Chinese Journal of Cancer Research 9(3):203-206,1997.

MRI FEATURES AND RESECTABILITY PREDITION OF ESOPHAGEAL CARCINOMA

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To evaluate MRI in esophageal carcinoma and its resectability. MR imaging (sagittal, coronal, axial) were performed in 30 cases (male 24 cases, female 6 cases, average age 58 years) and retrospectively analyzed. Results showed that MRI clearly demonstrated the location, actual length, and extent of esophageal carcinoma as well as its relation with surrounding structures in all cases. Metastasis to other organs was found in 7 cases. The conclusion indicated that MR imaging played an important role in preoperative diagnosis of esophageal carcinoma, providing valuable information in determining resectability of the tumor.

Key words: Esophageal tumor, Magnetic resonance imaging.

The present imaging examinations of esophageal carcinoma mainly depends on barium esophagography, by which changes of esophageal mucous and functional disturbance of esophagus were observed. However, it was difficult to demonstrate the actual length, extent and relation with surrounding structures of the tumors, especially to access resectability of the tumors. There were quite a few reports on CT and MRI about the above.[1-6] From April 1992 to May 1995, we reviewed MRI features in 30 cases of esophageal carcinoma and further evaluated the value of MRI in esophageal carcinoma as well as its resectability.

Accepted July 31, 1997

MATERIALS AND METHODS

General Information

Thirty cases of esophageal carcinoma (24 male, 6 female) aged 40–71 years (mean age=58 years). Their primary symptoms were dysphagia and retrosternal pain. 6 other cases manifested obvious emaciation and exhaustion. The course of disease ranged 1–6 months. All patients were examined with barium esophagography and esophagoscopy before and after undergoing MRI. Moreover, chest radiography was performed in 12 patients and 3 other patients received CT scans. These examinations were referred in analyzing MR images.

Imaging Method

All studies were performed on the 0.5 T Philips superconductive MR scanner with body coil in sagittal, coronal and axial planes. SE sequence was used routinely, with T1WI (TR/TE=500/15 ms), T2WI (TR/TE=2000/20, 90 ms), 5 mm slice thickness, 0.5 interstice gap, 256×256 matrix, 2 excitations. Prior to scanning, 1 ‰ Gd-DTPA contrast agent was taken orally to fill up stomach. ECG gating was not used.

RESULTS

Of all patients, 23 cases underwent surgical

resection or exploration. The others failed to get operation because of MRI finding of metastases to other organs. All cases were documented to be squamous cell carcinoma by operation or esophagoscopic biopsy and pathological examination. The features of these tumors on MRI were as following:

Location of Tumors and Change of Signal

The accurate location and actual length of the tumors were evaluated in 30 cases. These tumors ranged 5–15 cm in length on sagittal MR images. Of all tumors, 2 cases located at superior esophagus, 8 cases supermedial, 9 cases middle, 7 cases inferomedian and 4 cases inferior. The average length of masses in MRI was 4 cm longer than in barium esophagogram. The tumors showed intermediate signal intensity on T1W images, similar to soft tissue, and high signal intensity on T2W images.

Changes of the Wall and Lumen of the Esophagus

Thickened wall and narrowed lumen of esophagus involved with tumor were found in all cases. Of these cases, irregularly thickened wall and eccentrically narrow lumen were found in 21 cases and circularly thickened wall and concentrically narrow lumen in 9 cases because tumors involved entire wall of esophagus.

Changes Outside the Lumen of Esophagus

Nine cases of tumor grew outside the lumen of esophagus as soft tissue masses. Of these cases, three extended left and posterior and connected closely with descending aortas and left pulmonary arteries, encasing descending aortas, which were compressed and narrowed consequently. 4 cases grew antero-inferior, forming masses below bifurcation of tracheas, enclosing left primary bronchi and projecting into their lumens with the disappearing of fat signal of mediastern.

Metastases

Two cases had liver metastasis, which manifested as multiple nodules in different size, slightly longer T1 and T2 signal than normal liver. Additionally, target sign was seen. 2 cases of thoracic vertebrae metastasis showed destruction of multiple vertebrae bodies and abnormal signal.

DISCUSSION

Value of MRI on Esophageal Carcinoma

Demonstrating the Anatomical Location and Actual Length of Esophageal Carcinoma Exactly

We had measured and compared the length and location of esophageal carcinoma demonstrated on MRI and barium esophagography in 30 patients respectively. The results showed that the average length (ranged 5–15 cm) of tumors in MR images was 4 cm longer than that (ranged 2–9 cm) in esophagograms. According to the length of the tumors, the anatomical location of the masses in MRI was determined and compared which in esophago-grams. The results indicated that 2 of four cases of superior esophageal carcinoma detected by esophago-graphy actually were supermedial. Of 20 cases of middle esophageal carcinoma detected by esophago-graphy, 6 cases were supermedial carcinoma and 5 cases were inferomedian carcinoma respectively. Two of 6 cases of inferior carcinoma actually were inferomedian ones. Carcinoma cell was not found at the resected esophageal ends in 18 cases resected by surgery. All these demonstrated MRI is more sensitive to detect infiltration of esophageal carcinoma along the wall, more accurate to evaluate actual length and anatomical location of esophageal carcinoma, and more valuable to determine surgical protocol than barium esopha-gography. Especially, when tumors grow into lumen of esophagus and narrow or obstruct lumen so that the patients fail to undergo barium meal or endoscope, we suggest MRI be performed presurgically because only with which the total length of esophageal carcinoma can be displayed.

Demonstrating Sufficiently Extent of Tumor and Relation with Adjacent Structures

MRI has high special resolution and ability of mutiplanar imaging with multiple parameters. Moreover, normal mediansternal structures such as heart, great vessels, trachea, bronchus and fat have special MRI signal, so tumors are more easily differentiated from these structures with MRI than with CT. In our study, MRI demonstrated that 21

cases of tumors localized in esophageal lumen, having well-defined borders among tumors and surrounding structures with presence of fat signal, including 3 cases with signs of slight compression but no invasion of vital structures. Of 9 other cases of tumors growing outside lumen, 3 cases enclosed the descending aortas, resulting in their compression and stricture, presenting obscure delimitation lines with left pulmonary arteries, accompanying with disappearance of fat signal; 4 cases grew in various directions and formed larger masses, invading aortas or bronchi; 2 cases delimited unclearly with posterior wall of tracheas, invading prevertebral soft-tissue with disappearance of fat signal. 3 of the above 9 cases underwent CT scan which showed the length of tumors and relation with adjacent structures were inferior to that with MRI, in accordance with the literatures.

Detecting Simultaneously Metastases to Adjacent Structures

Body coil can obtain large scanning field, besides depicting the full appearance of esophageal carcinoma, inferior neck, chest, epigastrium were also included; moreover, metastases can be shown simultaneously. In present study, metastases to the above sites were detected in 7 cases, thus unnecessary surgical treatment was avoided.

MRI Was Useful for Staging of Esophageal Carcinoma

With regard to this, we didn't do much work. However, from analysis of the present data, it may be difficult for MRI to detect mucousal and submucousal infiltration, which was defined as stage T1. But it is easier to diagnose stage T2, T3 and T4 of tumor. Definitive Criterion of the staging of esophageal carcinoma requires further study.

Comprehensive Evaluation of Resectability

After MR scans of 18 cases resected and 5 cases explored surgically were retrospectively analyzed and compared with results of operation, we concluded that the following conditions were important to determine resectability of esophageal carcinoma.

The tumors localized in lumen or wall of esophagus and without invading to adjacent structures can be resected by operation. Of 16 cases in the study, only 3 cases failed to get operation because of metastasis to other organs. The others were not found to adhere to surrounding structure during operation and were easily separated and removed.

The tumors without invasion to important surrounding structures can be resected despite growing outside. In our study, 5 cases of tumors were observed to be only slightly adherent to posterior wall of trachea and anterior soft tissue of vertebral column. Following careful separation, the tumors were resected.

The tumors invading pericardia or great vessels can not be resected. In this study, 3 cases were found to invade posterior wall of left atria, descending aorta and left pulmonary arteries with the disappearing of fat signal around them in MRI. During operation, the tumors were found to adhere to the above structures tightly and failed to be separated or resected.

The tumors invading tracheas or bronchi can not be resected. Two cases grew in multiple directions, enclosing tracheas, bronchi respectively, with disappearing of fat signal around them. During operation, the tumors were seen to adhere to tracheas, bronchi and form masses, which were fixed and could not be separated or resected.

The tumors metastating to other organs can not be resected. In the study, metastasis to liver, lung, mediasterum, vertebral column or cervical lymphnode were observed in 7 cases on presurgical MRI, so operations were not performed.

In general, tumors either localizing in lumen and wall of esophagus or not invading surrounding structures despite growing outside are important resectable indications, while tumors either invading pericardium, great vessels, tracheas and bronchi or metastasizing to other organs are important unresectable indications. It had been reported that accuracy of resectability of esophageal carcinoma ranged 90.0%–97.0% with these indications. Our result was 94.5%, similar to those reported.

MRI Techniques of Esophageal Carcinoma

Fewer publications described MRI techniques of esophageal carcinoma. We consider the following as reference:

As scanning, oral contrast agent should be taken to fill stomach. The effect of oral 1 ‰ Gd-DTPA solution was recommended. The method is necessary to understand the extent of inferior esophageal

carcinoma invading into stomach, and it helps to make differentiate normal cardia and cardiac masses. With the method, it was reported that smaller esophageal carcinoma could be detected.

Multiple orientations scan is necessary. Sagittal orientation is the most basic one, assisted with coronal and consecutive axial scans. This is because resectability of esophageal carcinoma should be comprehensively evaluated with the findings on the three orientations scan; otherwise, some important signs may be omitted, then the accuracy will reduce.

With SE sequence, without multiecho sequence, intravenous contrast agent and cardiac gating, we both save scan time and obtain satisfied images for diagnosis.

Effect with body coil is superior to that with surface coil because larger scanning field of view can be obtained with the former. Thus, esophagus carcinoma and metastasis to adjacent organs can be detected simultaneously, that has a practical significance for determining therapeutic plan.

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