Editorial

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The role of ^{18}F-FDG-PET in the detection of early cancers and precancerous polyps in colorectum

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Colorectal cancer is one of the most frequent cancers and also one of the most frequent causes of cancer-related death in the Western world. Overall 5-year survival is approximately 60%; however, for early cancer (stage I) it is around 90% [1]. In most cases, colorectal cancer is located in the rectum (40%), followed by the sigmoid and cecum [2]. Optical colonoscopy is regarded as a 'gold standard' for the early detection of colorectal cancer because not only tumor detection, but also tissue sampling and therapeutic intervention are possible [1]. However, considerable procedural pain, strict bowel cleansing, and risk of perforation limits patient acceptance of colonoscopy for screening. These facts have motivated the development and evaluation of additional modalities to assess the colon and rectum. Despite the limited value of conventional radiologic techniques, patients with incomplete colonoscopy and suspected colorectal cancer may benefit from a virtual computed tomography (CT) colonography. This review aims to outline the current and future role of ^{18}F-fluorodeoxyglucose (FDG) positron emission tomography (PET) in the field of colorectal malignancies.

The main indications for FDG-PET in colorectal carcinoma are in the diagnosis of recurrent disease, exclusion of other metastasis before liver/lung resection, or in the evaluation of a rising carcinogenic embryonic antigen level, whereas screening or staging of colorectal cancer is not indicated [3,4]. However, incidental colorectal FDG uptake is frequently observed with extensively used FDG-PET for the evaluation of noncolorectal cancer patients [5–9]. PET shows a higher sensitivity for detecting adenomas in the cecum, ascending colon, and descending colon, which may relate to the relative lack of movement with respiration of these regions of the colon that are predominantly retroperitoneal [4,10]. In contrast, preoperative sensitivity of PET for detection of biopsy-proven primary colorectal cancer has been reported to be as high as 100% with low specificity (43%) [11]. False negative results may be obtained when pathology is mucinous colorectal carcinoma or when necrotic lesions with a thin viable rim are present [1].

According to retrospective series, the incidence of unexpected FDG uptake in whole gastrointestinal track or colorectum has been reported as 1.32–3.27% [7–9]. Of these lesions, 59–68% were premalignant lesion or malignant tumor [7–9]. There are many investigators who have tried to explain the cause and pattern of incidental colorectal FDG uptake. At the beginning, uptake patterns were investigated (focal, multifocal, segmental, or diffuse hypermetabolism) with PET systems [8]. Results show that diffuse or segmental uptake is frequently associated with benign pathologies; however, colonoscopy is suggested as a next step for nodular high FDG uptake [8]. Just after the introduction of combined PET/CT systems, different centers published their retrospective data with this new technology [7,9]. Results were similar for noncontrast PET/CT imaging; high-intensity focal hypermetabolism indicated advanced adenoma [7,9]. However, measurement of maximum standardized uptake value does not allow the differentiation between benign and (pre)neoplastic lesions [7]. In addition, they demonstrated that coregistration of PET and CT improves the differentiation between malignant and physiologic or inflammatory process [7]. Today, standard oncological PET/CT studies are being obtained with oral contrast agents safely in many departments and colorectal FDG uptake is evaluated more accurately.

Unfortunately, PET imaging has physical and biological limitations for the detection of early disease [12–14]. Partial volume effect, spatial resolution (generally >1 cm), lesion-to-background contrast (high-physiologic surrounding bowel activity, grade of dysplasia), and motion artifacts (secondary to respiratory or bowel movement) affect the ability to detect small colorectal lesions and quantify absolute radioactivity by FDG-PET. In a prospective cohort study, Van Kouwen *et al.* [13] reported that the sensitivity of PET/CT increased with size (21%, 1–5 mm; 47%, 6–10 mm; 72%, >11 mm) and grade of dysplasia (33%, low grade; 76%, high grade; 89%, carcinoma).

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Sometimes, optical colonoscopy, which is a 'gold standard', fails to show small or extraluminal colonic adenomas. More recently, Rehani *et al.* [5] reported a case of an advanced adenoma ($45 \times 30 \times 5$ mm, exophytic, external polipoid lesion) diagnosis with FDG-PET in a visibly normal mucosa on colonoscopy. As mentioned in that case report, positive FDG-PET with normal colonoscopy cannot rule out malignancy and carefully correlation with CT or follow-up colonoscopy should be performed to prevent progression to advanced disease [5].

Combination of new CT technologies (such as CT colonography, three-dimensional rendering virtual colonoscopy, and CT enteroclysis) with PET open new horizons for gastrointestinal imaging [14–16]. The pilot studies showed feasibility and potential clinical utility of new PET/CT techniques for diagnostic lesion characterization and preprocedural planning. However, PET/CT colonography techniques do not seem to be routinely used in all oncological PET studies, because of the bowel cleansing regimen, air insufflation in to the bowel, and patient discomfort in supine PET/CT acquisition.

Nonmalignant uptake which decreases the specificity and sensitivity is another limitation of FDG-PET. Focal hot spots such as focal smooth muscle uptake, non-uniform lymphocyte concentration in cecum and right colon, overlapping intestinal loops, undistended bowel, or diverticulitis may mimic the focal malignant lesion and diffuse segmental FDG accumulations (inflammation/infection or drugs) may obscure the focal lesions [13,14,17–19].

The last issue for FDG-PET in colorectal cancers is its use a cancer-screening test. At the end of the 2007, Japanese investigators published the performance profile of FDG-PET for cancer screening on 50 558 healthy participants [20]. In this population, colorectal cancer was detected with high sensitivity (90%). Other Japanese studies with smaller groups supported this data with report of the usefulness of the FDG-PET cancer screening [21].

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