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Magnetic Resonance (MR) rectography in diagnostics of small-size rectal neoplasms

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Abstract. Purpose was the assessment of diagnostic efficiency of MR-rectography in diagnostics of small-size rectal neoplasms. 12 patients with polyps and small tumors of a rectum are examined, the size of detected neoplasms varied in the range 3–18 mm. Native MRI and MRI with retrograde contrasting by ultrasonic gel was carried out. Results of MRI are compared with results of videocolonoscopy. Sensitivity of native MRT was 24%, MR-rectography was 88%. MR-rectography can be used in diagnostics of small-size rectal neoplasms.

1. Introduction

Colorectal cancer (CRC) belongs to the category of socially significant neoplasms. Nowadays CRC in Russia occupies the second place among malignant tumors in mortality. The prevalence of colorectal cancer in Russia in 2013 was 93.6 per 100 000 people [1]. According to the published data, the main part of patients now admit to specialized hospitals with the locally and regionally advanced process (T3-T4, N2-N3), and patients with III–IV stages are operated most often [2, 3]. The five-year survival rate of CRC patients with I–II stages is up to 90%, whereas the relapse rate at the locally advanced cancer achieves 46%, while the five-year survival rate is no higher than 38% [4]. In 60–90% cases, CRC arises in "adenomatous polyp–cancer" series [5]. The rate of cases of CRC development from villous adenomas (polyps) greater than 2cm in diameter is 35-53%, while for polyps greater than 3cm in diameter the probability of their malignization is 100%. Villous tumors are observed most often in rectum (80%) and, to a lesser degree, in the rectosigmoid section and sigmoid colon [6, 7, 8]. Thus, the problem of early diagnostics of small-size volume neoplasms in rectum is an important task in prevention of cancer, and the early detection of tumors will increase the survival rate and improve the late fate.

The leading methods in diagnostics of colorectal polyps and tumors are endoscopic methods, such as videocolonoscopy (VCS). The use of modern endoscopic instrumentation and novel methods, such as chromocolonoscopy, narrow-band, magnifying, and autofluorescence endoscopy, allows the high-accuracy visualization of minimal pathological changes in colon [9, 10]. An important advantage of the endoscopic method is the possibility of sampling for morphological examination. The VCS sensitivity ranges from 75 to 95%, and specificity achieves 98% [11, 12]. One of VCS disadvantages

is relative intolerance due to pronounced pain syndrome, which not always can be controlled by local anesthesia. Examination under general anesthesia is not always possible because of technical impossibility and for patients with contraindications to general anesthesia, which leads to withholding of examination.

The relatively new method of examination is virtual colonoscopy (VCS) – method of noninvasive colon examination based on indirect visualization from data of X-ray computer tomography. The VCS sensitivity in detection of colorectal polyps is 93%, and specificity is 78% [13, 14, 15]. The diagnostic efficiency of this method is inversely proportional to the size of neoplasm. In particular, the sensitivity of this method in diagnostics is 90% for polyps greater than 1cm, 80% for polyps of 0.5–0.9 cm, and 67% for polyps no greater than 5mm [16, 17]. However, this method did not become a frequent routine practice due to the complex reconstruction algorithm and the need in colon distention, which is often poorly tolerable by patients. Also, virtual colonoscopy evaluates the internal relief of colon, while colon walls and surrounding structures can be evaluated only from data of native sections, whose tissue contrast is rather low.

MRI is a method of choice in diagnostics of pathologies in the small pelvis [18, 19, 20]. However, the efficiency of native study in diagnostics of rectal polyps and small-size tumors is limited due to the complex relief of the mucous tunic, close intensities of MR signals from polyps and from unchanged colon wall, as well as difficult visualization of small-size tumors against the background of unchanged colorectal mucous tunic.

A possible solution for this problem is MR colonography, which allows colon walls to be distended due to retrograde filling of rectum with contrasting agent and thus the method efficiency to be improved [21]. However, the data on the efficiency of this method at rectal polyposis and small-size neoplasms are few. In the study published by Purkayastha [22], the method sensitivity and specificity were 91% and 98%, respectively. As in the case of virtual colonoscopy, the diagnostic efficiency of the method is inversely proportional to the polyp size [23]. Disadvantages of MR colonography include the relatively long duration of the procedure, impossibility of high-accuracy examination all over the colon length, as well as presence of peristaltic artifacts caused by colon wall distension. Solutions used as intraluminal contrast agent also cause artifacts from movement in colon lumen. Artifacts from movement caused by patient discomfort at colon distension introduce additional difficulties.

Nowadays there is no technique combining high efficiency and good subjective tolerance for colorectal examination for polyposis and small-size neoplasms. All the above-said cause the need in MRI optimization in order to increase the MRI efficiency and to provide the subjective tolerance of examination in diagnosis of colorectal pathological changes.

2. Methods

2.1. Characteristics of patients

Twelve (seven male and five female) patients with colorectal polyps and small-size tumors (malignized polyp) were examined by the standard MRI method and by the modified technique (MR rectography).

The average age of the patients was 56.8 years. The patients with suspected volume colorectal neoplasms undergoing examination in our institute were included in the study.

2.2. MRI aqusition

MRI was carried out at the MAGNETOM ESSENZA (SIEMENS) 1.5T MR tomograph. The MRI protocol included T2-VI in three planes with section thickness of 3 mm, (TR-4900ms, TE-87ms).

2.3. Modification MRI techniques

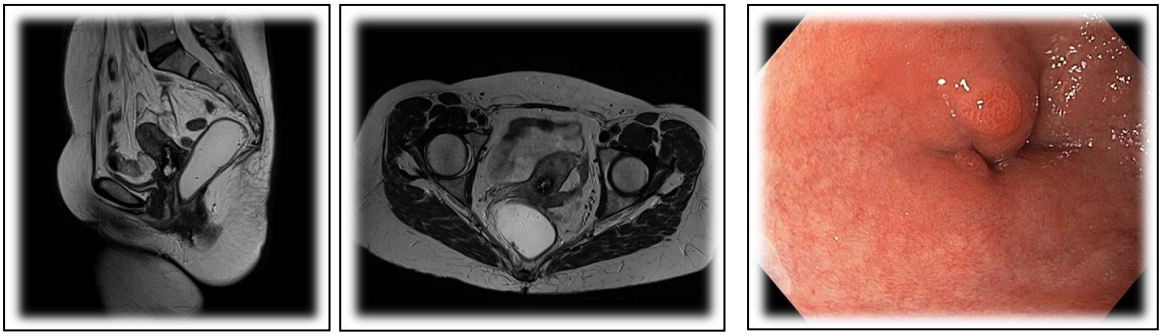
In our study, we propose modification of standard MRI examination procedure with isolated retrograde filling of rectum with 120-150 ml of viscous contrast substance. We have chosen a gel for

ultrasonic examination as a contrast agent owing to its availability and biological passivity. The volume injected per rectum in all cases was well tolerated by patients.

2.4. Evaluation of images

The size of detected neoplasms varied in the range 3–18 mm. Examination was conducted before and after the retrograde filling of rectum with determination of the number of neoplasms. The number of neoplasms detected from data of native MRI and with the use of MR rectography was compared with VCS data.

Criteria of the presence of a volume colorectal neoplasm from the data of MR rectography were local thickening or exophytic evagination of smoothened colon wall against the background of intraluminal contrast agent. Neoplasms had sharp, even or torous contours, the intensity of MR signal was close or equal to that from adjacent parts of unchanged colorectal mucous tunic, and in all the cases the external layer of colon remained sharp (Figure.1).



T2-weighted images T2-weighted images Video colonoscopy

Figure. 1. T2-weighted images of a rectal polyp in case of retrograde filling with a gel . Video colonoscopy of the same patient.

Differential diagnostics of malignant and nonmalignant neoplasms was not carried out.

3. Results

Results are summarized in Table 1.

Table 1. Results of native MRI and MR rectography in comparison with virtual colonoscopy (VCS).

patient	Number of neoplasms Standard MRI	truth positive	false negative	Number of neoplasms MRI rectography	truth positive	false negative	Number of neoplasms VCS
1	1	1	1	2	2	0	2
2	0	0	1	1	1	0	1
3	1	1	4	3	3	2	5
4	0	0	2	2	2	0	2
5	1	1	3	5	4	1	4
6	0	0	3	3	3	0	3
7	0	0	3	2	2	1	3
8	2	1	0	1	1	0	1
9	1	1	1	3	2	0	2
10	0	0	1	1	1	0	1
11	1	1	1	2	2	0	2
12	1	1	2	2	2	0	3
total	8	7	22	27	25	4	29

The sensitivity of native MRI in detection of small-size volume colorectal neoplasms was 24% (7/29) and 86% (25/29) with the use of MR rectography. At the native MRT, the number of false negative cases was 22 because of the difficult separation of small-size neoplasms against the background of colorectal folds. With MR rectography, four false-negative cases were detected, which was connected with the small size of neoplasms in three cases, and in one case a polyp was assigned as a near-wall gas bubble.

4 Discussion

MR colonography is highly sensitive for detection of rectal polyps (86%) and does not cause discomfort to patients. MR rectography is not positioned as an alternative to video colonoscopy. This method can be used for identifying polyps and small malignant tumors of the rectum, as well as for dynamic monitoring of patients who do not tolerate video colonoscopy or have contraindications to it.

References

[1] A Davydov MI, Aksel' EM 2010 *Vestnik RONTs im. N.N. Blokhina RAMN* **21 2 (80)** (Suppl. 1)
[2] Butenko AV, Razbirin VN. 2011 *Sib. Onkolog. Zhurnal.* **6 (48)** 83–89
[3] State of cancer care in Russia in 2011. Ed. by VI Chissov, VV Starinskii, GV Petrova. Moscow, 2012. 240
[4] Berlin JW, Gore RM, Yaghmai V, Newmark GM 2009 *Semin Roentgenol.* **35** 370–384
[5] Laoteva EA, Kozlova IV, Myalina YuN. 2013 *Saratov Nauchno-Med. Zhurnal*. **9** 2
[6] Egorenkov VV, Moiseenko FV 2010 *Prakt. Onkologiya* **11** 81–87
[7] Shul'pekova you 2002 *Ros. Zhurn. Gastroenterol. Gepatol. Koloproktol.* **12(4)**64–68
[8] Zinkiewicz K 2004 *Dis. Colon. Rectum.* **47**1115
[9] Kashin SV, Zav'yalov DV, Kamkina GV, Akhapkin NV 2012 *Klinik. Edoskopiya* **34** 16-25
[10] The Paris endoscopic classification of superficial neoplastic lesions: esophagus, stomach and colon: November 30 to December 1, 2002. *Gastrointest Endos* **58** 3-43
[11] Jover R.et al. 2012 WEO *Colorectal Cancer Screening Committee Meeting* **5(18)** 23
[12] Matsuda T 2012 *WEO Colorectal Cancer Screening Committee Meeting* **5(18)**54
[13] Pickhardt PJ, Hassan C, Halligan S, Marmo R 2011 *Radiology* **259** 393–405
[14] Atkin W, Dadswell E, Wooldrage K 2013 *Lancet* **381** 1194–202
[15] Halligan S, Wooldrage K, Dadswell E 2013 *Lancet* **381** 1185–93
[16] de Haan MC, van Gelder RE, Graser A, Bipat S, Stoker J 2011 *Eur Radiol* **21** 1747–63
[17] White TJ, Avery GR, Kennan N et al. 2009 *Corectal. Disease* **11(2)**138–145
[18] Prorokov VV, Malikhov AG, Knysh VI. 2002 *Prakt. Onkologiya*. **3(2)**1–5
[19] Brown G, Daniels IR, Richardson C et al. 2005 *Br. J. Radiol.* **78 (927)** 245–251
[20] Chun HK, Choi D, Kim MJ et al. 2006 *AJR.* **187 (6)** 1557–1562
[21] Laghi A, Bellini D, Petrozza V et al 2015. *Colorectal Dis.* **1(17)**36-43
[22] Purkayastha S, Athanasiou T, Tekkis PP, Constantinides V 2007 *Colorectal Dis.* **9** 100–110
[23] Zijta FM, Bipat S, Stoker J 2010 *Eur Radiol* **20** 1031–46