^{18}F FDG PET-CT for EBRT Planning in Inoperable Rectal Carcinoma after Receiving Chemotherapy– A Case Report

Shamim M F Begum, Fatima Begum, Raihan Hossain, Md. Abu Bakker Siddique, Khokon Kumar Nath and Mizanul Hasan

National Institute of Nuclear Medicine and Allied Sciences (NINMAS), Dhaka, Bangladesh

Correspondence address: Prof. Dr. Shamim Momtaz Ferdousi Begum, Professor and Head Nuclear Nephrology Division National Institute of Nuclear Medicine & Allied Sciences, BAEC, Email: pragyna06@yahoo.com

ABSTRACT

Colorectal cancer (CRC) is the third most commonly diagnosed cancer in men and the second in women globally. The incidence varies with geographic difference. In Bangladesh, hospital based cancer registry shows rate of CRC in male 10.1%- 12% and in female 3% - 12.0%. The prognosis of the disease and treatment planning depends upon the staging of the disease. Surgery is usually a common way of treatment of rectal cancer except some cases with advanced stage. Radiation therapy, often with chemotherapy, is frequently used in the adjuvant or neoadjuvant setting for the treatment of rectal cancers. External beam radiation therapy (EBRT) is a well practiced method of treatment in the in-operable cases of rectal cancer. 18F FDG PET-CT is a well recognized imaging tool in the pretreatment evaluation of colorectal cancer worldwide. Accurate staging is needed for proper selection of treatment and cost effectiveness. Here, we discussed a case of rectal cancer (stage IV) with post chemotherapy state with history of palliative loop iliostomy bypass. The patient was referred for 18 F FDG PET-CT scan for restaging of the disease and to localize functioning tumor site for external beam radiotherapy (EBRT) planning. FDG PET-CT imaging revealed FDG avidity at the primary tumor site, peri-rcetal fat and multiple FDG avid hypermetabolic lymphnodes in pelvic cavity. A focal FDG avid lesion in anterior aspect of liver suggests hepatic involvement. The fusion PET-CT imaging has played an important role in the further management of the patient by providing guidelines in EBRT.

Key words: **Rectal carcinoma, PET-CT, EBRT (External beam Radiation Therapy).**

INTRODUCTION

Colorectal cancer is the second leading cause of cancer-related deaths in the Western world and continues to be a major health problem worldwide. The cumulative lifetime risk is approximately 5%, the incidence in the Western world is 50/100,000 and the 5-year survival rate now-a-days is approximately 55% (1). The incidence and mortality rates of colorectal cancer (CRC) vary markedly geographically and country specific. It is the third most commonly diagnosed cancer in males and the second in females, globally. About 1.4 million new cases and almost 694,000 deaths estimated to have occurred in 2012 due to CRC. Rates are higher in males than in females (2). In United States, approximately 132,700 new cases of large bowel cancer are diagnosed, of which 93,090 are colon and the remainder rectal cancers. Annually, approximately 49,700 Americans die of CRC, accounting for approximately 8 percent of all cancer deaths (3, 4). There is no population based cancer registry in Bangladesh to provide reliable data on colorectal cancer incidence or prevalence and mortality. Two hospitals based study and cancer registry with small populations showed that the rate of CRC in male is 10.1% and 12%; in female 3% and 12.0% respectively (5, 6). Rectal cancer was reported to be one of the five leading cancers of men and accounts 2.17%, at the hospital registry of National Institute of Cancer Research and Hospital (NICRH), Dhaka, among the outpatient department (7).

Rectal cancer is defined as a malignant lesion within 15 cm of the anal verge as seen by rigid proctoscopy. Approximately 30% of patients with rectal cancer present with metastatic disease (8). After histological diagnosis via tumor biopsy, the initial work-up to evaluate the extension of the disease provide guidelines for subsequent management.

Proper staging is essential to make decisions regarding neoadjuvant versus adjuvant therapy. Operative versus palliative surgical intent will be based on clinical stage (9). A multimodality approach including computed tomography (CT), magnetic resonance imaging (MRI) (rectal cancer only), and ultrasonography including endoscopic ultrasonography should be employed in the diagnostic work up of colorectal cancer patients (10, 11). Currently positron emission tomography using 18 F-fluorodeoxyglucose (FDG-PET) is an accepted imaging modality for the evaluation of patients with known or suspected recurrent colorectal cancer. It is indicated as an initial test for diagnosis and staging of recurrence, and for preoperative staging of lymph nodes metastasis and distal metastasis. PET-CT affects the clinical management plan through guiding the procedures like biopsy, surgery or radiation therapy (12, 13). The external beam radiation therapy (EBRT) is a well practiced method of treatment in the inoperable cases of rectal cancer. Here, a diagnosed case of inoperable rectal cancer (stage IV), with history of palliative loop iliostomy bypass is discussed. The patient was treated with chemotherapy and came for 18F FDG PET-CT scanning for restaging of the disease and to localize the functioning tumor site for EBRT planning.

CASE REPORT

A 30 years old male was referred to National Institute of Nuclear Medicine and Allied Sciences with an advice of 18 F FDG PET-CT imaging for EBRT planning from a private Medical College Hospital. The patient was a diagnosed case of moderately differentiated adenocarcinoma of rectum with local invasion, pelvic lymphadenopathy and left sided hydronephrosis. At the time of diagnosis, March 2015 he had multimodality approaches for diagnostic work up, like contrast enhanced CT scan, MRI and colonoscopy. CT and MRI revealed a rectal mass with local infiltration in the perirectal fat plane with perirectal, regional and mesenteric lymphadenopathy. Involvement of the distal end of left ureter and left sided hydronephrosis was also present. Depending upon the stage of the disease the patient was treated with chemotherapy and he had received 6 cycles chemotherapy before surgery. In the follow up colonoscopy on August 2015, regression of rectal lesion was evident. The patient underwent surgical intervention in the same year. Per-operative findings showed fixed rectum, involvement of whole peritoneal cavity with metastatic nodules. The caecum, jejunum, greater omentum were also involved with metastatic nodules. Fixed large lymph nodes were present at the root of the superior mesenteric vessels and at porta hepatis. The lesions were non-resectable. Then palliative loop ileostomy (bag in situ) was done at the proximal ileum. The patient received another 6 cycles of chemotherapy and completed on third December, 2015. For EBRT planning 18F FDG PET- CT scan was done without any contrast by following the protocol of NINMAS. On CT scan there was thickening of the rectal wall in axial section (Figure 1).

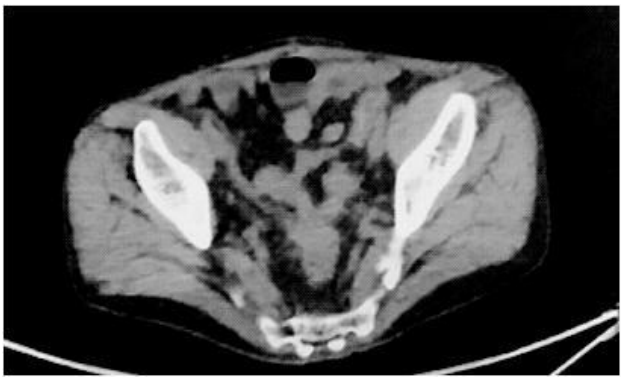

Figure 1: Rectal wall thickening on CT.

Intense FDG avidity was evident in that area (SUVmax- 12.9 and measures 27 mm X 22 mm) of rectum (Figure 2).

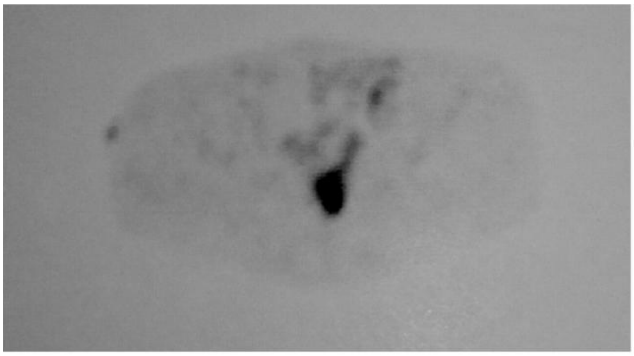

Figure 2: Rectal wall shows FDG radiotracer uptake on axial FDG-PET.

The fusion image of PET-CT showed correlation of CT and PET image suggested presence/ persistence of disease at primary site (Figure 3). FDG avid multiple lymph nodes (>4) were present in the prerectal, precoccygeal and left iliac regions (Figure 4). Small focal FDG avidity in the anterior aspect of VIII segment of right lobe of liver placed superficially suggested hepatic involvement, which was not evident in CT (Figure 5). The TNM staging of the disease was done and it was in stage IV (T4b, N2a, M1).

Figure 3: Increased FDG uptake on FDG-PET correlates with thickening due to rectal carcinoma (primary site) seen on CT.

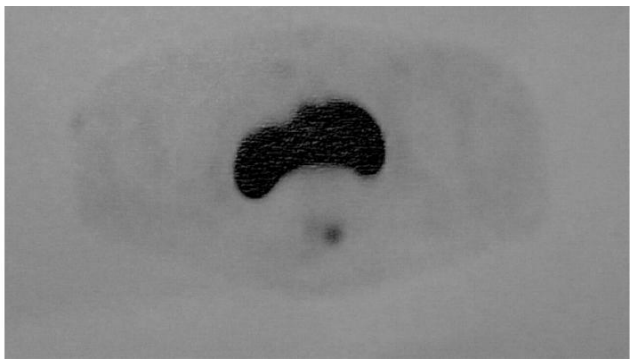

Figure 4: A small focus of avid FDG uptake in precoccygeal area on FDG-PET corresponding to size significant lymph node on CT.

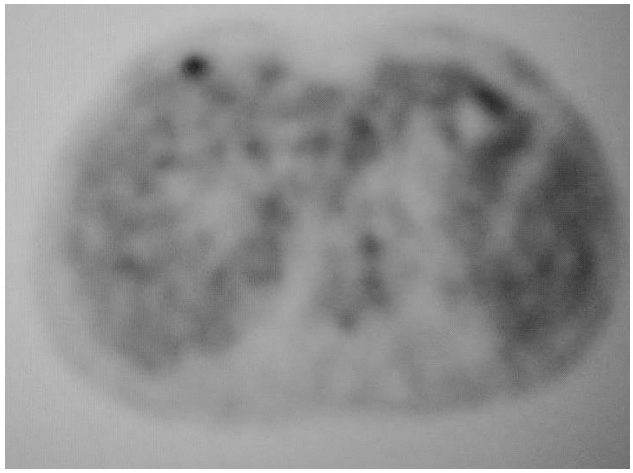

Figure 5: Liver metastatic deposit in segment VIII in the right lobe of liver on FDG-PET.

DISCUSSION

Advances in imaging technology are playing an increasing role in the diagnosis and management of patients with colorectal cancer. 18F FDG-PET imaging is being increasingly used in the evaluation of patients with many types of cancers, including colorectal cancer (14). FDG-PET imaging is a widely used for evaluating the patients with known or suspected colorectal cancer. Although the role of FDG-PET is limited in the diagnosis and initial staging of colorectal cancer but it is used as an initial test for staging of recurrence and for preoperative staging of known recurrence (6). A number of studies have compared the results of combined FDG PET-CT imaging and CT with PET alone in colorectal cancer.

Studies showed that combined PET-CT fusion imaging has improved anatomic localization and increased the certainty and detection of metastatic disease, which played a vital role to guide management decision making (15). The role of PET/CT in radiotherapy planning and response monitoring is under evaluation. Meinel FG et al in their report have recommended a targeted use of PET-CT in cases of unclear M staging, prior to metastasectomy and in suspected cases of residual or recurrent colorectal carcinoma with equivocal conventional imaging (16). Several studies reported that FDG PET is superior to CT in assessing disease with a sensitivity of 84–100% and a specificity of 80–100% in the detection of local recurrence and the accuracy ranges from 74% to 96% (17, 18, 19).

This is the first reported case on PET- CT imaging for EBRT planning in rectal cancer patient at NINMAS. Adenocarcinomas comprise the vast majority (98%) of colon and rectal cancers; more rare rectal cancers include lymphoma (1.3%), carcinoid (0.4%), and sarcoma (0.3%) (20). This case is a histologically proven moderately differentiated adenocarcinoma of rectum with local infiltration in perirectal fat plane and involvement of loco-regional as well as mesenteric lymph nodes at time of diagnosis. A multidisciplinary approach that includes medical oncology, colorectal surgery, and radiation oncology is required for optimal treatment of patients with rectal cancer. For proper staging proctoscopy, colonoscopy, cross-sectional imaging of the chest, abdomen and pelvis including endoscopic ultrasound (EUS) and magnetic resonance imaging (MRI) can assess depth of tumor penetration or invasion of local structures, lymph node status, and presence of metastasis (10-11). In addition to imaging, a preoperative carcinoembryonic antigen level combined with basic laboratory values play important roles in the preoperative workup (21). This patient had multimodality approach for diagnostic work up and staging of the disease with CT, MRI, colonoscopy, carcinoembryonic antigen level and other laboratory studies, which are mentioned earlier. The patient was at distant stage of the disease and was treated with chemotherapy followed by surgery. Per-operative findings revealed that the case was in inoperable stage of the disease and palliative loop ileostomy was done. After completing another six cycles of chemotherapy regime, PET-CT imaging was recommended for pre radiotherapy planning.

Radiation therapy or radiotherapy is a common way to treat rectal cancer. Radiation therapy involves the use of high-energy x-rays. Radiotherapy is used after surgery to destroy any cancer cells that may remain in the area of the operation. In advanced stages of rectal cancer when the lesion is inoperable, radiation therapy is often given before surgery or may used instead of surgery. It may also give in combination with chemotherapy which can improve the effectiveness of radiation. Radiation therapy for rectal cancer is typically given by a machine that aims x-rays at the body (external beam radiation). EBRT for rectal cancer is given as an outpatient basis, 5 days a week, for approximately 5 to 6 weeks. EBRT begins with a planning session by radiation oncologists, where marks are placed on the body and measurements are taken in order to line up the radiation beam in the correct position for each treatment. By using a special CT scan and targeting computer, the radiation beam can be delivered more precisely to cancer-containing areas. This is known as three-dimensional conformal radiation therapy, or 3D-CRT. The use of 3D-CRT usually reduces the chance of injury to nearby normal body structures, such as the bladder or rectum. Since 3D-CRT can better target the area of cancer, higher doses of radiation can be given safely with greater cancer cures (22, 23).

Rasmus K Petersen et al has reported the clinical impact of FDG PET-CT in colorectal cancer patients. They found, the use of FDG-PET-CT had changed the planned treatment strategy in 30% of the patients, who had equivocal findings in conventional imaging (13). In this case the staging of the disease was provided by PET-CT images and EBRT was planned and treated accordingly. After completion of the therapy we have the plan to follow up the case for response of the therapy.

CONCLUSION

FDG PET-CT is useful in detection of persistence of disease or recurrence, metastasis of rectal cancer and plays an important role in EBRT planning.

REFERENCES

1. Ruers T, Bleichrodt RP. Treatment of liver metastases, an update on the possibilities and results. Eur J Cancer. 2002; 38:1023–33.
2. Torre LA, Bray F, Siegel RL, et al. Global cancer statistics, 2012. CA Cancer J Clin 2015; 65:87.
3. Kohler BA, Sherman RL, Howlader N, et al. Annual Report to the Nation on the Status of Cancer, 1975-2011, Featuring Incidence of Breast Cancer Subtypes by Race/Ethnicity, Poverty, and State. J Natl Cancer Inst 2015; 107:djv048.
4. Siegel RL, Miller KD, Jemal A. Cancer statistics, 2015. CA Cancer J Clin 2015; 65:5.
5. Islam Md.Fokhrul, Hasan A.H.M Nazmul, Begum Anjuman Ara, Chowdhury Sanchita Sharmin, Wahed Tania Binte. Distribution of Cancer Patients and Patterns Of Cancer Treatment at Dhaka Medical College Hospital, Bangladesh. IRJP 2012, 3 (4) : 157-61. www.irjponline.com
6. Rafia Parveen, Shaikh Shofiur Rahman, Syeda Adib Sultana, Zakir Hossain Habib. Cancer Types and Treatment Modalities in Patients Attending at Delta Medical College Hospital. Delta Med Col J. Jul 2015; 3(2):57 – 62.
7. Orrom WJ, Hayashi AH, Kuechler D, Ross AC, Kuechler PM, Larsson S, Rusnak CH, Weinerman B. The surgical management of rectal cancer: a comparison of treatment methods and outcomes over 2 time periods in the same geographic region. Am J Surg. 2007;193:623– 26.
8. Hospital Cancer Registry Report 2008-2010 (printed) and 2011-2013, National Institute of Cancer Research and Hospital (NICRH) Dhaka Tribune, Published: 03:12 January 19, 2014.
9. Engstrom PF, Arnoletti JP, Benson AB 3rd, Chen YJ, Choti MA, Cooper HS, Covey A, Dilawari RA, Early DS, Enzinger PC, et al. NCCN Clinical Practice Guidelines in Oncology: rectal cancer. J Natl Compr Canc Netw. 2009;7:838–81.
10. Bipat S, Glas AS, Slors FJ, Zwinderman AH, Bossuyt PM, Stoker J. Rectal cancer: local staging and assessment of lymph node involvement with endoluminal US, CT, and MR imaging--a meta-analysis. Radiology. 2004; 232:773–83.
11. Bartram C, Brown G. Endorectal ultrasound and magnetic resonance imaging in rectal cancer staging. Gastroenterol Clin North Am. 2002;31:827–39.
12. Delbeke D1, Martin WH. FDG PET and PET/CT for colorectal cancer. 2011;727:77-103. doi: 10.1007/978-1-61779-062-1_6.
13. Rasmus K Petersen,Søren Hess, Abass Alavi, and Poul F Høilund-Carlsen. Clinical impact of FDG-PET/CT on colorectal cancer staging and treatment strategy. Am J Nucl Med Mol Imaging. 2014; 4(5): 471–82.
14. Vitola J, Debelke D. Positron emission tomography for evaluation of colorectal carcinoma. Semin Roentgenol. 2002;37:118-128.
15. Clinical diagnosis, colorectal cancer [session 12]. Proceedings of the Society of Nuclear Medicine, 50th Annual Meeting; June 21-25, 2003; New Orleans, Louisiana.
16. Meinel FG, Schramm N, Haug AR, Graser A, Reiser MF, Rist C. Importance of PET/CT for imaging of colorectal cancer. Radiologe. 2012 Jun;52(6):529-36. doi: 10.1007/s00117-011-2284-x.
17. Ogunbiyi OA, Flanagan FL, Dehdashti F, et al. Detection of recurrent and metastatic Surg Oncol. 1997;4:613–20.
18. Moore HG, Akhurst T, Larson SM, et al. A case-controlled study of 18-fluorodeoxyglucose positron emission tomography in the detection of pelvic recurrence in previously irradiated rectal cancer patients. J Am Coll Surg. 2003;197:22–8.
19. Gearhart SL, Frassica D, Rosen R, et al. Improved staging with pretreatment positron emission tomography/computed tomography in low rectal cancer. Ann Surg Oncol. 2006;13:397–404.
20. Rectal Cancer, Author: Burt Cagir, MD, FACS; Chief Editor: N Joseph Espat, MD, MS, FACS. emedicine.medscape.com/article/281237
21. Wasserberg N, Kaufman HS. Palliation of colorectal cancer. Surg Oncol. 2007;16: 299–310.
22. Radiation Therapy for Colorectal Cancer therapy. www.webmd.com/colorectal-cancer/radiation-x .
23. Radiation Therapy for Colon Cancer. http://cancerconnect.com©2005-2016 WebMD, LLC.