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2nd Department of Radiology, Medical University of Lublin

MAREK PASŁAWSKI, JANUSZ ZŁOMANIEC

Rectal carcinoma in spiral computed tomography: MPR, VRT and virtual rectoscopy

Carcinoma of the colon and rectum is one of the most common malignant neoplasms. The diagnosis of colorectal tumor is based on the clinical history and the results of physical examination, barium enema and endoscopy; however, none of these methods permits the correct staging of the tumor before surgery (6). Colonic carcinoma is an important medical problem in developed countries. There are a lot of risk factors for the development of colonic carcinoma. The factors that can be encountered are genetic factors, or chronic inflammatory processes as ulcerative colitis and adenomatous polyps. Adenomas always represent the primary stage in the development of colorectal carcinoma. Detection and appropriate therapy of polyps are the crucial importance in the prevention of colorectal cancer (1). Colorectal carcinoma is often diagnosed after the occurrence of rectal bleeding of during the workup of patients with anemia, who are suspected of having gastrointestinal disease. A variety of factors affect the prognosis of patients with colorectal carcinoma; these include the depth of tumor penetration into the bowel wall, the presence of regional or distant lymph node metastases, and the occurrence of distant metastases. There is 70% 5-year survival rate if the tumor is limited to the bowel wall (6).

Digital examination by en experienced surgeon has been a most reliable method for preoperative evaluation of advanced rectal carcinoma. However, the introduction of imaging modalities such as endoluminal ultrasonography, computed tomography scan, and magnetic resonance imaging has made it more objective and accurate than digital examination (4).

The aim of the study is to present the possibilities of modern CT imaging in evaluation of rectal carcinoma.

MATERIAL AND METHODS

The material comprises a group of 14 patients with rectal carcinoma. In all patients the CT examination was performed, in prone position, after insufflating of air through rectal catheter, and in supine position after small barium enema, both before and after administering the contrast agent IV. Examination was performed in spiral technique, scan collimation was 5mm, and pitch 1,5. After scanning, axial sections and the MPR reconstructions of the rectum were assessed. Then VRT and Virtual colonoscopy images were performed and evaluated.

RESULTS

In 9 patients there was annular rectal cancer, seen as annular wall thickness on axial images obtained after insufflations of air through rectal catheter (Fig. 1A) as well as on axial images obtained after small barium enema (Fig. 1B). Polypoid carcinomas were found in 5 patients, and were clearly

seen on axial images (Fig. 2AB). Annular cancer narrowing the rectal lumen were clearly seen on MPR reconstructions, on which the filling defect was seen (Fig. 3). On VRT images reconstructed out of images set obtained after barium enema, filling defect was clearly seen, on images before (Fig. 4A) and after editing of the bone structures (Fig. 4B). Virtual endoscopy images showed either annular tumor narrowing rectal lumen (Fig. 5A) or polypoid, parietal structures (Fig. 5B).

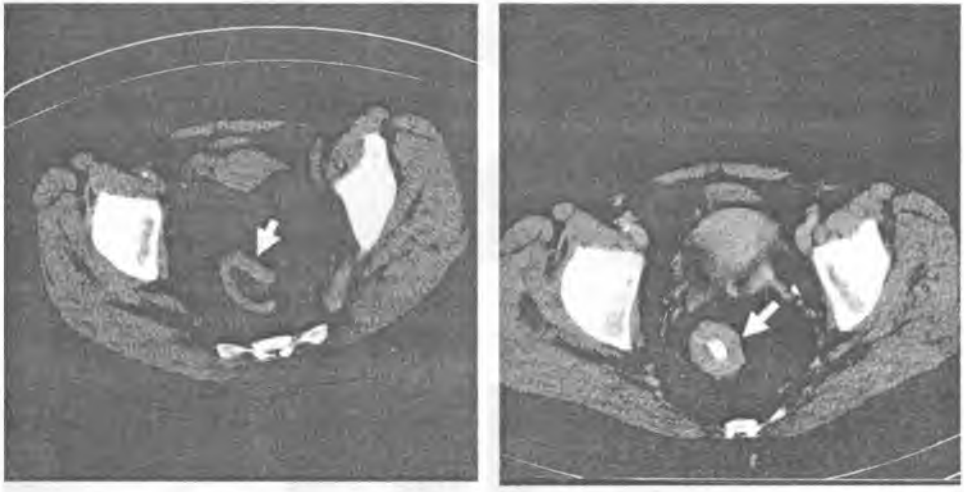

Fig. 1. Annular rectal carcinoma (arrows). axial images obtained after insufflations of air through rectal catheter – A; on axial images obtained after small barium enema – B

Fig. 2. Polypoid rectal carcinoma (arrows). axial images obtained after insufflations of air through rectal catheter – A; on axial images obtained after small barium enema – B

Fig. 3. MPR reconstruction of annular rectal carcinoma. Wall thickening causing filling defect easily seen – arrowheads

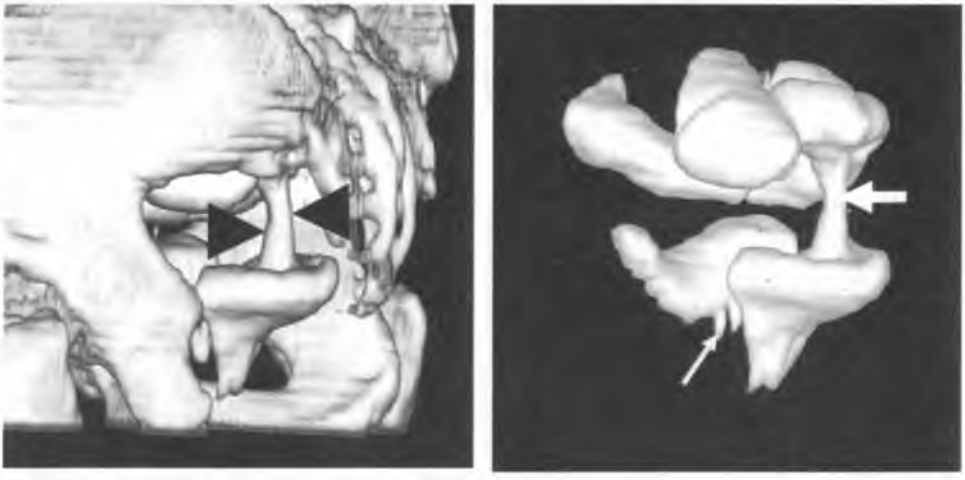

Fig. 4. VRT images of annular rectal carcinoma before (A) and after editing unnecessary bone structures (B). Filling defect – black arrowheads (A) and large arrows (B). Small diverticulum – small arrow (B)

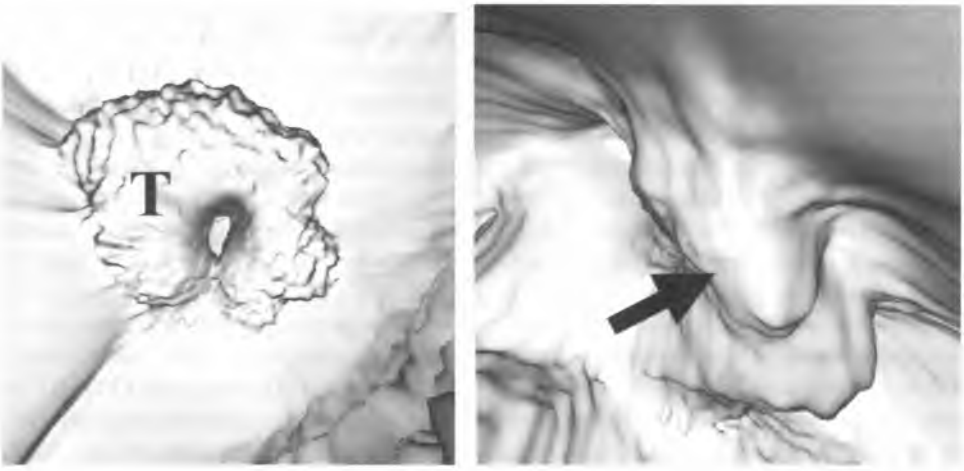

Fig. 5. Virtual rectoscopy. A – annular rectal carcinoma narrowing the lumen (T – tumor). B – polypoid carcinoma – arrow

DISCUSSION

The responsibility of a radiologist in colon tumor has three aspects: screening and diagnosis; staging and follow-up. The radiological diagnosis of the tumor can be performed by means of barium studies, while preoperative staging and follow-up is done by transrectal ultrasonography, computed tomography and magnetic resonance (1). Screening for colonic cancer improved the detection of colon tumors at early stage. The diagnostic modalities used in detection of intraluminal tumors are ednoscopy and biphasic examination of barium enema. It is evident that flexible sigmoidoscopy reduces colorectal carcinomas by detecting early cancers or adenomas. However, as approximately 40–50% colonic tumors are located at the right and transverse colon segment. Flexible sigmoidoscopy can not visualize tumors located at this segment of the colon. Although colonoscopy incompletely examines the colon in about 10–15% of patients, double contrast barium enema help visualize the entire colon in almost all patients (1). Morphological appearance of colonic cancer is annular, semiannular, polypoid, flat plaque, ulcerated and caper lesions. Annular cancers are the most common form of advanced colonic cancer (1).

Preoperative staging of rectal carcinoma is of importance in the decision-making of surgical procedures. When the depth of invasion is behind the bowel wall, and invasion to the adjacent organs such as the prostate, urinary bladder, uterus or sacrum is suspected, the extended surgery is the treatment of choice (5, 6). Although endoscopy and double contrast barium enema demonstrate the intraluminal component of the lesion, the extent of the tumor in the bowel wall layers and the extraluminal component of the tumor can be evaluated with endoscopic US, CT and MRI (1).

CT has an important role in staging of colorectal carcinoma. Computed tomography does not compete with endoscopy or double contrast barium studies in the detection of colon cancer, but it is an established method in staging the involvement of the liver and periluminal tumor extension (1, 4). Principles of CT examination include intestinal cleansing, opacification and distension with diluted contrast material or water; imaging during the arterial phase of IV injection of contrast material; and thin section scans over the pathologic area. Three dimensional spiral CT combined with virtual endoscopy appears to be the potential alternative screening technique to colonoscopy for detection of polypoid colonic lesions (1). Although CT cannot demonstrate invasion of individual bowel wall layers as wee as endoscopic ultrasound,

it is superior in the assessment of local or regional extension, liver and retroperitoneal lymph nodes, peritoneal cavity and retroperitoneal metastasis. CT findings of colonic cancers can by defined as circumferential or eccentric wall thickening, pericolonic fat tissue infiltration, and enlarged lymph nodes. Pericolonic adipose tissue infiltration is seen as serosal irregularity (1, 4).

Colorectal carcinomas are usually seen as focal irregular wall thickening in CT. In small tumors without wall thickness arterial contrast enhancement may be the only indicator of tumor growth, whereas the difference in the wall thickness is a more relevant criteria in evaluation of more advanced tumor stages. Three dimensional imaging by means of spiral CT allowed a new modality called CT virtual colonoscopy (1).

Multidetector-row computed tomography is more accurate than conventional computed tomography for evaluating the depth of tumor invasion or rectal carcinomas. However, both modalities show similar, modest diagnostic accuracy in the evaluation of lymph node metastasis (5). Whole body FDG-PET is an excellent scanning method for the evaluation of recurrence of disease in patients with colorectal carcinoma, showing a significantly higher accuracy when compared to conventional CT (3). VRT reconstructions provide images similar to those obtained from barium enema, but more precisely depicting mutual relation of anatomical structures. Rotation on any desired angle, editing of obscuring or unnecessary structures, as bone, or some intestinal loops helps in assessment of the pathology.

Computed tomographic (CT) three dimensional colonography or virtual colonoscopy (VC) was introduced in 1994 as a non-invasive rapid imaging method of the colon and rectum. On the basis of initial studies, VC appears to be an excellent diagnostic procedure compared with conventional colonoscopy for detection of polyps and carcinomas. Optimal bowel preparation; observing the two dimensional image set first before switching to the more time consuming study of three dimensional images; and scanning in both prone and supine positions to mobilize fluid deposits. It is done after colonic cleansing. The air is insufflated through a rectal catheter. Volume rendering or perspective volume rendering may be better than surface rendering programs but these require a more complex computer workstation. Although not a replacement for conventional colonoscopy, virtual colonoscopy is becoming a proved and accepted non-invasive diagnostic tool. The advantage of colonoscopy is that it allows simultaneous biopsy and polypectomy (1, 2, 7).

CONCLUSIONS

CT is a valuable method of examination and staging rectal carcinoma. Spiral CT with its spatial possibilities makes it even more useful. VRT images after small barium enema enable visualization of filling defect just like during double-contrast barium examination – providing images that radiologists and clinicians are familiar with. Virtual rectoscopy provides images similar to those from real endoscopy, while the imaging of the areas after the stenoses, which often can not be assessed by real endoscopy, is still possible.

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SUMMARY

The aim of the study is to present the possibilities of modern CT imaging in evaluation of rectal carcinoma. The material comprises a group of 14 patients with rectal carcinoma. In all patients the CT examination was performed, in prone position, after insufflating of air through rectal catheter, and in supine position after small barium enema, both before and after administering the contrast agent IV. Examination was performed in spiral technique, scan collimation was 5mm, and pitch 1,5. After scanning, axial sections and the MPR reconstructions of the rectum were assessed. Then VRT and Virtual colonoscopy images were performed and evaluated. In 9 patients there was annular rectal cancer, seen as annular wall thickness on axial images obtained after insufflations of air through rectal catheter as well as on axial images obtained after small barium enema. Polypoid carcinomas were found in 5 patients, and were clearly seen on axial images. Annular cancers narrowing the rectal lumen were clearly seen on MPR reconstructions, on which the filling defect was seen. On VRT images reconstructed out of images set obtained after barium enema, filling defect was clearly seen, on images before and after editing of the bone structures. Virtual endoscopy images showed either annular tumor narrowing rectal lumen or polypoid, parietal structures. CT is a valuable method of examination and staging rectal carcinoma. Spiral CT with its spatial possibilities makes it even more useful. VRT images after small barium enema enable visualization of filling defect just like during double-contrast barium examination – providing images that radiologists and clinicians are familiar with. Virtual rectoscopy provides images similar to those from real endoscopy, while the imaging of the areas after the stenoses, which often can not be assessed by real endoscopy, is still possible.

Rak odbytnicy w spiralnej tomografii komputerowej: MPR, VRT i wirtualna rektoskopia

Celem pracy jest przedstawienie możliwości nowoczesnych technik obrazowania TK w ocenie raka odbytnicy. Materiał stanowiła grupa 14 pacjentów. U wszystkich wykonano badanie TK w ułożeniu na brzuchu, po insuflacji doodbytniczej powietrza, oraz w ułożeniu na plecach po wykonaniu małej wlewki doodbytniczej przed i po podaniu iv. bolusa środka kontrastowego. Badanie było wykonane w technice spiralnej, kolimacja skanu 5mm, pitch 1,5. Po akwizycji oceniano przekroje osiowe oraz rekonstrukcje MPR. Następnie wykonywano i oceniano rekonstrukcje VRT oraz obrazy wirtualnej rektoskopii. U dziewięciu pacjentów stwierdzono okrężny naciek, widoczny jako pogrubienie ściany zarówno na przekrojach osiowych po insuflacji powietrza, jak też na przekrojach po wykonaniu wlewki doodbytniczej. Polipowatą postać raka stwierdzono u pięciu pacjentów. Okrężny naciek przewężał światło odbytnicy, co było widoczne na przekrojach osiowych jak też na rekonstrukcjach MPR, gdzie stwierdzono ubytek wypełnienia. Na obrazach VRT wyraźnie widoczny był ubytek wypełnienia

kontrastem barytowym, zarówno na obrazach przed, jak i po edycji struktur kostnych. Obrazy wirtualnej endoskopii uwidoczniały okrężny naciek przewężający światło odbytnicy albo polipowate uwypuklenia błony śluzowej. Badanie TK jest wartościową i uznaną metodą wykrywania i oceny stopnia zaawansowania raka odbytu. Spiralna tomografia komputerowa z rekonstrukcjami przestrzennymi jest jeszcze bardziej użyteczna. Obrazy VRT umożliwiają uwidocznienie ubytku zacienienia, dając obrazy, do których radiolodzy i klinicyści są przyzwyczajeni. Wirtualna rektoskopia dostarcza obrazów podobnych do uzyskiwanych w bezpośredniej endoskopii, przy czym umożliwia uwidocznienie odcinka odbytnicy poza miejscem przewężenia, niedostępnego w czasie konwencjonalnej endoskopii.