Value of F18-FDG PET/CT in post-operative assessment for patients with colorectal carcinoma.

Thesis

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Eman Mohamed Hassanin

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List of Abbreviations

Abbreviation	Name
18F-FDG	18F- FluoroDeoxyGlucose
CRC	Colorectal cancer
CT	Computed tomography
CECT	Contrast enhanced CT
GLUT	Glucose Transporters
IV	Intravenous
KeV	Kilo electron Volt
KV	Kilo Volt
mA	Milliamper
MCi	Micro Curies
MeV	Mega electron Volt
Mm	Millimeter
MRI	Magnetic Resonance imaging.
N	Neutron
P	Proton
PET	Positron Emission Tomography
RECIST	Response Evaluation Criteria in Solid Tumors
SUV	Standardized Uptake Value
SUVmax	Maximum Standardized Uptake Value
US	Ultrasound
RFA	Radiofreqency ablation

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Introduction

Colorectal cancer is one of the most common cancer worldwide and associated with a high mortality rate ***(Laurens and Oyen, 2015)***.

Radical resection is the primary therapy for colorectal carcinoma, but local recurrence and/ or metastasis rate in two years after operation are up to 30-40 % ***(Han et al., 2011)***.

Relapse after initial surgery for colorectal cancer is responsible not only for significant morbidity and mortality but also for impaired quality of life ***(Schaefer and Langer, 2007).***

Early detection and accurate postoperative staging is very helpful for designing the subsequent therapeutic scheme for example secondary operation, radiotherapy and /or chemotherapy ***(Han et al., 2011)***.

Multiple imaging modalities including computed tomography (CT), magnetic resonance imaging (MR) and fluorine-18-2-fluoro-2-deoxy-D-glucose positron emission tomography (FDG-PET) are used for the early detection of recurrent disease ***(Kitajima et al., 2009).***

Positron emission tomography (PET) is a noninvasive molecular imaging technique that can distinguish between cancer cells and normal cells by detecting difference in their metabolic activities ***(Bailey et al., 2015).***

Currently, PET is combined with CT to provide both metabolic and anatomic imaging data with a single device during a single diagnostic session ***(Yu et al., 2015).***

When these modalities are combined, the sensitivity and specificity of detecting recurrent colorectal cancer range from 87% to 95% and 85 % to 95% respectively ***(Bailey et al., 2015).***

PET/CT is recommended for determining management and prognosis if conventional imaging is equivocal for the presence of metastatic disease ***(Chan et al., 2012).***

PET is the most sensitive and specific for the detection of recurrent colorectal cancer when used for patients with increasing carcinoembryonic antigen (CEA) levels who have undergo non diagnostic CT imaging ***(Kyoto et al., 2010).***

More recently there have been studies indicating that PET/CT may be useful in detecting recurrence in patients with normal CEA levels ***(Laurens and Oyen, 2015).***

Aim of the Work

To assess the role of F18- FDG PET/CT in post operative assessment in patient with colorectal cancer, hence guiding the clinician to the proper management strategy.

Anatomy of the Colon and Rectum

The large intestine extends from the ileocecal valve to the anus, a length of approximately 1.5 meter. It extends from the cecum to the rectum. It has three outer longitudinal muscular layers called taenia coli causing characteristic sacculations interrupted by incomplete rings called haustra ***(Edith, 2010) fig1a.***

The large bowel divided into the following parts:

I-The Cecum:

Blind ending first part of the colon. It lies below the ileocaecal valve. The appendix typically arises from its posteromedial surface, 2 cm inferior to the ileocaecal valve. It is covered by peritoneum except posteriorly.

II- Ascending colon:

Extends from the cecum to transverse colon (meets the transverse colon at the hepatic flexure where it turns 90°to the left. It is located in the retroperitoneum, has no mesentery& separated from the posterior abdominal muscles by the right kidney ***(Federle et al., 2017) fig 1b***

III- Transverse colon:

It is the longest part of large intestine & most mobile part, it extends across the abdomen from the right colic (hepatic) flexure to the left colic (splenic) flexure where it makes inferior 90° turn to becomes the descending colon ***(Federle et al., 2017) fig 1a***

It is almost completely invested by peritoneum (intraperitoneal) & is suspended by a mesentery which is called transverse mesocolon ***(Edith, 2010) fig 1b***

Greater omentum drapes downwards from transverse colon, and gastrocolic ligament connects greater curvature of stomach and transverse colon ***(Stephanie et al., 2011)***.

IV- Descending colon:

It is retroperitoneal & has no mesentery, which extends from splenic flexure downwards and turns medially as it becomes sigmoid colon ***(Federle et al., 2017).***

IV- Sigmoid colon:

Mobile, S-shaped intraperitoneal portion of left colon. It has its own long mesentery (the sigmoid mesocolon) ***fig 1b***

It begins at the pelvic brim, crosses the sacrum, and then curves to the midline at the third sacral segment where it becomes the rectum ***(Edith, 2010)***.

V- The rectum:

The last part of the large intestine measuring 15-20cm & extends from rectosigmoid junction (variable position but usually begins at S3 level) down to the anal canal ***(Stephanie et al., 2011).***

The rectum is partially covered with peritoneum but has no mesentery, therefore it is considered retroperitoneal.
It is Divided into 3 segments: Lower 1/3 (7-10 cm from anal verge), middle 1/3 (4-5 cm long), and upper 1/3 (last 4-5 cm) ***(Edith, 2010)***.

The upper 1/3 covered by peritoneal lining anteriorly and laterally, while middle 1/3 covered by peritoneum

anteriorly only; no peritoneal covering for lower 1/3. The rectum is surrounded by perirectal fat (mesorectum), which is bounded by mesorectal fascia. Mesorectal fascia defines "circumferential resection margin" utilized surgically when patients undergo total mesorectal excision for rectal cancer (and key landmark when staging rectal cancer using MR). The rectum continues as the anal canal at the level of the coccyx tip ***(Federle et al., 2017).***

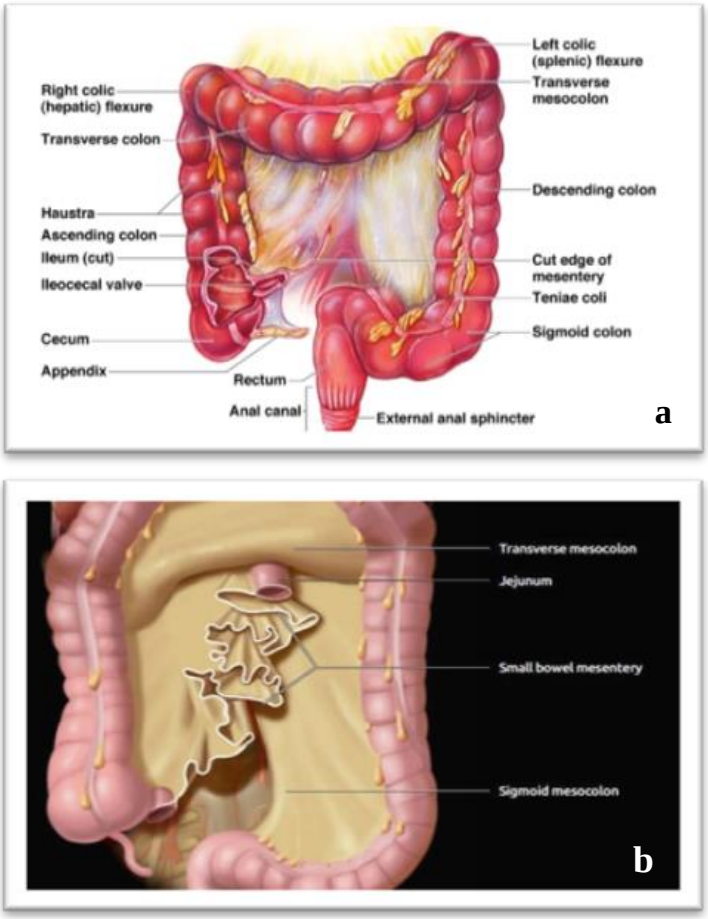

Fig (1)*: (a)** Illustration shows the different parts of the colon, **(b)** illustration showing that the ascending &descending colon are largely retroperitoneal while the transverse & sigmoid colon have a mesentery ***(Edith, 2010).

Histological (mural wall) anatomy of the colon

In general, the gut consists of four concentric layers: the mucosa, submucosa, muscularis propria & serosa. Longitudinal muscle layer is not continuous (unlike small bowel) but separated into taeniae (except in rectum). Submucosa contains numerous discrete lymphoid follicles ***(Stephanie et al., 2011)***.

The wall of the colon consist of:

- Taeniae coli: 3 thickened, flat bands of smooth muscle constituting outer longitudinal layer of smooth muscle.
- Haustra: sacculations of colon wall caused by contractions of taeniae, separated by semilunar folds.
- Semilunar folds (plicae semilunares): furrows between haustra consisting of mucosa, submucosa, and circular muscle
- Epiploic appendages: subserosal pockets of fat extending from colonic surface ***(Federle et al., 2017)***. ***Fig 2***

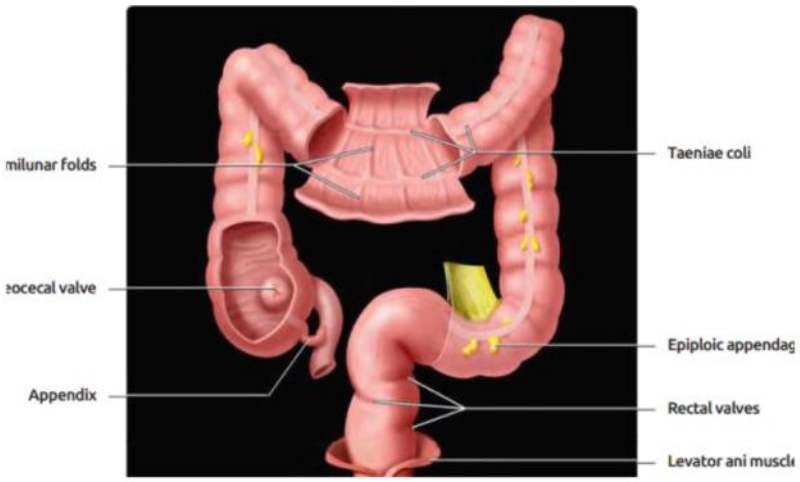

Fig (2): Illustration shows the surface & mucosal view of the colon ***(Federle et al., 2017)***

Blood supply of the colon:

I- Arterial supply:

- The cecum, ascending colon, and right part of the transverse colon are supplied by the superior mesenteric artery via the ileo-colic, right colic, and middle colic arteries. ***fig 3***

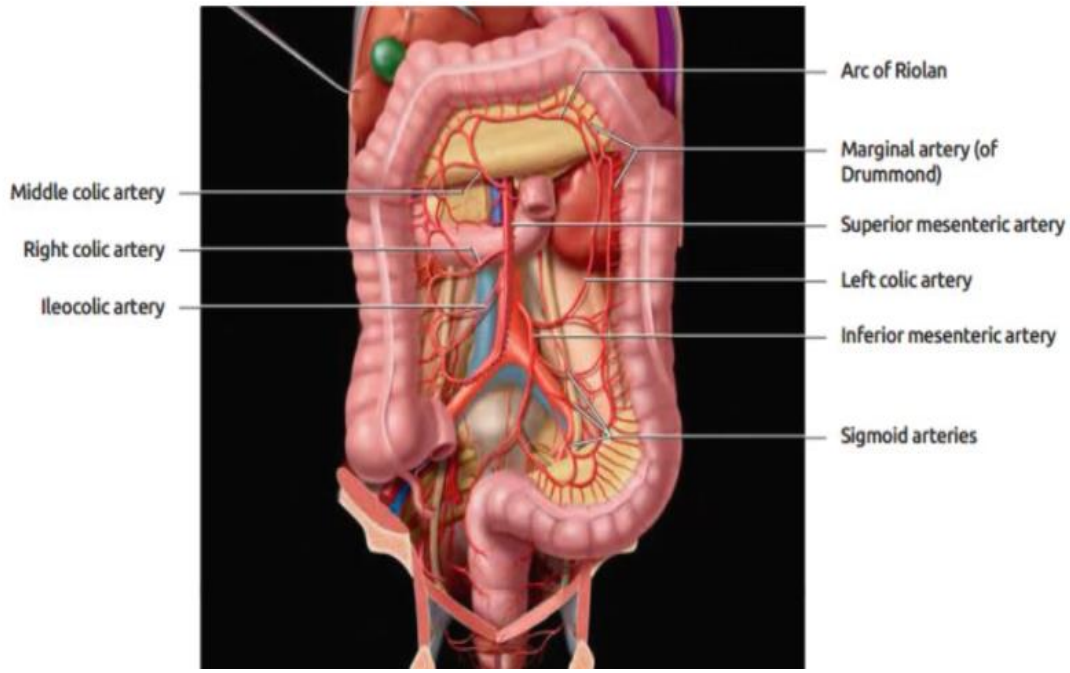

Fig. (3): Illustration shows the arterial supply of the colon ***(Federle &Raman, 2015)***.

- The left half of the transverse colon, the descending and sigmoid colon, and most of the rectum receive their blood supply from the inferior mesenteric artery through the left colic, sigmoid and superior rectal arteries ***(David et al., 2003).***