Time-intensity curve (TIC) of rectal lesions on dynamic contrast-enhanced MRI at 3T

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Objectives: MRI is useful for the diagnosis and local staging of rectal cancer However, the role of dynamic contrast–enhanced MR sequences is not clear. The purpose of this study is to determine the pattern of time-intensity curve (TIC) of rectal lesions on dynamic contrast-enhanced magnetic resonance imaging (DCE-MRI) at 3 Tesla and to evaluate TIC for diagnosing and differentiating rectal cancer from other lesions.

Materials and Methods: DCE-MRI was performed in 51 patients (male 33, female 18, age 21-85) with suspected rectal tumor or inflammatory lesions on a 3T MR scanner (GE Signa Excite) using an 8-channel phased-array surface coil for signal transmission and reception. Bowel preparation included laxative cleansing, distension with sodium chloride enema and anisodamine to reduce peristalsis. Multiphase axial 3D SPGR with fat suppression (15-20 phases) was performed with 14-16 second temporal resolution using TR/TE/flip angle = 4.1/1.9/20°, NEX = 1, slice thickness = 5 mm, FOV = 36 x 36 cm, matrix = 256 × 192 with a 3D spatial resolution of 1.4 × 1.9 × 5 mm for a total DCE-MRI data acquisition time = 4 - 6 minutes.

DCE-MRI acquisition was started simultaneously with intravenous injection of 0.1 mmol/kg gadopentetate demeglumine (Schering, Berlin) at a rate of 3 mL/sec. All DCE-MRI data were post-processed using Functool to obtain time-intensity curves, peak enhancement ratio (ER_{peak}) and time to peak enhancement (T_{peak}) of rectal lesions. These data were correlated with histological findings. Statistical analyses were performed using SPSS version 11.5.

Results: Histological examination confirmed 38 primary rectal cancers, 5 local recurrences, 2 adenomas, 6 peri-anal abscess/fistulas. TICs were classified into four types according to time to peak enhancement and contrast wash out (Figure 1). Benign adenomas (n = 2) showed fast homogeneous, early Type A enhancement with short T_{peak} (Table 1). Primary rectal adenocarcinoma (n = 33) was more heterogeneous, with 88% showing either type A (n = 18) or type B (n = 11) enhancement but with longer T_{peak} allowing differentiation from benign adenomas. Local recurrences and abscesses/fistulae were indistinguishable with B, C and D type TIC and delayed T_{peak}. For signet cell cancer/mucinous carcinoma with the worst differentiation (n = 5), the patterns of TIC were variable from type B to type D.

Discussion: In addition to delineating rectal lesions, DCE-MRI also provides information on local microcirculation. In our limited study population, TIC and T_{peak} are helpful for the differentiation of rectal cancer from benign adenomas. Type A enhancement with early peak time and low enhancement ratio favors the diagnosis of benign rectal adenoma. Primary rectal cancer with relatively better prognosis tends to enhance sooner or later to a higher peak point followed by contrast agent wash out. Type C enhancement can be identified in either rectal cancer (n = 5) or perianal abscess, but the ring-shaped enhancement is typical of abscess. Type D TIC without identifiable peak point is more likely to bring the possibility of local recurrence or high grade Signet Cell carcinoma.

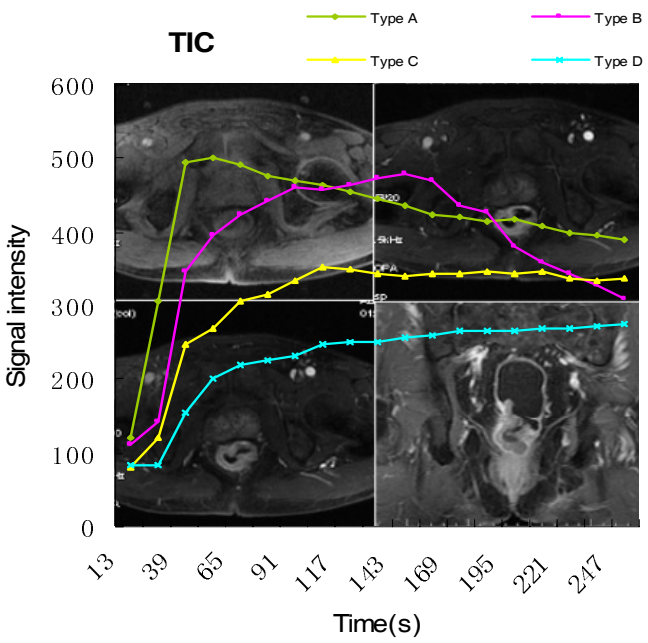

Table 1. TIC types and parameters of different rectal diseases

	n	Type A	Type B	Type C	Type D	ER_{peak}	T_{peak}(s)
Primary adenoCA	33	18	11	4	0	3.07±0.78	94 ± 53
Primary Signet Cell	5	0	3	1	1	4.05±1.19	145±17
Local recurrence	5	0	2	0	3	3.22±0.24	210 ± 41
Perianal abscess	6	0	2	4	0	3.23±0.29	139 ± 26
Adenoma	2	2	0	0	0	2.51±0.05	39 ± 0
p						0.144	0.000

Figure 1. Four types of TIC were identified for rectal disease: type A, signal intensity of local lesion increases rapidly at early phases and enhances to the peak (SI_{peak}) in 80 s after the contrast injection, then decreases gradually; type B, signal intensity increases slowly and SI_{peak} was reached after 80 s, then decreases gradually; type C, same pattern of rising phase as type B followed by a plateau phase; type D, the curve keep rising all over the process without identifiable SI_{peak}.

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