European Review for Medical and Pharmacological Sciences 2017; 21: 1219-1225

Correlation analysis of MR/CT on colorectal cancer lymph node metastasis characteristics and prognosis

L. ZHOU, J.-Z. WANG, J.-T. WANG, Y.-J. WU, H. CHEN, W.-B. WANG, F. CAO, G.-X. CHENG

Department of Radiology, Affiliated Hospital of Hubei University of Arts and Science (Xiangyang central Hospital), Xiangyang, Hubei Province, China

Ling Zhou and *Jingzhong Wang* are equal contributors

Abstract. – OBJECTIVE: Colorectal cancer incidence showed increasing trend with living standard improvement and lifestyle changes. This study investigated the relationship and diagnostic value of colorectal cancer lymph node metastasis and prognosis using magnetic resonance (MR) and computed tomography (CT).

PATIENTS AND METHODS: Siemens Avanto 3.0T MR and GE Light Speed Pro 64 row helical CT were used to scan 318 cases of colorectal cancer patients diagnosed by pathology. The relationship between colorectal cancer lymph node metastasis and prognosis after surgery was analyzed.

RESULTS: The accuracy of MR and CT in judging colorectal cancer lymph node metastasis ratio (LNR) was 92.5% and 75.5%, respectively. MR showed significantly higher accuracy than CT ($p < 0.05$). The coincidence rate of LNR result derived from MR and CT with colorectal cancer histopathological results was 57.6% and 54.7%, respectively. MR and CT sensitivity were 42.6% and 25.0%, while their specificity was 74.1% and 41.3%, respectively. The positive predictive value and negative predictive value of MR and CT were 61.1% and 51.4%, 57.1% and 66.7%, respectively. χ^2-test showed that MR diagnosis result was consistent with histopathological result ($p < 0.05$). The coincidence rate of MR and CT evaluation on 5-year disease-free survival and overall survival were 56.7% and 43.8%, respectively.

CONCLUSIONS: MR showed a better effect on prognosis than CT and could be treated as the first choice to predict LNR and prognosis. MR demonstrated a good correlation with pathological results and could be used to predict LNR and prognosis.

Key Words:

Colorectal cancer, Magnetic resonance, Computed tomography, Lymph node metastasis, Prognosis.

Introduction

Colorectal cancer is one of the most common digestive system malignant tumors worldwide[1]. Its incidence in our country ranks the fourth among all tumors. Surgery is one of the important methods for colorectal cancer treatment[2]. Accurate preoperative pathological staging is important for choosing the best treatment strategy. Lymph node metastasis is a critical index for colorectal cancer pathological staging, treatment choice, and prognosis evaluation[3,4]. Recent researches[5-7] showed that the 5-year survival rate of colorectal cancer patients with lymph node metastasis was 50%-68%, while in the patients with the same condition without lymph node metastasis reached up to 95%. In clinic, metastatic lymph node number has become an important basis for colorectal cancer pathologic staging. Lymph nodes metastatic ratio (LNR) is the ratio of lymph node metastatic number confirmed by pathology after surgery and lymph node metastatic number excised. Scholars[8-10] have considered LNR as important evidence for predicting colorectal cancer and gastric cancer patients' prognosis. In our country, however, only a few doctors treated LNR as indicator for the prognosis of colorectal cancer patients[11]. Therefore, this work will investigate the relationship and value of LNR on colorectal cancer postoperative prognosis. Magnetic resonance (MR) and computed tomography (CT) imaging are two most common clinical examination methods[12]. This study applied MR and CT scan to explore the correlation of LNR and colorectal cancer postoperative prognosis. We compared and analyzed the diagnostic value of

Corresponding Author: Yongjuan Wu, MD; e-mail: guanxuncheng123@163.com

MR and CT in colorectal cancer by studying 318 cases of patients diagnosed by pathology and laboratory examination.

Patients and Methods

Patients' Selection

318 cases of colorectal cancer patients receiving radical surgery and treatment after MR and CT examination between January 2014 and July 2015 were enrolled in affiliated Hospital of Hubei University of Arts and Science. According to the literature[13,14], inclusion criteria were as follows: (1) colorectal cancer patients with defecate habit change, hematochezia, abdomen mass, and acute intestinal obstruction; (2) patients receiving surgical resection without chemotherapy, radiotherapy or other auxiliary treatment before MR and CT examination; (3) tolerate MR and CT examination; (4) no operative taboo; (5) informed consent. There were 114 females and 204 males with average age at 55.6 ± 14.1 (21-69) years old. All patients had complete clinical information and follow-up data. The mean duration of follow-up was 60 ± 1 month, and the follow-up rate was 94.99%. Follow-up data criteria: survival end point died of cancer, and disease-free survival end point was tumor metastasis or recurrence.

Bowel Preparation

Colorectal cancer patients in this study received intestinal cleaning. Low residue diet began at 3 days before MR or CT scan, and laxative was used at one day before MR or CT scan to prevent the impact of food in the lumen. 2 ml glucagon was intramuscular injected and 1600 ml air was anal injected before MR or CT scan[15].

MR Scan

Siemens Avanto 3.0 T superconducting magnetic resonance instrument was used for MR scanning[16,17]. All patients in this study were parallel scanned and enhanced scanned using phased array coils. Normal fast spin echo condition was as follows: echo time was 80 ms, and echo repeat time was 3600 ms. Scanning field visual field was 46 cm, matrix was 368 × 128, layer spacing/thickness = 1 mm/6 mm. Echo train length was 15 cm. Respiratory triggering technique was applied. Fat suppression (S TIR): TR 3 000 ms, TE 100 ms, and echo train length were 24. MR scanning range was based on scanning position, vital signs and auxiliary examination results, starting from the edge of diaphragm to the end of the edge of the pubic bone. Sagittal, transverse and coronal scan were used. During MR enhancement scan, 0.15 mmol/kg gadolinium-diethylenetetramine pentaacetic acid was intravenous injected. Arterial period scanning time delay was 60 s, while intravenous period scanning time delay was 120 s.

CT Scan

GE Light Speed Pro 64 row helical CT was used for phased array coils parallel scan and enhanced scan[18,19]. Helical CT parameters were as follows: rotation time was 0.8 s, scanning voltage was 160 kV, scanning current was 200 mA, layer thickness was 1.75 mm, thread pitch was 1.8 mm, reconstruction interval was 1.5 mm. Patients kept supine during CT scan. Patient's position was first scanned to analyze colon aeration status. Continuous helical CT scan was adopted after one-time hold breath. CT scan was from diaphragmatic dome to pelvic floor. During CT enhanced scan, 500 mg/ml nonionic contrast agent iohexol was median cubital vein injected at 5 ml/s. Media sea alcohol as enhancement scanning s, from central elbow is using high-pressure injector for intravenous injection, the rate of 5 ml/s. Arterial period scanning time delay was 60 s, while intravenous period scanning time delay was 120 s.

MR and CT Image Analysis

MR and CT image results were analyzed by three radiology technicians through double-blind method[20]. MR and CT tumor infiltration depth criteria was as follows: T1 or T2, fat gap out of the intestinal wall of the lesion site was clear, intestinal wall surface was smooth without nodule under enhanced scan; T3, fat gap out of the intestinal wall of the lesion site has spot image with strip-shaped low signal (MR) or high density (CT) image, intestinal wall surface was rough with enlarged node; T4, fat gap disappeared out of the intestinal wall of the lesion site, image boundaries were unclear under enhanced scan. Lymph node metastasis criteria were as follows: lymph node diameter was greater than 3 mm, lymph nodes abnormal signal, abnormal CT enhanced scan images or irregular edge was considered as lymph node metastasis, lymph node number greater than 3[21].

Statistical Analysis

Fourfold table was applied to collect MR and CT diagnosis accuracy, positive predictive value, negative predictive value, sensitivity, and speci-

Table I. Colorectal cancer pathological lymph node metastasis.

Stage	T1 and T2	T3	T4	N0	N1	N2	Total
Cases	42	51	66	81	45	33	318
Percentage	13.2%	16.0%	20.8%	25.5%	14.2%	10.4%	100%

ficity[22]. All data were analyzed by SPSS 16.0 software (SPSS Inc., Chicago, IL, USA). X^2-test was adopted for MR and CT preoperative staging, postoperative pathology, and prognosis. $p < 0.05$ was considered as statistical significance.

Results

The Pathology Staging Results of Colon Cancer Patient's Lymph Node Metastasis

A total of 318 cases of colorectal cancer patients diagnosed by surgical pathology, including 6 cases of carcinoma, 18 cases of mucous carcinoma, and 294 cases of adenocarcinoma. The staging results were as follows: 42 patients in stage T1 and T2 (13.2%), 51 patients in stage T3 (16.0%), and 66 patients in stage T4 (20.8%); 81 cases with N0 (25.5%), 45 cases with N1 (14.2%), and 33 cases with N2 (10.4%) (Table I). The mean duration of follow-up was 60 ± 1 month, and the follow-up rate was 94.99%. A total of 1284 lymph nodes were detected after radical resection, and 4.04 lymph nodes in each patient. There were a total of 444 metastatic lymph nodes, and 1.40 metastatic lymph nodes in each patient. The pathological results revealed that both LNR and metastatic lymph node number were correlated with colorectal cancer patient's prognosis. The 5-year overall survival rate was 57.77%.

MR and CT Lymph Node Metastasis Judgment

We analyzed the result of MR (Figure 1) and CT (Figure 2) evaluation on lymph node metastasis. The accuracy of MR and CT in judging colorectal cancer LNR was 92.5% and 75.5%, respectively (Table II and III). MR showed significantly higher accuracy than CT ($p < 0.05$) (Table IV). The coincidence rate of LNR result

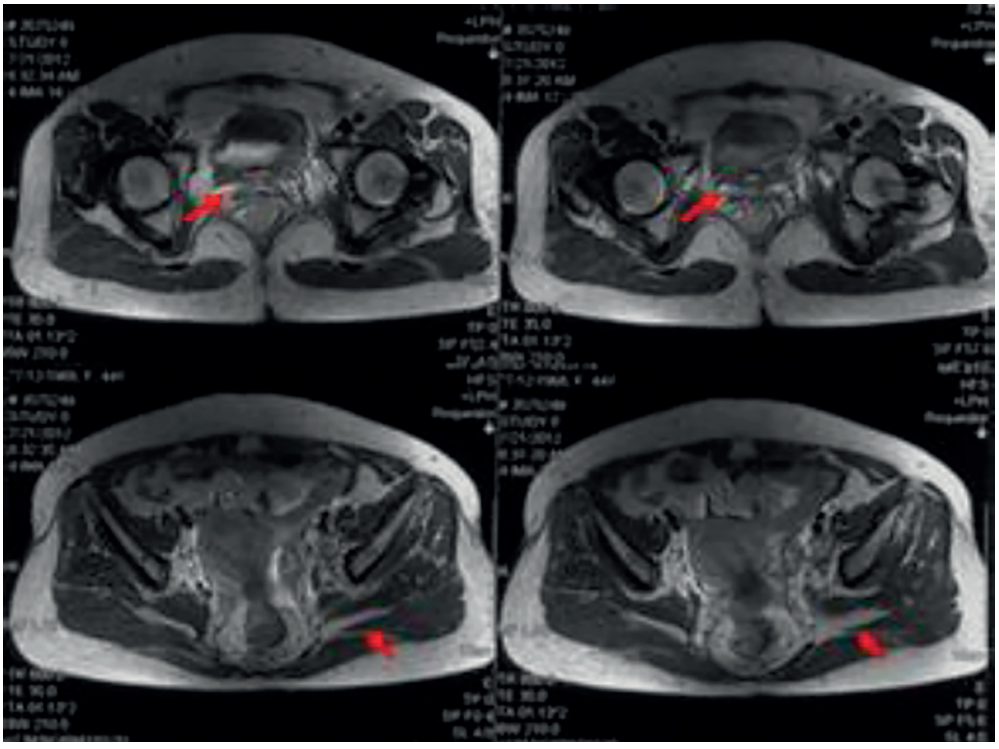

Figure 1. MR detection of colorectal cancer patient lymph node metastasis. Red arrow: metastatic lymph node.

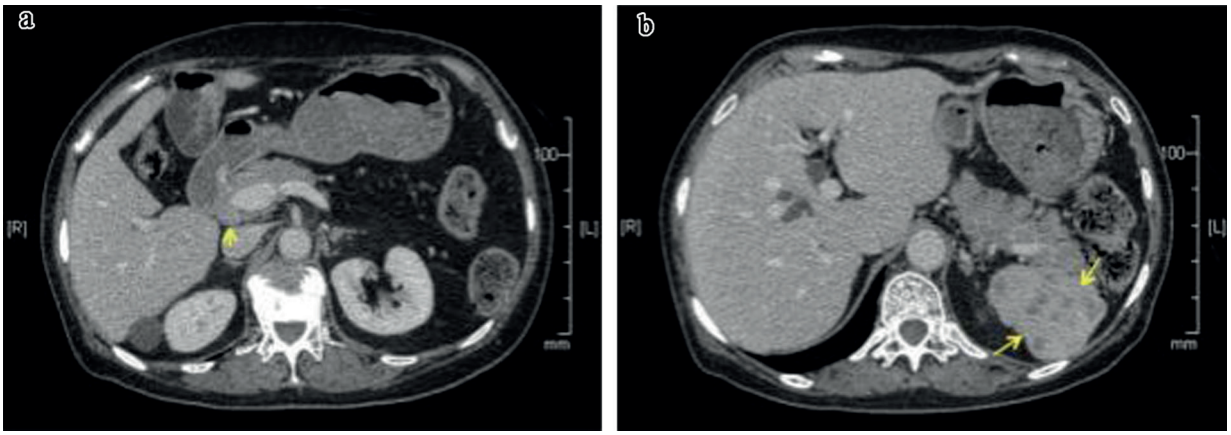

Figure 2. CT detection of colorectal cancer patient lymph node metastasis. Yellow arrow: metastatic lymph node.

Table II. Accuracy of MR scan on lymph node metastasis diagnosis.

Pathological staging	MR staging (cases)			Total	Accuracy (%)
	T1-2	T3	T4		
T1-2	78	6	0	84	92.6
T3	0	96	6	102	94.1
T4	0	12	120	132	90.9
Total	78	154	126	318	92.5

Table III. Accuracy of CT scan on lymph node metastasis diagnosis.

Pathological staging	MR staging (cases)			Total	Accuracy (%)
	T1-2	T3	T4		
T1-2	42	42	0	84	50
T3	6	90	6	102	88.2
T4	0	24	108	132	81.1
Total	48	156	114	318	75.5

derived from MR and CT with colorectal cancer histopathological results was 57.6% and 54.7%, respectively. MR and CT sensitivity were 42.6% and 25.0%, while their specificity was 74.1% and 41.3%, respectively. The positive predictive value and negative predictive value of MR and CT were 61.1% and 51.4%, 57.1% and 66.7%, respectively (Table V).

MR and CT Judgment on Prognosis

X^2-test showed that MR diagnosis result was consistent with histopathological result (Kappa

Table IV. MR and CT diagnosis accuracy on LNR.

Examination method	LNR	Accuracy (%)
MR	96/102	94.1
CT	90/102	88.2
χ^2	0.162	0.192
p	0.016	0.028

Table V. MR and CT detection of metastatic lymph node number comparison.

Examination method	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Accuracy (%)
MR	42.6 (66/156)	74.1 (120/158)	61.1 (66/108)	57.1 (120/210)	58.5 (186/318)
CT	25 (38/158)	41.3 (66/162)	51.4 (108/210)	66.7 (72/108)	56.6 (180/318)
χ^2	28.23	23.87	19.38	28.47	18.97
p	0.0028	0.0068	0.018	0.0026	0.0031

= 0.039, 0.496, $p < 0.05$) (Table VI). The coincidence rate of MR and CT evaluation on 5-year disease-free survival and overall survival were 56.7% and 43.8%, respectively.

Discussion

There is an upward trend of colorectal cancer incidence. Colorectal cancer examination, treatment and prognosis are of great importance[23]. This study investigated the relationship and diagnostic value of colorectal cancer lymph node metastasis and prognosis using MR and CT. This article has three major innovations: (1) MR and CT diagnosis showed high coincidence rate with colorectal cancer lymph node metastasis and prognosis. MR and CT diagnosis plays an important role and value for LNR and prognosis. (2) MR showed better effect on prognosis than CT and could be treated as the first choice to predict LNR and prognosis. (3) MR demonstrated good correlation with pathological results and could be used to predict LNR and prognosis. A previous study[24] also used MR for pathological staging in patients with colorectal cancer and obtained good results. This study investigated MR value on lymph node metastasis detection and prognosis. Similar to previous findings, MR judgment accuracy was high. Our results showed that the coincidence rate of 5-year overall survival rate evaluated by MR with patients prognosis was 56.7%. Previous reports[25] revealed that intestinal tract water or air injection can significantly improve the effect of CT angiography, resulting in the diagnosis accuracy as high as 80%. The accuracy of CT angiography in our work was 74.6%, which was in accordance with previous results[25]. It may be caused by the intestinal air injection method still needs to be improved. Therefore, the accuracy of this article needs to be further enhanced. Previous studies considered that nodal diameter greater than 1 mm could be judged for lymph node metastasis. However, it is often accompanied by inflammation or tumor necrosis phenomenon, which further led to lymph node enlargement[26]. Therefore, we considered diameter larger than 3 mm means lymph node metastasis in this study. This is also the reason of low accuracy of MR and CT diagnosis. Also, MR and CT diagnosis based on lymph node density, size and enhance degree lead to higher false negative rate[27-30].

This article also has three aspects of shortcomings and insufficiency: (1) the limited case number enrolled, larger size is needed in the future research; (2) the accuracy of MR and CT diagnosis of colorectal cancer lymph node metastasis and prognosis of accuracy is still to be further improved. Though MR and CT can effectively judge LNR and prognosis in patients with colorectal cancer, its judgment accuracy is only about 50%, which limits MR and CT application; (3) the false positive rate limits MR and CT diagnosis. This article adopted MR and CT diagnosis to analyze LNR and prognosis in patients with colorectal cancer. The results suggested that MR and CT diagnosis played an important role in LNR and postoperative prognosis. In comparison, MR diagnosis showed good correlation with

Table VI. MR and CT judgment on colorectal cancer patients' prognosis.

Examination method	Metastatic lymph node number	LNR	Coincidence rate (%)
MR	96	94.1	56.7
CT	90	88.2	43.8
χ^2	9.82	28.47	18.97
p	0.043	0.0086	0.017

colon cancer lymph node metastasis and prognosis, indicating that MR can better predict LNR and prognosis in patients with colorectal cancer.

Conclusions

MR and CT diagnosis showed important value for colorectal cancer LNR and prognosis. MR showed a better effect on prognosis than CT and could be treated as the first choice to predict LNR and prognosis. MR demonstrated a good correlation with pathological results and could be used to predict LNR and prognosis.

Acknowledgements

We would like to thank Dean Zhigang Zhang for his careful guidance and strong support to my work, and we would particularly like to thank Director Huiyun Zhuang for the help in the experiments and manuscript writing.

Conflict of Interest

The Authors declare that they have no conflict of interests.

References

1) Riedl CC, Slobod E, Jochelson M, Morrow M, Goldman DA, Gonen M, Weber WA, Ulaner GA. Retrospective analysis of 18F-FDG PET/CT for staging asymptomatic breast cancer patients younger than 40 years. J Nucl Med 2014; 55: 1578-1583.
2) Zhou J, Zhan S, Zhu Q, Gong H, Wang Y, Fan D, Gong Z, Huang Y. Prediction of nodal involvement in primary rectal carcinoma without invasion to pelvic structures: accuracy of preoperative CT, MR, and DWIBS assessments relative to histopathologic findings. PLoS One 2014; 9: e92779.
3) Riches SF, Payne GS, Desouza NM, Dearnaley D, Morgan VA, Morgan SC, Partridge M. Effect on therapeutic ratio of planning a boosted radiotherapy dose to the dominant intraprostatic tumour lesion within the prostate based on multifunctional MR parameters. Br J Radiol 2014; 87: 20130813.
4) Caldarella C, Annunziata S, Treglia G, Sadeghi R, Ayati N, Giovanella L. Diagnostic performance of positron emission tomography/computed tomography using fluorine-18 fluorodeoxyglucose in detecting locoregional nodal involvement in patients with anal canal cancer: a systematic review and meta-analysis. ScientificWorldJournal 2014; 2014: 196068.
5) Hanly AM, Ryan EM, Rogers AC, McNamara DA, Madoff RD, Winter DC, Group MS. Multicenter Evaluation of Rectal cancer ReImaging pOst Neoadjuvant (MERRION) Therapy. Ann Surg 2014; 259: 723-727.
6) Chang GJ, You YN, Park IJ, Kaur H, Hu CY, Rodriguez-Bigas MA, Skibber JM, Ernst RD. Pretreatment high-resolution rectal MRI and treatment response to neoadjuvant chemoradiation. Dis Colon Rectum 2012; 55: 371-377.
7) Ippolito D, Monguzzi L, Guerra L, Deponti E, Gardani G, Messa C, Sironi S. Response to neoadjuvant therapy in locally advanced rectal cancer: assessment with diffusion-weighted MR imaging and 18FDG PET/CT. Abdom Imaging 2012; 37: 1032-1040.
8) Buijsen J, van den Bogaard J, Janssen MH, Bakers FC, Engelsman S, Ollers M, Beets-Tan RG, Nap M, Beets GL, Lambin P, Lammering G. FDG-PET provides the best correlation with the tumor specimen compared to MRI and CT in rectal cancer. Radiother Oncol 2011; 98: 270-276.
9) Tan J, Lim Joon D, Fitt G, Wada M, Lim Joon M, Mercuri A, Marr M, Chao M, Khoo V. The utility of multimodality imaging with CT and MRI in defining rectal tumour volumes for radiotherapy treatment planning: a pilot study. J Med Imaging Radiat Oncol 2010; 54: 562-568.
10) Gu J, Khong PL, Wang S, Chan Q, Law W, Zhang J. Quantitative assessment of diffusion-weighted MR imaging in patients with primary rectal cancer: correlation with FDG-PET/CT. Mol Imaging Biol 2011; 13: 1020-1028.
11) Huppertz A, Schmidt M, Wagner M, Puettcher O, Asbach P, Strassburg J, Stockmann F, Schoffski O, Maurer MH. Whole-body MR imaging versus sequential multimodal diagnostic algorithm for staging patients with rectal cancer: cost analysis. Rofo 2010; 182: 793-802.
12) Mainenti PP, Mancini M, Mainolfi C, Camera L, Maurea S, Manchia A, Tanga M, Persico F, Addeo P, D'Antonio D, Speranza A, Bucci L, Persico G, Pace L, Salvatore M. Detection of colo-rectal liver metastases: prospective comparison of contrast enhanced US, multidetector CT, PET/CT, and 1.5 Tesla MR with extracellular and reticulo-endothelial cell specific contrast agents. Abdom Imaging 2010; 35: 511-521.
13) Szumacher E, Harnett N, Warner S, Kelly V, Danjoux C, Barker R, Woo M, Mah K, Ackerman I, Dubrowski A, Rose S, Crook J. Effectiveness of educational intervention on the congruence of prostate and rectal contouring as compared with a gold standard in three-dimensional radiotherapy for prostate. Int J Radiat Oncol Biol Phys 2010; 76: 379-385.
14) Steele SR, Chang GJ, Hendren S, Weiser M, Irani J, Buie WD, Rafferty JF, Clinical Practice Guidelines Committee of the American Society of C, Rectal S. Practice guideline for the surveillance of patients after curative treatment of colon and rectal cancer. Dis Colon Rectum 2015; 58: 713-725.
15) Rai B, Patel FD, Chakraborty S, Kapoor R, Sharma SC, Kumaravelu S, Raghukumar P, Aprem AS. Bladder-rectum spacer balloon versus vaginal gauze packing in high dose rate brachytherapy in cervical cancer: a randomised study (part II). Clin Oncol (R Coll Radiol) 2015; 27: 713-719.

16) Feng H, Lu AG, Zhao XW, Han DP, Zhao JK, Shi L, Schiergens TS, Lee SM, Zhang WP, Thasler WE. Comparison of non-schistosomal rectosigmoid cancer and schistosomal rectosigmoid cancer. World J Gastroenterol 2015; 21: 7225-7232.

17) Zerini D, Jereczek-Fossa BA, Fodor C, Bazzani F, Maucieri A, Ronchi S, Ferrario S, Colangione SP, Gerardi MA, Caputo M, Cecconi A, Gherardi F, Vavassori A, Comi S, Cambria R, Garibaldi C, Cattani F, De Cobelli O, Orecchia R. Salvage image-guided intensity modulated or stereotactic body reirradiation of local recurrence of prostate cancer. Br J Radiol 2015; 88: 20150197.

18) Mariados N, Sylvester J, Shah D, Karsh L, Hudes R, Beyer D, Kurtzman S, Bogart J, Hsi RA, Kos M, Ellis R, Logsdon M, Zimberg S, Forsythe K, Zhang H, Soffen E, Francke P, Mantz C, Rossi P, DeWeese T, Hamstra DA, Bosch W, Gay H, Michalski J. Hydrogel spacer prospective multicenter randomized controlled pivotal trial: dosimetric and clinical effects of perirectal spacer application in men undergoing prostate image guided intensity modulated radiation therapy. Int J Radiat Oncol Biol Phys 2015; 92: 971-977.

19) Beuran M, Stoica B, Tanase I, Negoi I, Paun S. Massive intraoperative bleeding after laparoscopic assisted abdominoperineal resection: a case report and systematic review of the literature. Chirurgia (Bucur) 2015; 110: 165-170.

20) Lo AC, Morris WJ, Pickles T, Keyes M, McKenzie M, Tyldesley S. Patterns of recurrence after low-dose-rate prostate brachytherapy: a population-based study of 2223 consecutive low- and intermediate-risk patients. Int J Radiat Oncol Biol Phys 2015; 91: 745-751.

21) Ozturk H. Primary spindle cell sarcoma of the prostate and (18)F-fluorodeoxyglucose-positron-emission tomography/computed tomography findings. Urol Ann 2015; 7: 115-119.

22) Liu FY, Yen TC, Wang JY, Yang TS. Early prediction by 18F-FDG PET/CT for progression-free survival and overall survival in patients with metastatic colorectal cancer receiving third-line cetuximab-based therapy. Clin Nucl Med 2015; 40: 200-205.

23) Udare A, Sable N, Kumar R, Thakur M, Juvekar S. Solitary osseous metastasis of rectal carcinoma masquerading as osteogenic sarcoma on post-chemotherapy imaging: a case report. Korean J Radiol 2015; 16: 175-179.

24) Rajeev KR, Menon SS, Beena K, Holla R, Kumar RR, Dinesh M. A comparative study of set up variations and bowel volumes in supine versus prone positions of patients treated with external beam radiation for carcinoma rectum. J Cancer Res Ther 2014; 10: 937-941.

25) Nomiya T, Akamatsu H, Harada M, Ota I, Hagiwara Y, Ichikawa M, Miwa M, Kawashiro S, Hagiwara M, Chin M, Hashizume E, Nemoto K. Modified simultaneous integrated boost radiotherapy for an unresectable huge refractory pelvic tumor diagnosed as a rectal adenocarcinoma. World J Gastroenterol 2014; 20: 18480-18486.

26) Ghouti L, Pereira P, Filleron T, Humeau M, Guimbaud R, Selves J, Carrere N. Pelvic exenterations for specific extraluminal recurrences in the era of total mesorectal excision: is there still a chance for cure? A single-center review of patients with extraluminal pelvic recurrence for rectal cancer from March 2004 to November 2010. Am J Surg 2015; 209: 352-362.

27) Iwama K, Yamazaki H, Nishimura T, Oota Y, Aibe N, Nakamura S, Ikeno H, Yoshida K, Okabe H. Frequency and predisposing factors for interfractional rectal displacement requiring repeated precaution in prostate cancer patients treated with image-guided intensity-modulated radiation therapy. Anticancer Res 2014; 34: 7373-7378.

28) van Stiphout RG, Valentini V, Buijsen J, Lammering G, Meldolesi E, van Soest J, Leccisotti L, Giordano A, Gambacorta MA, Dekker A, Lambin P. Nomogram predicting response after chemoradiotherapy in rectal cancer using sequential PETCT imaging: a multicentric prospective study with external validation. Radiother Oncol 2014; 113: 215-222.

29) Giovinale M, Fonnesu C, Soriano A, Cerguaglia C, Curigliano V, Verrecchia E, De Socio G, Gasbarrini G, Manna R. Atypical sarcoidosis: case reports and review of the literature. Eur Rev Med Pharmacol Sci 2009; 13 Suppl 1: 37-44.

30) Zhao LX, Gao Q, Liu YJ, Ma QL, Li DY, Jiang YZ. Study on 256-slice spiral CT bronchial artery imaging of common pathological types of central-type lung cancer. Eur Rev Med Pharmacol Sci 2016; 20: 3211-3216.