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ORIGINAL ARTICLE

Effects of MSCT enhanced scan image diagnosis on clinical outcome of patients after radical gastrectomy and its influence on misdiagnosis rate

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Summary

Purpose: *To explore the effect of multi-slice spiral computed tomography (MSCT) enhanced scan image diagnosis on clinical outcome of patients after radical gastrectomy and its influence on misdiagnosis rate.*

Methods: *A total of 62 patients diagnosed with gastric cancer and undergoing radical gastrectomy were selected. All patients were reexamined 2-6 months after operation. Conventional CT and MSCT enhanced scan were performed for image diagnosis, and the results were compared with those of gastroscopic biopsy. Finally, the misdiagnosis rate, negative predictive value, positive predictive value, sensitivity and specificity of conventional CT and MSCT enhanced scan for postoperative recurrence were analyzed.*

Results: *According to the results of gastroscopic biopsy, there were 35 cases suspected of recurrence, and 27 cases without postoperative recurrence. The specificity and sensitivity of conventional CT and MSCT enhanced scan were 85.19% vs. 92.59%, and 65.71% vs. 92.16%, respectively. Both specificity and sensitivity of MSCT enhanced scan were higher than those of conventional CT, with statistically significant differences ($p<0.05$). MSCT enhanced scan had a lower misdiagnosis rate for postoperative recurrence than conventional CT (5.71% vs. 22.86%) ($p<0.05$). Moreover, the negative predictive value and positive predictive value of conventional CT and MSCT enhanced scan were 65.71% vs. 86.21%, and 85.19% vs. 93.94%, respectively. The results showed that MSCT enhanced scan had higher negative predictive value and positive predictive value for postoperative recurrence than conventional CT, with statistically significant differences ($p<0.05$).*

Conclusion: *MSCT enhanced scan image diagnosis is of great significance for assessing the condition of disease, determining the recurrent foci after radical gastrectomy, and developing the subsequent therapeutic regimen.*

Key words: *MSCT enhanced scan, image diagnosis, misdiagnosis rate, radical gastrectomy.*

Introduction

Gastric cancer, a clinically common digestive tract malignancy, frequently occurs in people aged 40 years old and above, and it has high morbidity and mortality rates [1]. According to statistics, the incidence and mortality rate of gastric cancer rank 5th and 3rd, respectively, among malignancies in the world, and its morbidity rate in male patients is more than twice that in female patients [2]. After onset, the patient's physical health and gastric function will be greatly impacted. Surgical operation is the basic treatment means of the disease, the first choice of which is radical gastrectomy [3,4].

Through radical gastrectomy, the entire lymph nodes can be removed, thereby realizing *en bloc* resection of tumor. However, postoperative recur-

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rence occurs in about 40% of patients, leading to a poor overall effect [5]. Therefore, it is of positive significance to accurately assess the clinical effect of radical gastrectomy and control the residual lesions for improving surgical efficacy, prolonging survival, and avoiding tumor growth [6,7]. With the development of medical technology in recent years, multi-slice spiral computed tomography (MSCT) enhanced scan has been increasingly applied in the examination of gastric diseases. It was pointed out in a clinical report that MSCT enhanced scan image diagnosis has a satisfactory effect in the evaluation of clinical outcome of patients after radical gastrectomy [8], and it can help reduce misdiagnosis and improve diagnostic accuracy for postoperative recurrence, which provides an important guarantee for follow-up examination and therapeutic evaluation after radical gastrectomy.

In this study, the examination results of 62 patients undergoing radical gastrectomy were explored, so as to offer new references to the improvement of prognosis after radical gastrectomy.

Methods

General data

A total of 62 patients diagnosed with gastric cancer and undergoing radical gastrectomy were selected. All patients were reexamined 2-6 months after operation. Conventional CT and MSCT enhanced scan were performed for image diagnosis, and the results were compared with those of gastroscopic biopsy. There were 29 females and 33 males aged 32-76 years (mean 57.46±5.34). The tumor was located in the gastric body in 15 cases, pylorus in 37 cases, and gastric antrum in 10 cases. There were 30 patients in TNM stage II, and 32 in TNM stage III. The study was approved by the Medical Ethics Committee, and patients and their families signed the informed consent form.

Inclusion criteria

The inclusion criteria were as follows: (1) patients meeting the indications for radical gastrectomy [9], (2) those who gave informed consent to this study, (3) those undergoing whole abdominal CT scan prior to operation, without metastasis, (4) those in good mental state and able to cooperate in this study, and (5) those with complete clinical data.

Exclusion criteria

The exclusion criteria involved: (1) patients with incomplete clinical data, (2) those receiving emergency surgery, (3) those complicated with ascites, (4) those unwilling to sign the informed consent, (5) those with metastasis found by preoperative CT scan, (6) those receiving palliative surgery, or (7) those with liver, brain or kidney dysfunction other than heart disease.

Methods

Conventional CT scan: The patients were reexamined 2-6 months after radical gastrectomy. They were scanned in a supine position using a GE540 MSCT machine from

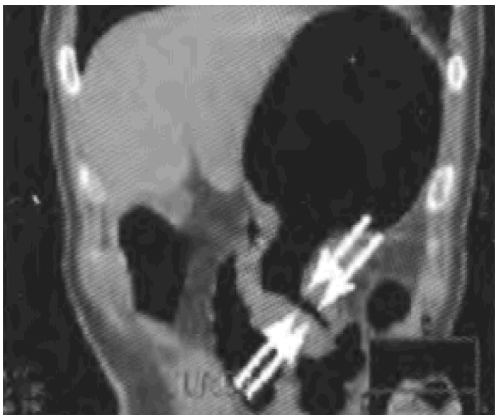

Figure 1. Anastomotic stenosis shown in conventional CT

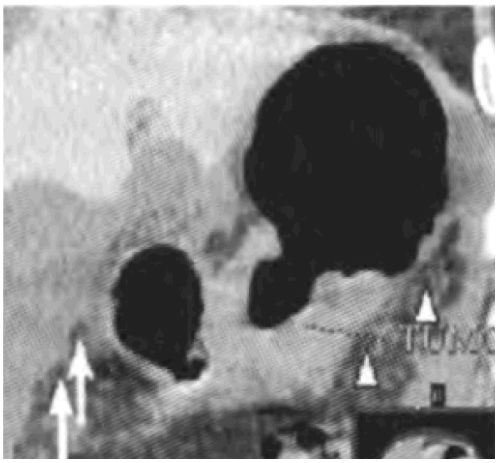

Figure 2. Invasion outside serosa shown in conventional CT (ascites indicated by arrows)

Table 1. Comparison of results of conventional CT and gastroscopic biopsy in 62 patients after radical gastrectomy (n)

Gastroscopic biopsy	*Conventional CT*		*Total*
	Suspected clinical recurrence	*No clinical recurrence*	
Suspected clinical recurrence	23	12	35
No clinical recurrence	4	23	27
Total	27	35	62

the diaphragmatic dome to the lumbar vertebrae, and the scanning plane was perpendicular to the abdomen (reference tube current-time product: 230 mAs, tube voltage: 120 KV, slice distance: 5 mm, slice thickness: 2.5-5 mm). The films were jointly read by two experienced clinicians, and finally reviewed by the radiology director.

MSCT enhanced scan image diagnosis: MSCT enhanced scan was conducted after plain scan. The patients were deprived of food for 6 h, and drank 800 mL of warm water at 0.5 h before enhanced scan. About 100 mL of ultravist (H20171327, Bayer Schering Pharma AG) was injected at 3 mL/s *via* the elbow vein using a high pressure syringe, followed by delay for 30-35 s. Then the scan data obtained were input to the image post-processing workstation for maximum intensity projection, shaded volume rendering, projection rendering and curve planar reconstruction of the stomach, and the angiography images were obtained and used to observe the condition of gastric cavity. The films were jointly read by two experienced clinicians, the recovery status of the patient's peritoneum, abdominal aorta, viscera relation and anastomotic stoma was carefully observed, and whether there was tumor recurrence was determined. The results of gastroscopic biopsy were used as the gold standard.

Observation indexes

(1) The diagnosis results of conventional CT and gastroscopic biopsy for recurrence after radical gastrectomy were recorded, the latter of which included suspected recurrence and no recurrence. (2) The diagnosis results of MSCT enhanced scan and gastroscopic biopsy for recurrence after radical gastrectomy were recorded. (3) The specificity and sensitivity after operation were recorded. Sensitivity = true positive cases/(true positive cases + false negative cases) × 100%. Specificity = true negative cases/(true negative cases + false positive cases) × 100%. (4) The misdiagnosis rate of MSCT enhanced scan and conventional CT for postoperative recurrence was recorded. (5) The negative predictive value and positive predictive value after operation were recorded. Negative predictive value = true negative cases/(true negative cases + false negative cases) × 100%, positive predictive value = true positive cases/(true positive cases + false positive cases) × 100%.

Statistics

SPSS 23.0 software package (IBM, Armonk, NY, USA) was used for data analysis. Measurement data were expressed as (x±s), and subjected to t-test. Enumeration data were expressed as percentage (%), and subjected to chi-square test. $P<0.05$ was considered to be statistically significant. Kappa statistics was used for consistency test of results of postoperative recurrence. Kappa value >0.75 suggested satisfactory consistency.

Results

Comparison of results of conventional CT and gastroscopic biopsy in 62 patients after radical gastrectomy

According to the results of gastroscopic biopsy, there were 35 cases suspected of recurrence, and 27 cases without postoperative recurrence. The results of conventional CT and gastroscopic biopsy

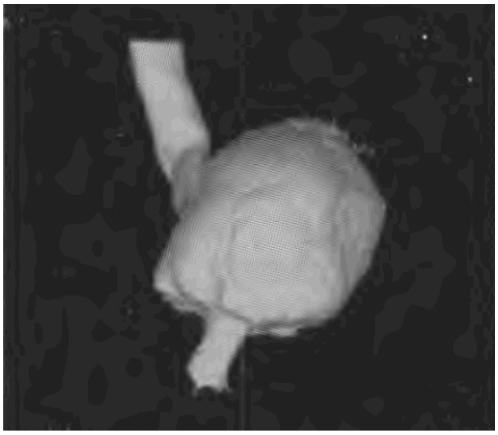

Figure 3. Anastomotic stenosis shown in MSCT enhanced scan

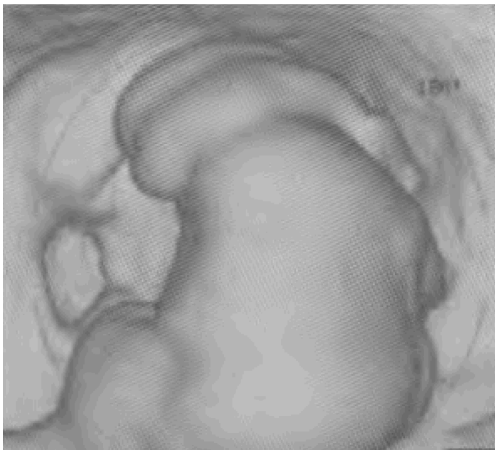

Figure 4. Filling defects in remnant stomach shown in MSCT enhanced scan

Table 2. Comparison of results of MSCT enhanced scan and gastroscopic biopsy in 62 patients after radical gastrectomy (n)

Gastroscopic biopsy	*MSCT enhanced scan*		*Total*
	Suspected clinical recurrence	*No clinical recurrence*	
Suspected clinical recurrence	31	4	35
No clinical recurrence	2	25	27
Total	33	29	62

are shown in Table 1, Figure 1 and Figure 2, and the Kappa value was 0.357 in consistency test, indicating no high consistency.

Comparison of results of MSCT enhanced scan and gastroscopic biopsy in 62 patients after radical gastrectomy

The results of MSCT enhanced scan and gastroscopic biopsy were similar. The results of MSCT enhanced scan and gastroscopic biopsy are shown in Table 2, Figure 3 and Figure 4, and the Kappa value was 0.592 in consistency test, indicating a high consistency.

Comparison of specificity and sensitivity in 62 patients after radical gastrectomy

The specificity and sensitivity of conventional CT and MSCT enhanced scan were 85.19% *vs.* 92.59%, and 65.71% *vs.* 92.16%, respectively. Both specificity and sensitivity of MSCT enhanced scan were higher than those of conventional CT, with statistically significant differences (p<0.05) (Table 3).

Comparison of misdiagnosis rate for postoperative recurrence

MSCT enhanced scan had a lower misdiagnosis rate for postoperative recurrence than conventional CT (5.71% *vs.* 22.86%) (p<0.05) (Table 4).

Comparison of negative predictive value and positive predictive value in 62 patients

The negative predictive value and positive predictive value of conventional CT and MSCT enhanced scan were 65.71% *vs.* 86.21%, and 85.19% *vs.* 93.94%, respectively. The results showed that MSCT enhanced scan had higher negative predictive value and positive predictive value for postoperative recurrence than conventional CT, with statistically significant differences (p<0.05) (Table 5).

Discussion

Gastric cancer is a frequently-occurring malignant tumor in the digestive system, and it is commonly seen in the pylorus and local cardia, mainly manifested as emaciation, malnutrition and anemia in cachexia in advanced stage [10,11]. Currently, general surgery is the main clinical treatment method of gastric cancer in China, among which radical gastrectomy has a more significant curative effect, and it can reduce surgical trauma and pain [12]. However, the overall curative effect is poor due to postoperative recurrence and metastasis of disease. Early detection of postoperative recurrence or metastasis and prompt treatment are helpful for raising the survival rate of patients

Table 3. Comparison of specificity and sensitivity in 62 patients after radical gastrectomy [n (%)]

Group	*n*	*Specificity*	*Sensitivity*
Conventional CT	62	85.19 (23/27)	65.71 (23/35)
MSCT enhanced scan	62	92.59 (25/27)	88.57 (31/35)
x^2	-	3.347	4.476
p	-	0.032	0.013

Table 4. Comparison of misdiagnosis rate for postoperative recurrence [n (%)]

Group	*Postoperative recurrence (n)*	*Accuracy rate*	*Misdiagnosis rate*
Conventional CT	35	27 (77.14)	8 (22.86)
MSCT enhanced scan	35	33 (94.29)	2 (5.71)
x^2	-	4.200	4.200
p	-	0.040	0.040

Table 5. Comparison of negative predictive value and positive predictive value in 62 patients [n (%)]

Group	*n*	*Negative predictive value*	*Positive predictive value*
Conventional CT	62	65.71 (23/35)	85.19 (23/27)
MSCT enhanced scan	62	86.21 (25/29)	93.94 (31/33)
x^2	-	4.527	4.258
p	-	0.031	0.042

[13]. Gastroscopic biopsy is the best examination method for gastric cancer and therapeutic evaluation after radical gastrectomy. In particular, it plays an important role in the diagnosis of early anastomotic recurrence, with unique advantages over other diagnostic methods [14]. However, since the postoperative recurrence of gastric cancer mainly involves distant organ and lymph node metastases, the diagnostic effect of gastroscopy remains unsatisfactory. Moreover, the pain during gastroscopic biopsy sampling is unbearable for some patients, thus restricting the clinical application of this method [15].

CT is a basic examination method, by which continuous and repeated cross-sectional scan can be performed using ultrasonic wave, penetrative light and detector, and then the scan site is displayed by computer [16]. It is characterized by easy operation, no pain, non-invasiveness, simplicity, good repeatability, a wide coverage and high scanning speed. However, the conventional CT images of the intestine distribution after radical gastrectomy are shown only in two dimensions and have no strong stereoscopic sensation, the remnant stomach has diverse morphology and contours, and the direction of intestine and gastric cavity is uncertain, so that misdiagnosis and missed diagnosis may be easily caused, indicating significant limitations [17]. Therefore, it is necessary to adopt a more effective diagnostic method in the clinic. With the development of medical technology in recent years, CT technique has been improved to a certain extent, and MSCT enhanced scan has been increasingly applied in the detection of gastric diseases. MSCT enhanced scan technique gradually improved and updated based on the microelectronics and computer technology is an emerging medical imaging technique, which makes a diagnosis through whole abdominal plain scan + enhanced scan, and realizes vascular reconstruction through two- and three-dimensional vascular imaging techniques, so that arterial-, portal venous- and equilibrium-phase scan can be conducted in a short time. In addition, real blood flow information and tissue motion noise can be distinguished by intelligent tracking technique, so that artifacts caused by breathing movement or peristalsis during diagnosis can be avoided, volumetric scan can be conducted and abundant data information can be obtained, thereby realizing model reconstruction and raising image quality. Moreover, the location of lesion can be accurately determined by multi-planar reconstruction. The reconstructed image and axial image can clearly reflect the condition of remnant stomach and the depth of gastric wall infiltration, and display the morphology of remnant stomach and the spatial configuration of anatomical structure in an all-round, multi-angle and three-dimensional way. They can also be used to deeply observe the size, density, morphology and enhancement mode of lymph nodes, accurately assess the clinical effect of radical gastrectomy, and comprehensively observe the tumor recurrence status, thereby providing more information for prognostic evaluation [18].

Zhou et al [19] found that MSCT enhanced scan could also achieve better results in the diagnosis of TNM stage before radical gastrectomy, and its diagnostic accuracy rate for T, M and N stage was 82.00%, 97.00% and 73.00%, respectively, with strong consistency in the examination results. The above results are similar to those in this study, suggesting that the application effect of MSCT enhanced scan image diagnosis has been recognized to a certain extent. In the present study, all patients received conventional CT and MSCT enhanced scan image diagnosis, and the results of gastroscopic biopsy were used as the gold standard. MSCT enhanced scan image had higher specificity and sensitivity in the diagnosis of recurrence than conventional CT, indicating that MSCT enhanced scan image diagnosis can improve the specificity and sensitivity in the detection of recurrence rate after radical gastrectomy to a certain extent, and help enhance the diagnostic efficiency for the prognosis after radical gastrectomy, with high safety. Moreover, the results of MSCT enhanced scan were similar to those of gastroscopic biopsy, and MSCT enhanced scan had higher negative and positive predictive values and a lower misdiagnosis rate for the recurrence than conventional CT. It can be seen that MSCT enhanced scan image diagnosis has an ideal application effect, which can help reduce misdiagnosis, improve the diagnostic accuracy for postoperative recurrence, and offer an important guarantee to follow-up examination and therapeutic evaluation after radical gastrectomy. MSCT enhanced scan is of importance for the imaging diagnosis of gastric cancer, and the determination of local infiltration status, distant organ and lymph node metastases and postoperative recurrence. With the development of modern molecular biological technique, the imaging research on gastric cancer has been gradually combined with tissue molecular biology, which is helpful for elucidating the complexity and diversity of gastric cancer imaging manifestations. Both conventional CT and MSCT enhanced scan can serve as reliable methods, but they each have obvious deficiencies. In this article, 35 cases were suspected of recurrence, and 2 cases were misdiagnosed by MSCT enhanced scan, manifested as localized band thickening of gastric

wall near the anastomotic stoma, uniform enhancement and obvious stratification. The reason for the misdiagnosis is that there is overdependence on the absolute value of the gastric wall thickness, but the surgery-induced changes in physiological function and anatomy are ignored. Therefore, MSCT enhanced scan image diagnosis cannot be used alone for determination of the clinical effect of radical gastrectomy, but should be combined with endoscopic biopsy [20]. In addition, it is necessary to comprehensively take possible influencing factors for the diagnosis results into account in the final diagnosis, and hypotonic injection can be performed followed by thin-slice scan if necessary, so as to reduce misdiagnosis and provide reasonable and accurate imaging data for clinical treatment. At the same time, the misdiagnosis is related to the sample size and inclusion criteria of patients in this study. In future research on the effect of MSCT enhanced scan image diagnosis on clinical outcome of patients after radical gastrectomy, therefore, it is expected to appropriately loosen the inclusion criteria for patients and expand the sample size.

Conclusions

The research results demonstrated that MSCT enhanced scan image diagnosis possesses unique advantages in the follow-up diagnosis after radical gastrectomy, which is of great significance for assessing the condition of disease, determining the recurrent foci after radical gastrectomy, and developing the therapeutic regimen. It can be used as an important examination method in follow-up after radical gastrectomy, and it is worthy of popularization in clinical diagnosis.

Conflict of interests

The authors declare no conflict of interests.

References

1. Assari S, Akhlaghipour G. Not Race or Age but Their Interaction Predicts Pre-Adolescents' Inhibitory Control. Child Teenagers 2020;3:50-71.
2. Assari S. Dimensional Change Card Sorting of American Children: Marginalization-Related Diminished Returns of Age. Child Teenagers 2020;3:72-92.
3. Mitrousias AS, Makris MC, Zani JR et al. Laparoscopic versus open gastrectomy with D2 lymph node dissection for advanced gastric cancer: a systematic review. JBUON 2019;24:872-82.
4. Goo HW, Goo JM. Dual-Energy CT: New Horizon in Medical Imaging. Korean J Radiol 2017;18:555-69.
5. Forghani R, De Man B, Gupta R. Dual-Energy Computed Tomography: Physical Principles, Approaches to Scanning, Usage, and Implementation: Part 1. Neuroimaging Clin N Am 2017;27:371-84.
6. Akin I, Nienaber CA. Prediction of aortic dissection. Heart 2020;106:870-1.
7. Moore A, Goerne H, Rajiah P, Tanabe Y, Saboo S, Abbara S. Acute Myocardial Infarct. Radiol Clin North Am 2019;57:45-55.
8. Letafatkar A, Rabiei P, Farivar N, Alamouti G. Long-term efficacy of conditioning training program combined with feedback on kinetics and kinematics in male runners. Scand J Med Sci Sports 2020;30:429-41.
9. Wannamaker R, Buck B, Butcher K. Multimodal CT in Acute Stroke. Curr Neurol Neurosci Rep 2019;19:63.
10. Vinogradskiy Y. CT-based ventilation imaging in radiation oncology. BJR Open 2019;1:20180035.
11. Almeida RR, Lo GC, Patino M, Bizzo B, Canellas R, Sahani DV. Advances in Pancreatic CT Imaging. Am J Roentgenol 2018;211:52-66.
12. Al'Aref SJ, Min JK. Cardiac CT: current practice and emerging applications. Heart 2019;105:1597-605.
13. Krauss B. Dual-Energy Computed Tomography: Technology and Challenges. Radiol Clin North Am 2018;56:497-506.
14. Giesel FL, Schneider F, Kratochwil C et al. Correlation Between SUVmax and CT Radiomic Analysis Using Lymph Node Density in PET/CT-Based Lymph Node Staging. J Nucl Med 2017;58:282-7.
15. Goo HW. Four-Dimensional Thoracic CT in Free-Breathing Children. Korean J Radiol 2019;20:50-7.
16. Ko BS. An Onsite CT-FFR Technique Based on TAG: A 1-Hit Wonder or Can We Expect More to Come? JACC Cardiovasc Imaging 2020;13:991-3.
17. Cremer PC. Compounding uncertainties with first-line computed tomography coronary angiography. Heart 2018;104:880-1.
18. Sekiguchi T. The Calcitonin/Calcitonin Gene-Related Peptide Family in Invertebrate Deuterostomes. Front Endocrinol (Lausanne) 2018;9:695.
19. Zhou J, Gou Z, Wu R, Yuan Y, Yu G, Zhao Y. Comparison of PSMA-PET/CT, choline-PET/CT, NaF-PET/CT, MRI, and bone scintigraphy in the diagnosis of bone metastases in patients with prostate cancer: a systematic review and meta-analysis. Skeletal Radiol 2019;48:1915-24.
20. Ihdayhid AR, Sellers SL. Novel method for assessing myocardium at risk: a new arrow in the diagnostic quiver of coronary CT. Heart 2020;106:1458-60.