Current Status on Performance of CT Colonography and Its Clinical Application

Essay

Submitted for the Partial Fulfillment of Master Degree in **Radiodiagnosis**

By

Salma Ahmed El Mokhtar Mohamed Mahfouz Hana
M.B., B.Ch.
Faculty of Medicine-Ain Shams University - 2011

Under Supervision of

Prof. Dr. Saad Aly Abd Rabu
Professor of Radiodiagnosis
Faculty of Medicine-Ain Shams University

Dr. Mohamed Sobhi Hassan
Lecturer of Radiodiagnosis
Faculty of Medicine-Ain Shams University

Faculty of Medicine
Ain Shams University
Radiodiagnosis Department
2015

الإستخدام الحالى للتنظير القولونى بإستخدام الأشعة المقطعية و تطبيقاته الأكلينيكية

رسالة

توطئة للحصول على درجة الماجستير في الأشعة التشخيصية

مقدمة من

الطبيبة / سلمى أحمد المختار محمد محفوظ هنا

بكالوريوس الطب والجراحة

جامعة عين شمس - ٢٠١١

تحت إشراف

أ.د/ سعد على عبد ربه

أستاذ الأشعة التشخيصية

كلية الطب- جامعة عين شمس

د/ محمد صبحى

مدرس الأشعة التشخيصية

كلية الطب- جامعة عين شمس

كلية الطب

جامعة عين شمس

قسم الأشعة التشخيصية

٢٠١٥

My great thanks and gratitude to **Allah** , for all gifts given to me, and whose help I always seek to put my feet in the right road.

I wish to express my sincere gratitude to **Professor Dr. Saad Aly Abd Rabu,** for his encouragement and constant advice.

I owe special gratitude to **Dr. Mohamed Sobhi Hassan,** for bearing with me and for his constant encouragement and most valuable advice throughout the execution of this work.

I would like to thank my professors for their support and inspiration.

Last but not least, sincere gratitude to ***My Parents*** your prayers are what sustains me.

سورة البقرة الآية: ٣٢

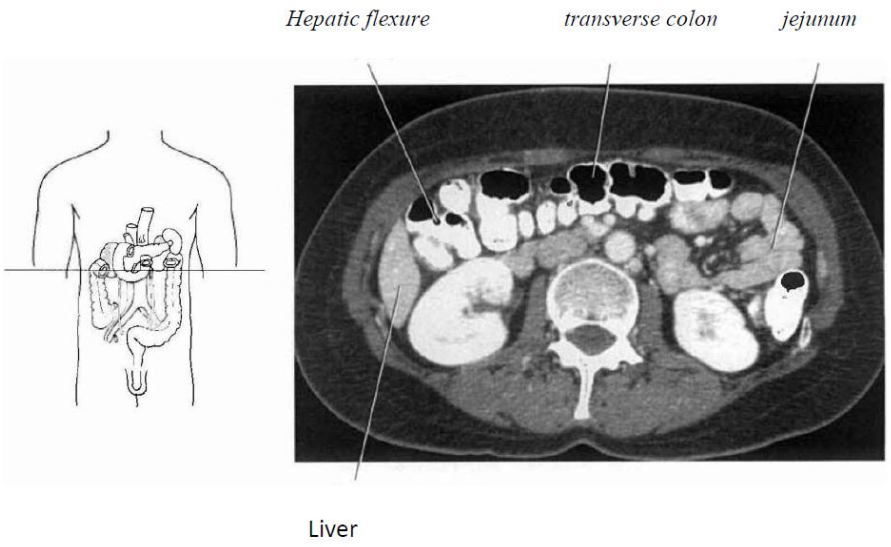

Fig. (1.3): Axial CT scan of hepatic flexure and transverse colon.

The transverse colon is located within the peritoneal cavity and is the largest and most mobile portion of the large intestine, making its position quite variable in the patient. The descending colon is retroperitoneal and continues inferiorly along the left lateral abdominal wall to the iliac fossa, where it curves to become the S-shaped sigmoid colon posterior to the bladder ***(fig1.4),*** and the sigmoid colon joins the rectum, which forms the terminal portion of the colon extending from the level of S3 to the tip of the coccyx ***(Kelley and Petersen, 2013).***

Contents

List of Abbreviations

ACS	American cancer society
ACRIN	The American College of Radiology Imaging Network
ACR	The American College of Radiology
BE	Barium Enema
CAD	Computer Aided Design
CC	Conventional colonoscopy
CRN	Colorectal neoplasia
CTC	CT colonography
EC	Electronic cleansing
ESGAR	European Society Of Gastrointestinal And Abdominal Radiology
ESGE	European Society Of Gastrointestinal Endoscopy
FIT	Faecal Immune Testing
FOBT	Faecal Occult Blood Test
NPV	Negative predictive value
OC	Optical Colonoscopy
PCP	Primary Care Physician
PPV	Positive predictive value
US-SEER	United States Surveillance, Epidemiology, and End Results
US-PSTF	United States Preventive Services Task Force

List of Figures

Introduction

CT Colonography, or what is known as virtual colonoscopy (VC), has been introduced to the medical society in the early 90's as a new modality for screening and diagnosis of colorectal carcinoma, ever since researches have blossomed to include clinical trials, software development, interpretation of visualization methods, radiation dose evaluation and the study of extracolonic findings ***(Dachman and Yoshida, 2003).***

In the early 1980 CT technology showed a rapid advancement, from single slice scanners to helical imaging which permitted the acquisition of a contiguous volume of anatomy during a single breath hold. At the same time, computer technology was rapidly advancing to allow virtual reality simulations.

Intravenous contrast enhanced CT had already been well established as a means of staging an already known cases of cancer colon, and inflation of the colon with gas to improve the visualization of the colon was done as early as 1981.Researchers at New York University reported then that the distention of the colon with gas helped in raising the detection rate of cancer colon to 95% versus 68% if no special attempts were made to promote visualization of the colonic wall ***(Laghi et al., 2013).***

The key invention for creating the 3D endoluminal fly-through method, was the work of Dr. David J. Vining, his inspiration for creating virtual colonoscopy as it is known nowadays was brought about by combining the advances in helical CT scanning technology with virtual reality computing that is used in flight simulator games, thus enabling him to navigate the volume of data generated by helical CT, and literally travel inside a simulation of the human body.

The first trial for the VC examination was done in September 1993, the single-slice spiral CT scanner that was used took approximately 1 minute to scan the patient during an attempt breath-hold, and the VC flight required more than 8 hours for the computer to process. Today, multidetector CT scans the body in a matter of seconds, and 3D processing occurs in real time on laptop computers.

Early clinical trials of VC yielded promising results, with some pioneer researchers reported high sensitivities exceeding 90% for the detection of polyps ≥ 1cm, while others countered those results by other less appealing results. Those differences were attributed to several factors including; the type of patient cohort, training and experience of the readers and 2D versus 3D analysis technique ***(Laghi et al., 2013).***

Near the end of the first decade of the new millennium, a study led by Dr. Perry Pickhardt, represented the largest screening trial to date with the evaluation of over 1,200 patients in the military. New technological breakthroughs were introduced, including stool tagging and subtraction, use of segmental unblinding to improve the reference standard beyond colonoscopy, and use of 3D as a primary image display review. Dr. Pickhardt's study set a benchmark of 90% sensitivity for the detection of polyps ≥1cm and 80% for 6-8mm polyps in asymptomatic patients at low risk ***(Laghi et al., 2013).***

As the first decade closed, studies evolved and new technologies emerged such that some recent studies show good sensitivity for the identification of non-polypoidal (flat) lesions as well. Furthermore, there are some researches to test the reliability of CTC as a screening program for early detection of cancer colon, yet it is not finally established.

Anatomy of the Colon

The colon is the last part of the intestinal canal, constituting the second main division of the large intestine with the other two parts being the caecum and the rectum ***(Kelly and Peteresen, 2013).***

The large intestine (large bowel) lies inferior to the stomach and liver and almost completely frames the small intestine. It has a larger diameter and thinner walls than the small intestine and is approximately 1.5 meters long, starting at the ileo-cecal junction and ending at the anus. The outer, longitudinal muscle of the large intestine forms three thickened bands called *taenia coli* that gather the caecum and colon into a series of pouch like folds called *haustra* ***(fig1.1a).*** On the outer surface of the large intestine there are small fat-filled sacs of omentum called the *epiploic appendages*.

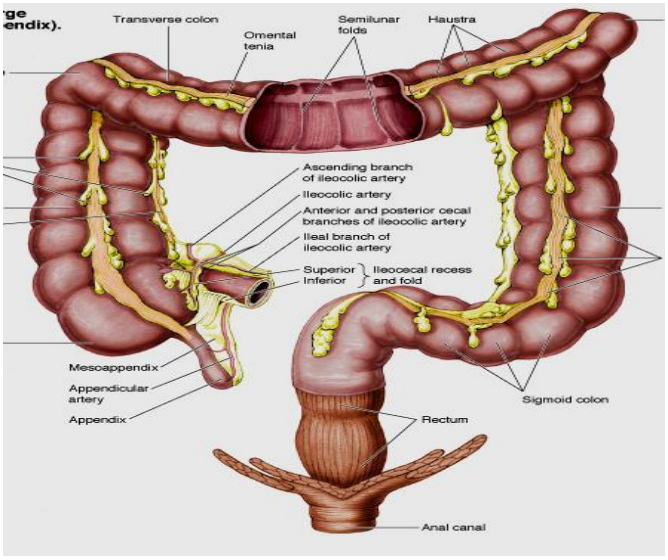

Fig. (1.1a): Illustration of the anatomy of the large intestine.