بسم الله الرحمن الرحيم

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بقسم التوثيق الإلكتروني بمركز الشبكات وتكنولوجيا المعلومات دون أدنى مسئولية عن محتوى هذه الرسالة.

ملاحظات:
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Role of PET/CT in Assessment of Post Operative Colorectal Cancer

Thesis submitted in Partial fulfilment of MD Degree
In Diagnostic Radiology

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Abstract

PET/CT is developing a major role in assessing colorectal cancer. The information provided by PET/CT is likely to combine the best imaging features of both modalities and become the gold standard for staging in colorectal carcinoma. PET/CT proved significantly more accurate in restaging, and detection of metastatic as well as recurrent colorectal cancer. PET/CT is also useful in monitoring tumor response to therapy.

Keywords: Colorectal cancer; PET/CT; Recurrence; Metastasis.

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List of Abbreviations

μ maps	Attenuation map
18F-FDG	^{18}F- FluoroDeoxyGlucose
AC/AL	Attenuation correction/Alignment
ACFs	Attenuation correction factors
CECT	Contrast enhanced computed tomography
CR	Complete Response
Cru	unconfirmed complete response
CT	Computed Tomography
ESR	Erythrocyte sedimentation rate
F 18	Fluorine 18
FDG	FluoroDeoxyGlucose
GLUT	Glucose Transporters
GSO	Gadolinium Silicate
GTD	Greatest transverse diameter
H+	Hydrogen ion
H2 (F-18)	Hydrogen fluoride
IV	Intravenous
IWC	International Workshop Criteria
KeV	Kilo electron Volt
KV	Kilo Volt
LDH	Lactate dehydrogenase
LSO	Lutetium Oxyorthosilicate
MCi	Micro Curies
MeV	Mega electron Volt
Mo	Months
MRI	Magnetic Resonance Imaging
N	Neutron,
P	Proton
PD	Progressive disease
PERCIST	PET Response Criteria in Solid Tumors
PET	Positron Emission Tomography
PET/CT	Positron Emission Tomography/ Computed Tomography
PFS	Progression Free Survival
PMTs	Photomultiplier tubes

PR	Partial Response
SD	Stable disease
RECIST	Response Evaluation Criteria in Solid Tumors
SLL	Small-cell lymphocytic lymphoma
SPD	Sum Of The Products Of The Greatest Diameters
ß-	Electron
ß+	Positron
SUV	Standardized Uptake Value
SUVavg	Average Standardized Uptake Value
SUVmax	Maximum Standardized Uptake Value
US	Ultrasound
WBC	White blood cells
WHO	World Health Organization
Wt	Weight
XRT	Radiotherapy
Γ	Photon

Introduction

Colorectal cancer is the third leading cause of cancer worldwide; it accounts for a large number of tumor related deaths. As with all types of cancer, early diagnosis of colorectal cancer is the key for its cure. If diagnosed early, before it has metastasized, the disease is considered curable. If the cancer has already spread to distant organs, the long term survival is much lower ***(Patrick et al.,2005).***

Determining the stage of colorectal cancer often requires multi-modality, multi-step imaging approach. Optical colonoscopy represents the reference standard in terms of cancer detection and tissue sampling. However optical colonoscopy only offers an endo-luminal view. Complete "conventional" staging concepts require additional imaging procedures to assess potential metastatic spread to lymph nodes and solid organs ***(Cohade C et al.,2003).***

Of these conventional imaging procedures, contrast enhanced computed tomography (CT) is the most common for both the abdomen and pelvis. However, CT offers only morphological data for the evaluation of tumor stage.Glucose analogue [18 F] fluorodeoxyglucose-positron emission tomography (FDG-PET) can display functional information and has been found to be accurate in the detection of colorectal cancer and its distant metastasis. However , based on its limited spatial resolution, FDG-PET often makes exact anatomical localization and demarcation of the lesion difficult ***(Cohade C et al.,2003)***

A limitation of CT and other radiological imaging procedures pertains to their lack of functional data, which may render determination of lesion size, potential infiltration of adjacent organs or involvement of loco-regional lymph nodes difficult. [18F] fluoro-deoxyglucose (FDG)PET, on the other

hand, is highly accurate when staging primary and recurrent colorectal cancer ***(Kantorova I et al.,2003)*.**

The functional data of fluorine 18 (18F) fluorodeoxyglucose (FDG) positron emission tomography (PET) have been reported to have an important complementary role in the detection of distant metastases and local recurrence and in the differentiation of tumoral and nontumoral masses in patients with colorectal cancer ***(Kalff et al.,2003).***

Thus fusion of functional with morphological data may be of benefit for tumor staging. As a consequence, combined PET/CT scanner has been introduced into clinical practice. Its ability to detect and characterize malignant lesions, with advantages over morphology and function alone, has been documented for different tumours including colorectal cancer ***(Valk PE et al,.1999).***

Whole-body PET/CT with integrated colonography is technically feasible for whole body staging in patients with colorectal cancer. This integrated protocol may be of substantial benefit in staging patients with colorectal cancer, focussing on patients with incomplete colonoscopy and those with small synchronous bowel lesions. ***(Patrick et al.,2005).***

Recurrence of colorectal cancer occurs in about one-third of patients within the first 2 years after surgery. Before PET was introduced, it was extremely difficult to monitor for suspected recurrence. The other techniques available for staging and assessment of potential recurrences lack sensitivity and precision. Moreover, frequent non-conclusive investigations result in diagnostic and therapeutic delay. In many colorectal cancer patients, pelvic CT will demonstrate a suspicious mass, but cannot distinguish mass tumor recurrence from post-operative or post-radiation scar ***(Kamel IR et al.,2004).***

Computed tomography (CT) and positron emission tomography (PET) are both well-established methods for the evaluation of patients with suspected recurrence. The results of CT depend on the site of recurrence, size and morphological appearance of the lesion. Because of the well-known high uptake of 18F-FDG in primary colorectal carcinomas and their recurrences, FDG-PET provides accurate information about changes in glucose metabolism; however, it is of limited value for anatomical localization and morphological depiction. Integrated imaging using both modalities improves the detection of recurrence. ***(Jana et al.,2006).***

In post-operative patients, an elevated serum carcinoembryonic antigen (CEA) level suggests recurrent and/or metastatic disease. Resection of isolated metastases is associated with improve survival while multifocal metastatic lesions are associated with less favorable prognosis **(*H. Jadvar and JA Parker.,2005).***

Early detection of recurrent colorectal carcinoma has become more important in the past decade, as the treatment options for localized disease have improved significantly. However, aggressive locoregional interventions (e.g. partial liver resections, radiofrequency ablation (RFA) of liver metastases, resections of pulmonary metastases) are as of yet considered futile in the presence of metastases elsewhere [1]. Therefore, detection of tumour sites throughout the body is needed with high sensitivity and specificity ***(Vogel,et al.2005).***

Whole body PET/CT imaging is said to be the most accurate diagnostic test for detection of recurrent colorectal cancer, and is a cost effective way to differentiate resectable from non-resectable disease ***(Kantorova et al.,2003)*.**

18F-FDG PET has been shown to be highly accurate in the detection of recurrent and metastatic colorectal cancer. A PET scan has comparable sensitivity to a CT scan for the detection of colorectal liver metastases but has superior sensitivity in the detection of extrahepatic disease, compared with CT, and changes the estimation of disease extent in over one third of patients. Several reports also indicate that PET can influence the management of patients with metastatic colorectal cancer ***(Scott A.M et al,2008).***

Interpreting fused images provided more accurate diagnosis than interpreting CT, PET, or PET + CT images. This method of manually fusing separately obtained PET and CT images increased the diagnostic certainty for detecting colorectal cancer recurrence and decreased the number of equivocal cases***.(Yuji et al.,2007).***

Aim of work:

- The aim of this study is to highlight the role of PET/CT in evaluation of post operative colorectal cancer, hence guiding the clinician to the proper management strategy.

Colorectal anatomy

The large intestine extends from the end of the ileum to the anus. It is about 1.5 meters long. It differs from the small intestine in its greater caliber, its more fixed position, its sacculated form, and in possessing certain appendages to its external coat, the appendices epiploicae. Further, its longitudinal muscular fibers do not form a continuous layer around the gut, but are arranged in three longitudinal bands. The large intestine is divided into the cecum, colon, rectum, and anal canal ***(Henry Gray 2004).***

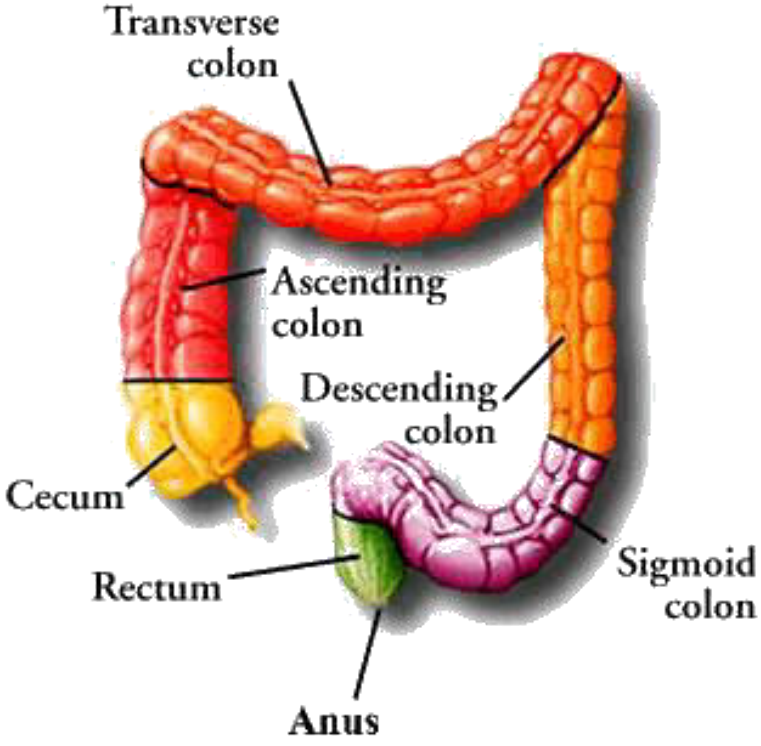

Fig1: large intestine (Brewer C,2004).

I-The Cecum:

It is attached to the ileum and extends approximately two and one-half inches below it. The cecum in an adult usually is adherent to the posterior wall of the peritoneal cavity and has a serosal covering on its anterior wall only. The cecum forms a blind pouch from which the appendix projects ***(Henry Gray 2004).***