the transverse portion of the large intestine along the posterior abdominal wall ***(Van De Graff,2001).***

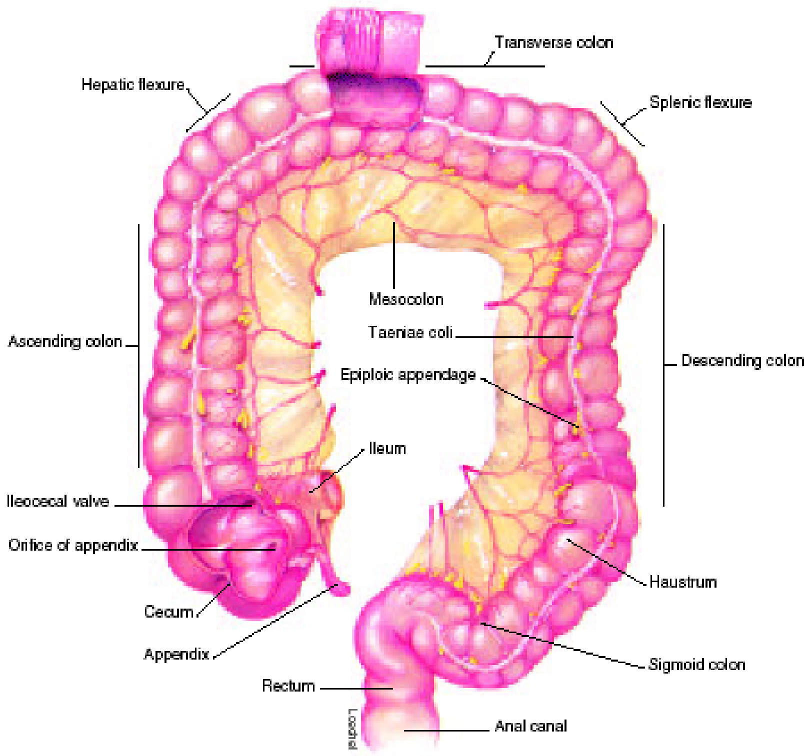

Figure (1): The structures of the colon including the teniae, haustra and appendices epiploicae *(Quoted from Van De Graaff, 2001).*

The large intestine differs from the small intestine in the following ways:It has a greater caliber.Its longitudinal muscle, though a complete layer, is concentrated into three longitudinal bands, taeniae coli, in all but the distal sigmoid colon and rectum.Small adipose projections, appendices epiploicae are sattered over the free surface of the whole colon, but they tend to be absent from the caecum, vermiform appendix and the rectum.Moreover, the colonic wall is puckered into sacculations (haustrations) which may, in part, be due to the presence of