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CASE REPORT

Rafał Maksim[1], Ewa Sierko[1, 2], Dominika Hempel[1, 2], Justyna Burzyńska-Śliwowska[3], Kamila Kidrycka[3], Piotr Szumowski[4], Krystian Kidrycki[5], Marek Z. Wojtukiewicz[2], Tomasz Filipowski[1], Małgorzata Mojsak[4]

[1]Department of Radiotherapy, Comprehensive Cancer Centre, Bialystok, Poland
[2]Department of Oncology, Medical University of Bialystok, Poland
[3]Department of Radiology, Comprehensive Cancer Centre, Bialystok, Poland
[4]Department of Gastroenterology and Internal Medicine, Medical University of Bialystok, Poland
[5]Bialystok Science and Technology Park within the Laboratory of Molecular Imaging and Technology Development at the Medical University of Bialystok, Poland

The usefulness of an ^{18}F-FDG-PET/MR examination in a patient with rectal and breast cancer. A case report

Address for correspondence:
Dr hab. n. med. Ewa Sierko
Zakład Radioterapii
Białostockie Centrum Onkologii
ul. Ogrodowa 12, 15–027 Białystok
Phone: +48 602 337 020
e-mail: ewa.sierko@iq.pl

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ABSTRACT

Recently, we have gained access to innovative radiological and metabolic examination methods. One of these methods is PET/MRI with fluorodeoxyglucose (18F-FDG) tracer. Performing this innovative examination in a 69-year-old woman with diagnosed rectal cancer brought additional benefits. The use of PET/MRI resulted in precise clinical staging, the detection of a synchronous early-stage right breast cancer, and in the optimisation of treatment of both cancers. To date, diagnostic guidelines concerning rectal and breast cancers do not recommend the use of functional imaging for routine imaging.

Key words: PET/MR, rectal cancer, breast cancer

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Introduction

New imaging methods make diagnostics more precise and help us diagnose illnesses at an earlier stage, which in turn increases the chances of curing the patient. One of the innovative diagnostic tools is a hybrid technique — MRI combined with PET. One of the main advantages of this technology is its ability to morphologically image the whole body while also imaging its metabolism by means of PET with the fluorodeoxyglucose isotope ^{18}F. It is worth noting that the classic PET/CT method uses a diagnostically sub-optimal low-dose cone beam tomography, whereas in PET/MRI the magnetic resonance images are of high quality, with T1 sequences with and without contrast, T2, and diffusion weighted imaging.

Case report

A 69-year-old patient in good general condition WHO-0, was referred to the Oncology Centre of Bialystok due to rectal cancer. A tumour was found during ordinary colonoscopy. The histopathological material obtained during the examination showed an intestinal type of adenocarcinoma. The patient had smoked about 10 cigarettes per day for 20 years and suffered from hypertension. She had a family record of breast cancer with her sister. The patient reported no problems. In the clinical examination the rectal tumour was beyond reach during rectal exam. CT showed a rectal tumour located about 3 cm behind the anal sphincter, infiltrating the mesorectum and possibly metastatic regional lymph nodes. About 12 cm

from the sphincter colonoscopy visualised a stiff, exophytic infiltration, bleeding on contact, narrowing the lumen to an extent that prevented further insertion of the apparatus. The patient was then preliminarily qualified for neoadjuvant radiochemotherapy with delayed surgery time.

The patient also underwent a PET/MRI examination, using a 3T Biograph mMR Siemens® device with ^{18}F-FDG tracer. The examination showed irregular thickening of the rectal wall to 14 mm over 72 mm, starting at about 50 mm above anal sphincter, with increased FDG uptake at SUV_{max} = 15.9. The fat planes around the visualised tumour were effaced but no infiltration to surrounding organs was found. The local lymph nodes: pararectal, parasigmoid, and presacral did not exceed 7 mm in diameter in the MRI examination, and no increased FDG uptake was found in PET. Moreover, T2- and T1-weighted images showed a somewhat well-limited focal lesion sized 20 × 18 mm of spicular outline with slightly increased FDG uptake — SUV_{max} = 2.2 in the right breast, in the lower internal quadrant, and a swollen lymph node under the right arm, sized 11 × 7 mm with a slightly increased FDG uptake at SUV_{max} = 0.78. Clinical examination showed no breast tumour nor any swollen axillary lymph nodes. The patient, due to her earlier family history, avoided screening tests for breast cancer.

Following further assessment of the clinical stage of the disease (which included the results of PET/MRI examination) it was decided that a new form of therapy should be adopted. The patient underwent 3D radiotherapy of X15 MV for the rectal tumour, mesorectum, and regional lymph nodes up to a total dose of 25 Gy in five fractions, then she underwent a surgical frontal rectal resection. During her stay at the Oncological Surgery Department, the patient underwent a core needle biopsy of the suspicious right breast tumour, which was visualised in PET/MRI, in order to collect diagnostic material for histopathological examination.

The postoperative histopathological examination from the rectum showed an ulcerated tumour taking up nearly the entire perimeter of the intestinal wall over a 4-cm segment. The transverse cross-section showed a whitish infiltration, which macroscopically included the subcutaneous tissue surrounding the rectum. Morphologically, a G2 adenocarcinoma with a mucous component — ypT3 — was diagnosed. All (15) lymph nodes of the mesorectum were inflamed. In the material obtained during the core-needle biopsy of the right breast, invasive duct carcinoma with a malignancy level at G2 was characterised by oestrogen receptor expression in 97% of the cancer cells, progesterone receptor expression in less than 1% of the cells, lack of HER2 expression, and the presence of Ki-67 protein

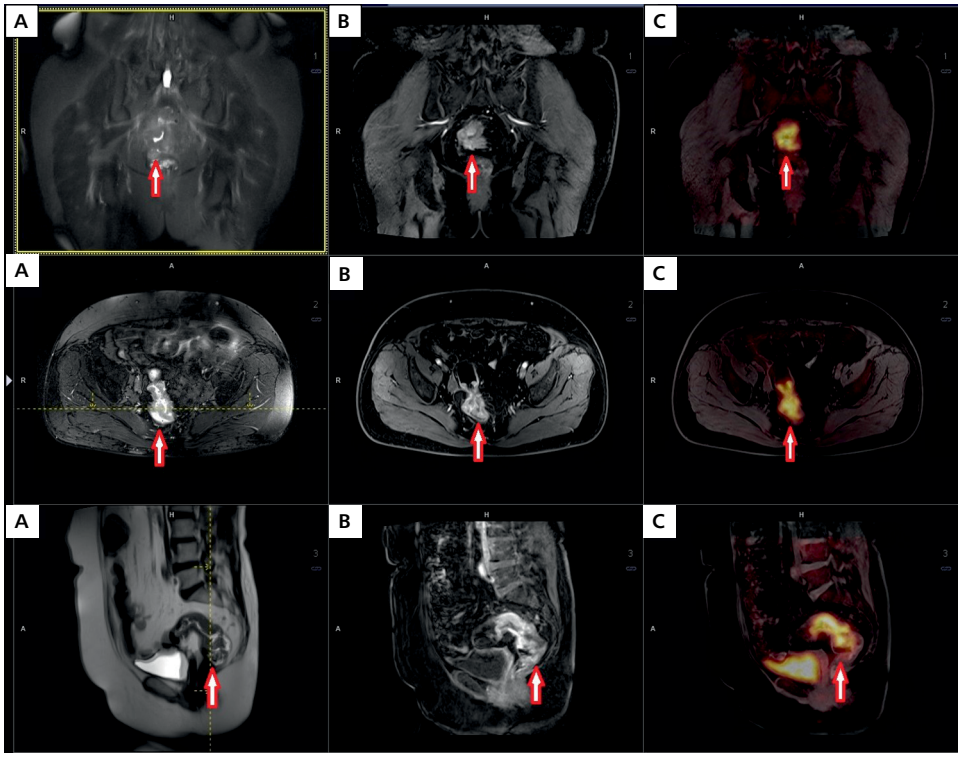

Figure 1. PET/MRI scan using a 3T Biograph mMR Siemens® with ^{18}F-FDG. The images show rectal carcinoma (arrow), respectively: **A.** MRI in T2-weighted sequence; **B.** MRI in T1-weighted sequence; and **C.** the fusion of MRI images in T1-weighted sequence and PET

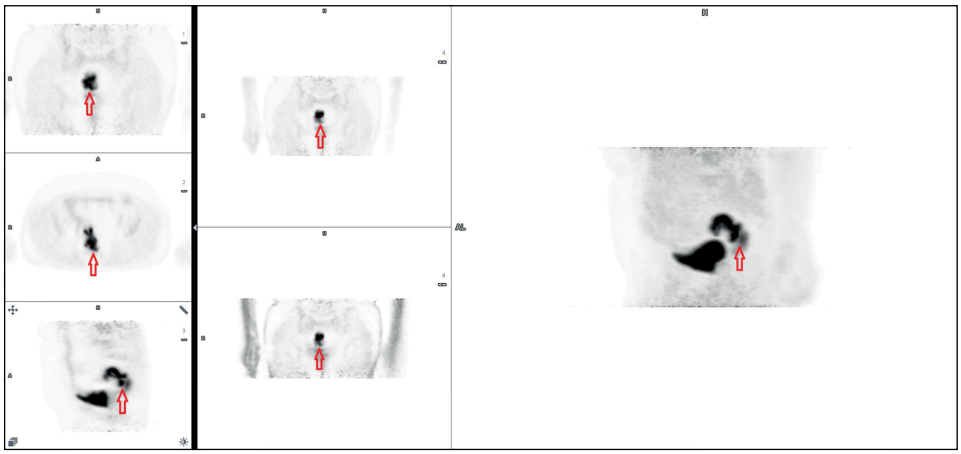

Figure 2. PET scan with tracer ^{18}F-FDG — metabolic imaging of the rectal carcinoma. The arrow points to the area of increased FDG uptake in the tumour, SUV — 15.9

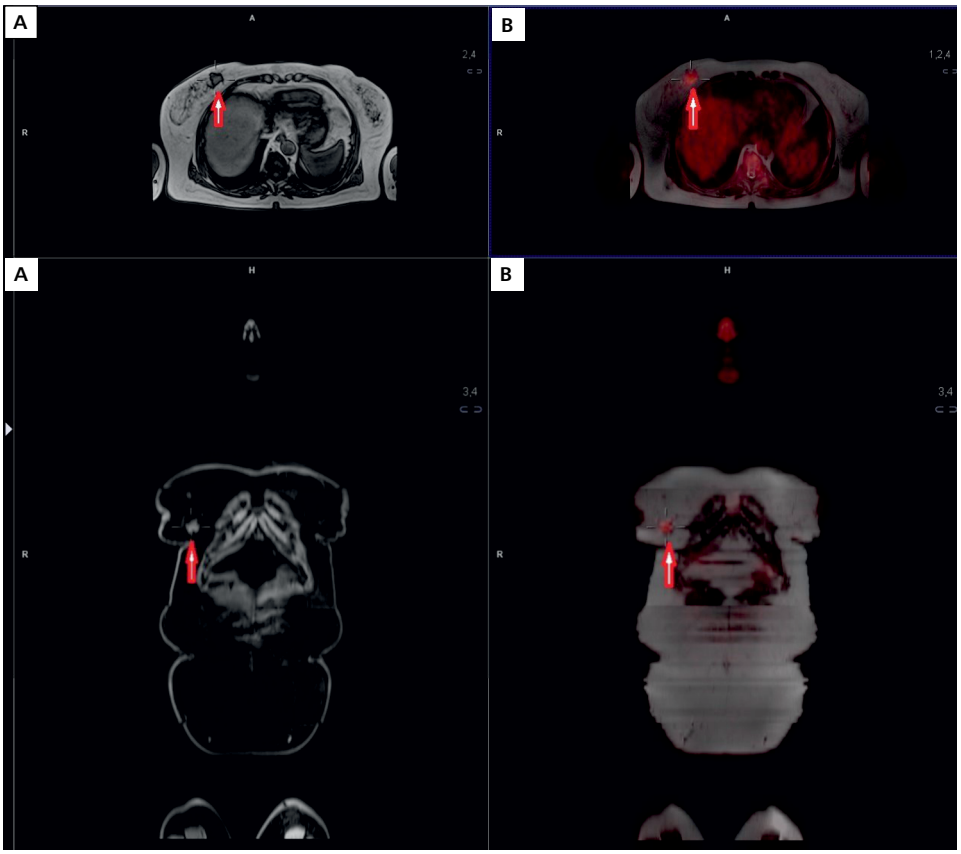

Figure 3. PET/MRI scan using a 3T Biograph mMR Siemens® with ^{18}F-FDG. The images show breast cancer (the arrow), respectively: **A.** MRI in T1-weighted sequence; **B.** the fusion of MRI images in T2-weighted sequence and PET

in 45% of the cells. In the material obtained during a USG-guided fine-needle biopsy of the right axillary lymph node visualised in PET/MRI, cells suspected of malignancy were found. The patient underwent a breast-conserving surgery and sentinel lymph node (SLN) procedure. Pathological postoperative breast material showed a white irregular tumour, with uneven boundaries, sized: 2.3 × 2 cm. Microscopically the image corresponded to invasive G2, pT2 carcinoma. In one of the seven sampled axillary lymph nodes a macrometastasis of the breast cancer was found. Next, the patient received adjuvant chemotherapy based on epirubicin and cyclophosphamide (four courses), then radical 3D radiotherapy X6/15 MV for the right breast and right

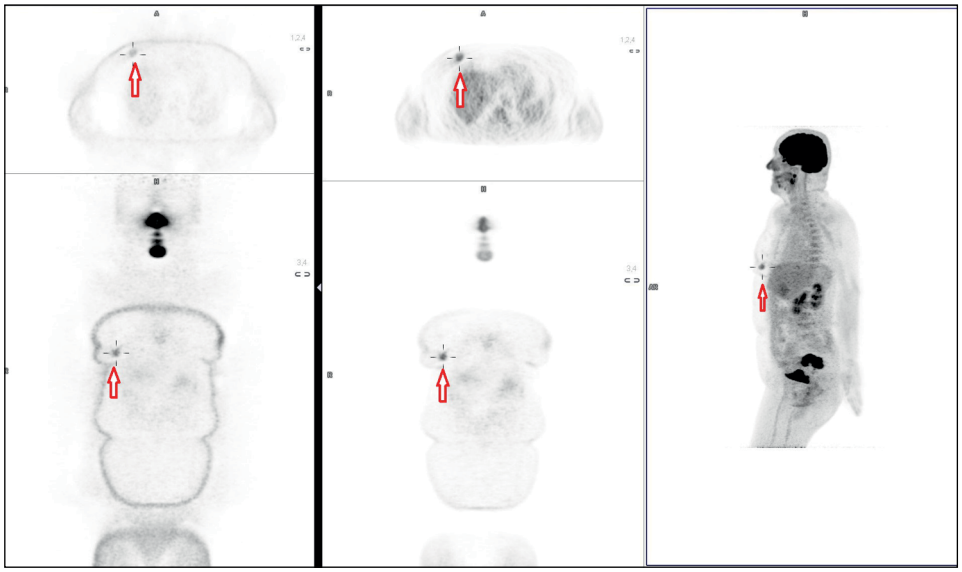

Figure 4. PET scan using a 3T Biograph mMR Siemens® with ^{18}F-FDG — metabolic imaging of the breast cancer. The arrow points to an area of increased FDG uptake in the tumour, SUV — 2.2

axillary lymph nodes up to the total dose of 45 Gy administered in 20 fractions. The dose was increased to the postoperative site after the excised breast tumour at 16 Gy in eight fractions. Radiotherapy was completed in March 2018. The patient is now undergoing hormonal therapy with letrozole.

Discussion

MRI examination has been used for many years now in preoperative evaluation of rectal carcinoma progression [1]. MRI makes it possible to better assess the risk of infiltration of the circular surgical margin, to better match and optimise therapies, and to single out the group of patients who do not need preoperative treatment [2]. The guidelines of the Polish Society of Clinical Oncology regarding evaluation of the local stage of rectal carcinoma suggest MRI examination of the lesser pelvis and transrectal USG [2]. Additionally, it is recommended that the thoracic cavity, abdominal cavity, and the pelvis [2] be CT scanned. In patients with rectal cancer, PET scan is not recommended routinely in the diagnostic process but only when a local relapse is suspected [2]. In the National Comprehensive Cancer network (NCCN) guidelines, a pelvic MRI with contrast is mandatory unless there are contraindications for the examination, e.g. an implanted heart pacer. PET/CT is recommended only in patients with confirmed disease spread with potentially resectable metastases [3]. Scientific publications do not report any significant information on the use of PET in the primary evaluation of rectal cancer; however, there is a lot of research confirming the effectiveness of PET at verifying the presence of metas-

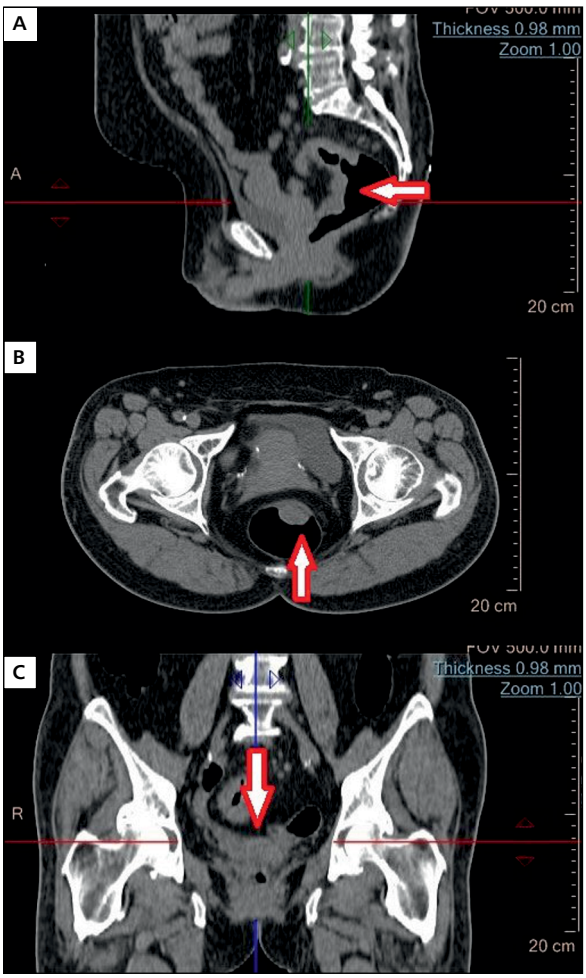

Figure 5. CT localising examination, no contrast. The images show rectal carcinoma (the arrow) in: **A.** the sagittal plane; **B.** the transverse plane; and C. the frontal plane

tases in regional lymph nodes (sensitivity and specificity are, respectively, 56.8% and 90.3%) [4], or at confirming the spread of cancer (sensitivity and specificity respectively — 91% and 76%) [5]. Similarly, PET examination is not a standard tool in breast cancer diagnostics; however, research suggests that it is very sensitive and specific in diagnosing this type of cancer — respectively, 97% and 80% [6], for lymph nodes — 46.3% and 91.1% and distant metastases of this cancer — 86–100% and 90–98% [7]. MRI with contrast is used in breast diagnostic procedures more often. In a large group of women (n = 2995) with intermediate and high risk of breast cancer, using this method resulted in finding just 27 new cases of cancer. However, it was characterised by a better sensitivity than ultrasonography (USG) or mammography (their sensitivity was, respectively: 86%, 58%, and 57%) [8]. In the presented case, the results of colonoscopy, CT, and PET/MRI were different with respect to the distance of the rectal tumour from the anal sphincter. The distance was respectively 12 cm, 3 cm, and 5 cm. The literature reports differences of this sort between MRI and colonoscopy [9]. They can amount to –3 to +8 cm [9]. It is likely to be caused by the lack of agreement between endoscopists regarding the proper technique of measuring the distance between the rectal tumour and the sphincter [9]. Jacobs at al. emphasise that in order to assess the distance between the rectal tumour and the sphincter an MRI examination should be performed [9]. Proper evaluation of the stage of the disease and the location of the rectal tumour in respect to the anal sphincter is crucial for the possibility of surgical intervention that could spare that sphincter, thus preserving of the continuity of digestive tract and consequently the quality of life of the patient after the treatment is finished [10]. Owing to precise, effective MRI imaging in PET/MRI in the reported case, it was possible to pinpoint with better precision the depth of the intestinal wall infiltration by the rectal carcinoma. The PET examination itself helped the patient to evaluate the surrounding lymph nodes, which initially looked suspicious in CT images. Re-evaluation of the stage of the disease using PET/MRI changed the therapeutic regiment from the so-called "long" chemotherapy to a short, five-day radiotherapy only. The results obtained in PET/MRI were confirmed in pathological examination in the case of the stage of both the rectal cancer (pT3N0) and the breast cancer (pT2N1). Performing a PET/MRI scan of the reported patient's body made it possible to detect breast cancer and to effectively treat both cancers. There are reports that in women with a family history of breast cancer with *BRCA* mutation and without it, using MRI leads to earlier detection of intraductal and invasive family or heritable breast cancer [11]. PET examination in women from a high-risk group of developing breast cancer offers better prospects of evaluating the stage of the disease for as many as 34.8% of patients and, consequently, it can help change therapeutic decisions in 74.1% of cases [12].

Conclusions

Simultaneous application of PET/MRI methods facilitates decreasing the time of diagnostics and helps optimise the treatment plan. More research is necessary to identify the group of patients who will gain clear therapeutic benefits from MRI imaging combined with PET.

References

1. Battersby N, How P, Moran B, et al. Prospective validation of a low rectal cancer magnetic resonance imaging staging system and development of a local recurrence risk stratification model. Annals of Surgery. 2016; 263(4): 751–760, doi: 10.1097/sla.0000000000001193.
2. Bujko K, Herman R, Pałucki J et al. Rak odbytnicy, aktualizacja na dzień 02.12.2015. In: Zalecenia postępowania diagnostyczno-terapeutycznego w nowotworach złośliwych. Tom I. Krzakowski M, Warzocha K et al. (ed.). Via Medica, Gdańsk 2013; 199.
3. NCCN Clinical Practice Guidelines in Oncology, Rectal Cancer, Version 3.2018.
4. Sasaki K, Kawasaki H, Sato M, et al. Impact of Fluorine-18 2-Fluoro-2-Deoxy-D-Glucose Uptake on Preoperative Positron Emission Tomography/Computed Tomography in the Lymph Nodes of Patients with Primary Colorectal Cancer. Dig Surg. 2017; 34(1): 60–67, doi: 10.1159/000448222, indexed in Pubmed: 27454870.
5. Brush J, Boyd K, Chappell F, et al. The value of FDG positron emission tomography/computerised tomography (PET/CT) in pre-operative staging of colorectal cancer: a systematic review and economic evaluation. Health Technol Assess. 2011; 15(35): 1–192, iii, doi: 10.3310/hta15350, indexed in Pubmed: 21958472.
6. Magometschnigg HF, Baltzer PA, Fueger B, et al. Diagnostic accuracy of (18)F-FDG PET/CT compared with that of contrast-enhanced MRI of the breast at 3 T. Eur J Nucl Med Mol Imaging. 2015; 42(11): 1656–1665, doi: 10.1007/s00259-015-3099-1, indexed in Pubmed: 26121928.
7. Vercher-Conejero JL, Pelegrí-Martinez L, Lopez-Aznar D, et al. Positron emission tomography in breast cancer. Diagnostics (Basel). 2015; 5(1): 61–83, doi: 10.3390/diagnostics5010061, indexed in Pubmed: 26854143.
8. Huzarski T, Górecka-Szyld B, Huzarska J, et al. Polish Hereditary Breast Cancer Study Group. Screening with magnetic resonance imaging, mammography and ultrasound in women at average and intermediate risk of breast cancer. Hered Cancer Clin Pract. 2017; 15: 4, doi: 10.1186/s13053-017-0064-y, indexed in Pubmed: 28265306.
9. Jacobs L, Meek DB, van Heukelom J, et al. Comparison of MRI and colonoscopy in determining tumor height in rectal cancer. United European Gastroenterol J. 2018; 6(1): 131–137, doi: 10.1177/2050640617707090, indexed in Pubmed: 29435323.
10. Dimitriou N, Michail O, Moris D, et al. Low rectal cancer: Sphincter preserving techniques-selection of patients, techniques and outcomes. World J Gastrointest Oncol. 2015; 7(7): 55–70, doi: 10.4251/wjgo.v7.i7.55, indexed in Pubmed: 26191350.
11. Kuhl CK, Schrading S, Leutner CC, et al. Mammography, breast ultrasound, and magnetic resonance imaging for surveillance of women at high familial risk for breast cancer. J Clin Oncol. 2005; 23(33): 8469–8476, doi: 10.1200/JCO.2004.00.4960, indexed in Pubmed: 16293877.
12. Kowalski ES, Cohen JD, Snider JW, et al. Positron emission tomography/computed tomography (PET/CT) in the initial evaluation of women with nonmetastatic breast cancer can frequently alter management. Int J Radiat Oncol Biol Phys. 2017; 99(2): E25–E26, doi: 10.1016/j.ijrobp.2017.06.652.