The Role of CT Scan in Preoperative Staging of Colorectal Carcinoma

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Objectives: *To evaluate the role of CT scan in preoperative staging of colorectal carcinoma by comparing it with the surgical-pathologic staging and pathologic findings.*
Material and Method: *The CT scans of twenty four patients with pathological proven primary colorectal carcinoma from January 1998 to December 2002 at Srinagarind hospital Khon Kaen University were review. The CT findings were analyzed according to serosal and or pericolic fat invasion,involvement of lymphnodes, liver or other metastases, and correlated the CT staging with TNM staging.*
Results: *The CT imaging had 100% sensitivity, 57% specificity, 87.5% accuracy for evaluating serosal and/or pericolic fat invasion, 93.2% sensitivity, 54% specificity, 75% accuracy for evaluating involvement of the lymph nodes. In the present study, the distant metastases was not detected.*
Conclusion: *The role of CT in preoperative staging of colorectal carcinoma in this report can be summarized as: (1) The sensitivity in detecting serosal and/or pericolic fat invasion is relatively higher than in previous reports. (2) The criteria for evaluation of nodal disease increased accuracy of CT, and its high sensitivity is considered clinically useful.*

Keywords: *Colorectal carcinoma, CT staging*

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The CT features of colorectal carcinoma are generally known but the usefulness of CT as a preliminary screening technique and its role in preoperative staging remain controversial. The accuracy rates for preoperative staging of colorectal cancer with CT ranges between 48%-77%[1-5].

On the basis of those reports, there had been an argument whether the preoperative local staging of colorectal carcinoma was clinically useful or otherwise it would not be recommended. But in the northeast of Thailand, the patients often came in with a higher stage of disease at initial diagnosis, therefore, preoperative CT may be useful for surgical planning or radiation therapy, particularly when local extension of the tumor into adjacent organs or distant metastasis are detected. The objectives of the present study were to evaluate the role of CT scan in preoperative staging of colorectal carcinoma by comparing the imaging findings with surgical-pathologic findings. Particular attention will be on whether the study is worthwhile.

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Material and Method

Preoperative CT scans of the whole abdomen obtained within the past 5 years (1998-2002) of 24 patients with pathological proven primary colorectal carcinoma were reviewed retrospectively.

Patients in whom preoperative radiation was administered were not included because of the potential for errors in interpretation.

The study included 14 men and 10 women, ranging in age from 28-75 years (mean age 52 years). The examinations were performed with either spiral CT scans (Toshiba, Exvision, EX MODEL, TSXCO2A),

or multislices CT scans (Seimens, Somatome Plus 4 Volume Zoom).

Standard bowel preparation was performed in all patients. Bowel opacification was achieved with administration of 900-1200 ml of diluted oral contrast medium before the examination for spiral CT scans (Toshiba), and 900- 1200 ml of water for multislices CT scans.

The contrast-enhanced CT images were obtained at 30 and 70 seconds after starting an intravenous injection of contrast medium (100 ml, 300 mgI) by mechanical injector at the rate of 3-5 ml/sec, from just above the dome of diaphragm to pubic symphysis with 8 or 10 mm contiguous sections.

All studies were reviewed by an experienced radiologist without knowledge of the histopathological findings.

For all CT findings, the following data were recorded,

1. The primary tumor characteristics, which included site of primary lesion, extent of tumor whether the tumor was limited to the muscularis propria (T2 in TNM staging) or extended into serosa and/or pericolic fat (T3 in TNM staging), invasion of nearby structures, other masses (T4 in TNM staging). The CT finding of extraluminal extension were recorded by a striated increased density of pericolic fat at the level of tumor involvement.

2. The lymph nodes involvement (a single node $\geq$ 5 mm or an abnormal cluster of normal size nodes).

The pathways of nodal metastases was based on the site of the primary tumors[6].

a. Epicolic nodes: lie on the wall of the colon beneath the peritoneum covering the colon, generally on the antimesocolic side of the colonic wall.

b. Paracolic nodes: lie along the marginal vessels along the mesocolic side of the colon.

c. Intermediate mesocolic nodes: lie in the mesocolon accompanying the vessels in mesocolon and draining into principal nodes at the root of the mesocolon.

d. Principle nodes.

3. Distant metastases (liver metastasis, intraperitoneal and mesenteric invasion, bony metastasis).

All data were compared and correlated with the surgical-pathologic staging by TNM staging[7].

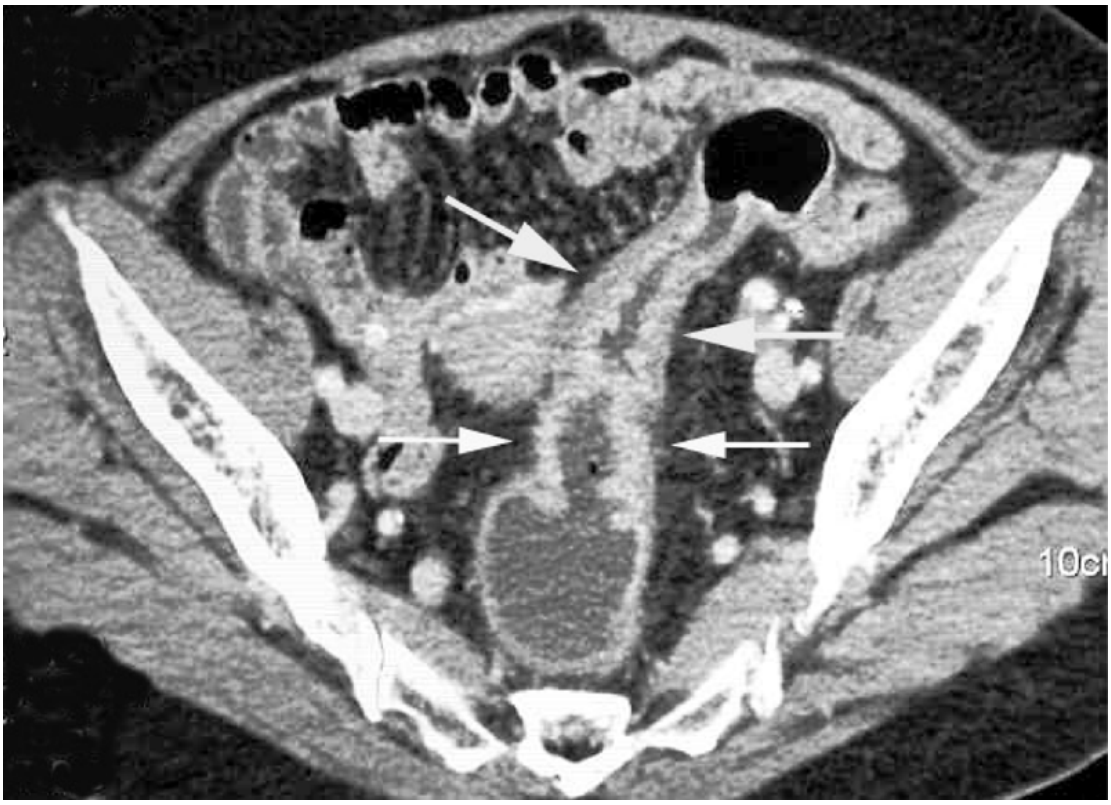

Fig. 1 CT scan is correctly staged for sigmoid tumor confined to colonic wall (arrows)

Results

The assessment of tumor extension was based on 24 patients, 19 with colonic cancer, 5 with rectal cancer.

Primary lesion in colorectal cancer

The extent of the tumor limited in muscularis propria was proved by histopathologic examination in 7 patients. The CT staging was correct in 4 patients (Fig. 1) and overstaged in 3 patients (Fig. 2)

Tumor invasion of serosa and/ or pericolic fat was proved at histopathological examination in 17 patients, there were all correctly staged by CT.

There were 17 true-positive cases (Fig. 3 A, B), 3 false-positive cases, 4 true-negative cases, and no false-negative case.

CT evaluation resulted in a sensitivity of 100% and a specificity of 57%. While the negative predictive value was 100%, CT exhibited an 85% positive predictive value (Table 1).

The lymph nodes

CT identified involvement of epicolic and paracolic lymph nodes in 14 cases, intermediate lymph nodes 1 case, and principal nodes 2 cases (paraaortic lymph nodes and inferior mesenteric lymph nodes). No node was found in 7 patients.

There were 12 true-positive cases (Fig. 4), 6 true-negative cases, 5 false-positive cases, and 1 false-negative case.

CT evaluation yielded a sensitivity of 92.3% and a specificity of 54%. The positive and negative predictive values were 70% and 14%, respectively (Table 2).

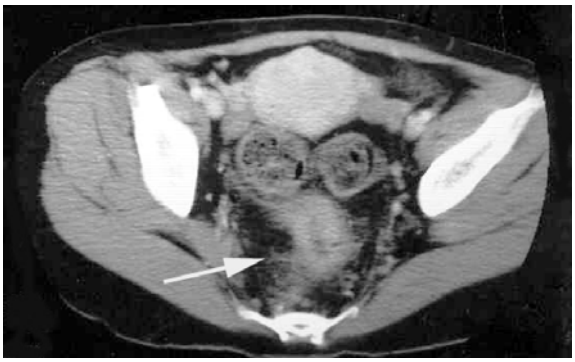

Fig. 2 CT scan is overstaged. It shown serosal invasion by the tumor (arrowhead). Pathologic examination shows a tumor confined to the colonic wall

Distant metastasis

Two patients had incidental liver cysts (Fig. 5). The liver cyst was aspirated in only one patient and the pathologic findings confirmed it to be a simple liver cyst. The other patient was not further investigated.

Discussion

The treatment of patients with colorectal carcinoma is predicted on total removal of the cancerous tissue. The prognosis is affected substantially by the extent of colorectal wall penetration, lymph node involvement and distant metastases.

Finlay and Mc Ardle reported[8] a 5 years motality rate of 10% in a group of patients without demonstrated hepatic metastases at initial diagnosis versus a motality rate of 94% in patients in whom CT and ultrasound depicted clinically occult lesions at initial diagnosis.

Table 1. Pathological extension of tumor in serosa and pericolic fat compared to computed tomographic (CT) findings in 24 patients

CT scan findings	Pathological findings		Total
	+	–	
+	17	3	20
–	0	4	4
Total	17	7	24

Sensitivity = (17/17) x 100 = 100%
Specificity = (4/7) x 100 = 57%
Accuracy = (21/24) x 100 = 87.5%
Positive predictive value = (17/20) x 100 = 85%
Negative predictive value = (4/4) x 100 = 100%

Table 2. Pathological results of lymphadenopathy compared to CT results in 24 patients

CT findings of LN	Pathological findings of LN		Total
	+	–	
+	12	5	17
–	1	6	7
Total	13	11	24

Sensitivity = (12/13) x 100 = 92.3%
Specificity = (6/11) x 100 = 54%
Accuracy = (18/24) x 100 = 75%
Positive predictive value = (12/17) x 100 = 70%
Negative predictive value = (6/7) x 100 = 85%

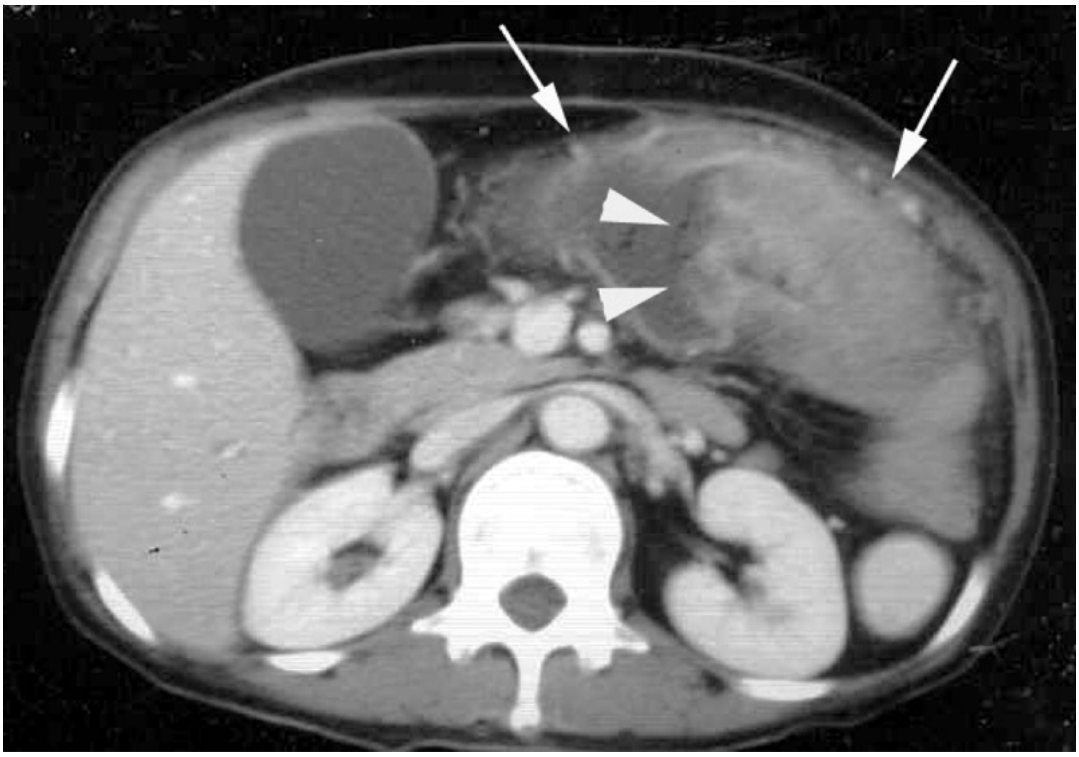

Fig. 3A True-positive CT scan for serosal invasion (arrows) of tumor mass of transverse colon (arrowheads)

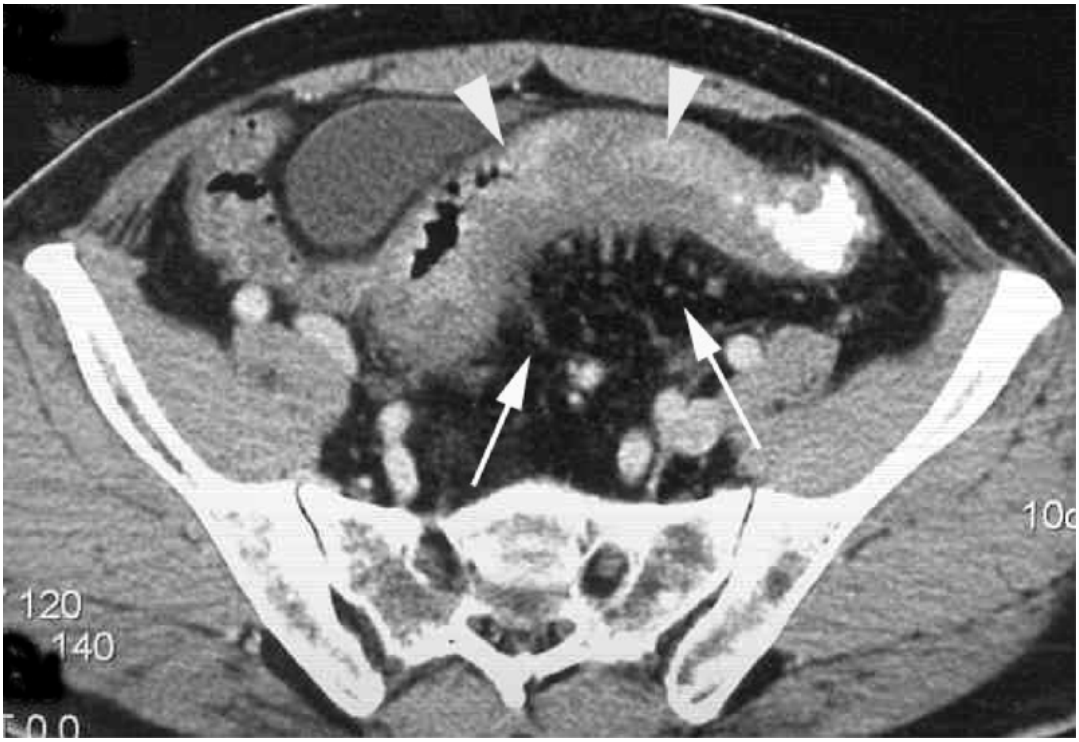

Fig. 3B True-positive CT scan for serosal invasion (arrows) of tumor mass of sigmoid colon (arrowheads)

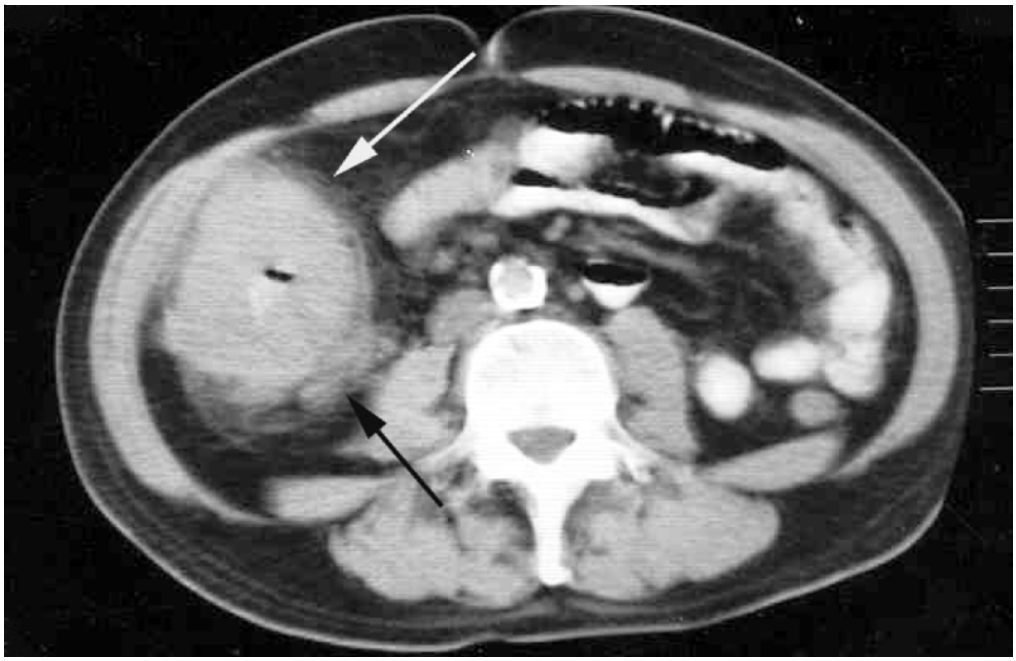

Fig. 4 True-positive CT scan for serosal invasion (white arrow) and nodal involvement (black arrow)

Fig. 5 CT scan shows incidental liver cysts (arrowhead). The cyst was aspirated and the pathologic findings confirmed it to be a simple liver cyst

In the present study, the authors attempted to analyze the images according to the best available measures of the truth for three specific staging tasks. These tasks were the determination of

(1) Serosal and/ or pericolic fat invasion.

(2) Involvement of the lymph nodes.

(3) Presence of liver metastasis and/or other metastasis such as bony metastasis.

Assessment of local tumor extent

The overall sensitivity of 100% for detection of serosal and/or pericolic fat in the present study correlated better with a sensitivity of 60% reported by Barakos et al[9], 55% reported by Balthazar et al[1], and 61% reported by Freeny et al[3].

This apparent difference in sensitivity could be related to a small group of patients and higher technology of CT scanner in the present study. The CT finding of striated increase density of pericolic fat at the level of tumor involvement may represent vascular or lymphatic congestion.So specificity of this finding is 57%.

Assessment of the lymph nodes

The detection of the lymph nodes in the present study was 92.3% sensitivity and 75% accuracy. The result is better than in other reports such as Balthazar et al[1], which was 73% sensitivity and 68% accuracy.

In the present study, the criteria for evaluating nodal disease increased accuracy of CT scans (node size 0.5 cm considered positive while it was 1cm in earlier reports). Its high sensitivity is considered clinically useful.

Assessment of distant metastasis

There was a limitation in evaluating the role of CT in preoperative staging of distant metastasis in the present study, due to the small group of patients. CT diagnosed a liver cyst in 2 patients, one was confirmed, the other was not further investigated.

The presented patients had only lower stage that did not affect the surgical treatment. Detection of metastatic lesion may lead to change in surgical planning and preoperative management. Surgical resections may be considered useless or not feasible, limited resections may be done instead of extensive curative procedures, or radiation and/or chemotherapy may be indicated before surgery. Then the preoperative CT evaluation of colonic cancer is useful. In addition, CT scans is superior to any other single staging technique and can be used to assess the entire peritoneal cavity, retroperitoneum and solid organs during a single examination. If any imaging technique is considered in the preoperative work-up, CT scans should be regarded as the technique of choice.

Conclusion

The role of CT in the preoperative staging of colorectal carcinoma in the present report can be summarized as follows:

- The sensitivity in detecting serosal and/or pericolic fat invasion is relatively higher than previous reports, may be because of newer technology nowadays which enhanced the greater rate of wall penetration in the present study.

- The criteria for evaluation of nodal disease increased accuracy of CT, and its high sensitivity is considered a worthy preoperative investigation.

- The important consideration for study of CT of gastrointestinal tract are proper distension of the bowel lumen, clearing of the content and adequate extraluminal fat. So CT staging of the rectal cancer may meet the successful factor than cancer in other parts of the colon.

References

1. Balthazar EJ, Megibow AJ, Hulnick D, Naidich DP. Carcinoma of the colon: detection and preoperative staging by CT. AJR Am J Roentgenol 1988; 150: 301-6.
2. Earls JP, Colon-Negron E, Dachman AH. Colorectal carcinoma in young patients: CT detection of an atypical pattern of recurrence. Abdom Imaging 1994; 19: 441-5.
3. Freeny PC, Marks WM, Ryan JA, Bolen JW. Colorectal carcinoma evaluation with CT: preoperative staging and detection of postoperative recurrence. Radiology 1986; 158: 347-53.
4. Gazelle GS, Gaa J, Saini S, Shellito P. Staging of colon cancarcinoma using water enema CT. J Comput Assist Tomogr 1995; 19: 87-91.
5. Thompson WM, Halvorsen RA, Foster WL Jr, Roberts L, Gibbons R. Preoperative and postoperative CT staging of rectosigmoid carcinoma. AJR Am J Roentgenol 1986; 146: 703-10.
6. Charnsangavej C. Pathways of lymph node metastases in cancer of the gastrointestinal and hepatobiliary tracts. In: Mayer MA, editor. Dynamic radiology of the abdomen: normal and pathologic anatomy. 5thed. New York: Springer-Verlage, 2000: 286-308.

7. Rolandelli RH, Roslyn JJ. Colon and rectum. In: Townsend CM Jr, Beauchamp RD, Evers MM, Mattox KL, editors. Sabiston textbook of surgery: the biological basis of modern surgical practice. 16thed. Philadelphia: W.B. Suanders; 2001: 929-73.
8. Finlay IG, McArdle CS. Occult hepatic metastases in colorectal carcinoma. Br J Surg 1986; 73: 732-5.
9. Barakos JA, Goldberg HI, Brown TJ, Gilbert JJ. Comparison of computed tomography and magnetic resonance imaging in the evaluation of focal hepatic lesions. Gastrointest Radiol 1990; 15: 93-101.

บทบาทของเอกซเรย์คอมพิวเตอร์ในการตรวจบอกระยะของมะเร็งลำไส้ใหญ่และทวารหนักก่อนผ่าตัด

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การตรวจโดยภาพเพื่อบอกระยะของมะเร็งลำไส้ใหญ่ และทวารหนักก่อนผ่าตัด จะเป็นสิ่งที่ช่วยในการวางแผนการรักษาร่วมกับการตรวจทางห้องปฏิบัติการ การตรวจโดยการส่องกล้อง การตรวจด้วยเอกซเรย์คอมพิวเตอร์เริ่มมีบทบาทมากขึ้น ในการบอกระยะและการลุกลามของมะเร็ง คณะผู้รายงานได้ทำการศึกษาย้อนหลังภาพการตรวจเอกซเรย์คอมพิวเตอร์ในผู้ป่วยซึ่งได้รับการวินิจฉัยว่าเป็นมะเร็งลำไส้ใหญ่ และทวารหนัก ในโรงพยาบาลศรีนครินทร์ย้อนหลัง 5 ปี (ปี พ.ศ. 2541 ถึง ปี พ.ศ. 2545) เพื่อเทียบกับผลการผ่าตัดและผลทางพยาธิวิทยาเพื่อหาความไวและความจำเพาะของ การตรวจด้วยวิธีนี้

พบว่า เอกซเรย์คอมพิวเตอร์มีความไวอยู่ในระดับสูงของการตรวจดูการลุกลามของมะเร็งออกนอกผนังลำไส้ การกระจายไปยังต่อมน้ำเหลือง การกระจายไปอวัยวะอื่น ๆ และพบว่าความสอดคล้องกันระหว่างการบอกระยะโดยเอกซเรย์คอมพิวเตอร์ ผลการผ่าตัด และผลการตรวจทางพยาธิวิทยา โดยใช้การแบ่งระยะตาม ระบบ TNM พบว่ามีความไวค่อนข้างสูง และนับว่าเอกซเรย์คอมพิวเตอร์เป็นวิธีการตรวจที่มีประโยชน์ในการตรวจดูการลุกลามและการแพร่กระจายของโรค