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Colorectal cancer tumoral and nodal staging : Comparison between CT findings and pathological findings

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Background and Rationale : *Colorectal cancer is a common malignancy of the gastrointestinal tract. In Thailand, colorectal cancer is the third most common cancer in males and fifth most common in females. Incidence rate of colorectal cancer has been rising in Thailand. Pathologic staging is the gold standard for colorectal cancer. However, it is followed by post-operative procedure. Computed tomography (CT) is noninvasive and preoperative assessment. Preoperative CT is useful for planning therapy by which local extension of the tumor into the adjacent organs or distant metastases are demonstrated. Differentiation between T2 and T3 colon cancer is important for consideration of chemotherapy.*

Objective : *To compare the multi-detected computed tomography (MDCT) of the whole abdomen for colorectal cancer staging correlated with pathologic staging including the accuracy of the staging of the tumor (T) and lymph nodes (N).*

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Research design : *Retrospective descriptive study.*

Setting : *Department of Radiology, Faculty of Medicine, Chulalongkorn University and King Chulalongkorn Memorial Hospital.*

Material and Methods : *Abdominal MDCT scans of 178 patients with pathologic diagnosis of colorectal cancer were retrospectively reviewed from 1st January 2007 to 31st December 2009 at King Chulalongkorn Memorial Hospital.*

Result : *Agreement of CT for T staging is good with excellent interobserver agreement. The overall accuracy of correct T stage from CT scan was 75.84%. All overstaged CT scans with pathologic stage ≤ T2 were pericolonic fat stranding due to mitoses, necrosis, mucin producing area, and desmoplastic reaction around the sheet of tumor from pathological reports. The causes of overstaging by CT scan with pathologic stage T3 were obliteration of fat plane of adjacent organs in 4 lesions, abutting peritoneum in 6 lesions, ascites in 1 lesion, and colonic perforation in 2 lesions. All cases of understaging by CT scan with pathologic stage T3 were no pericolonic fat stranding and 2 cases of understaging by CT scan with phathologic stage T4 were preserved fat plane between the mass and adjacent organs. The highest sensitivity, NPV and accuracy are stage T4 (86.4%, 97.8% and 89.9%, respectively). The highest specificity is stage T ≤ 2 (92.3%). The highest PPV is stage T3 (90.3%). Agreement of CT for N staging is poor with good interobserver agreement. The overall accuracy of correct N stage from CT scan was 32.27%. The highest sensitivity is stage N0 (63.8%). The highest specificity, PPV and accuracy are stage N2 (99.1%, 83.3% and 64.6%, respectively). The highest NPV is stage N1(74.6%).*

Conclusion : *CT scan is useful in preoperative evaluation of colorectal cancer. In our study, colorectal cancer staging from CT scan is considered satisfactory for tumor staging, but too low to determine the nodal staging. The overall accuracy of correct T stage by CT scan was 75.84%.*

Keywords : *Colorectal cancer tumor and nodal staging, CT staging of colorectal cancer in comparison with pathological staging, CT staging of colorectal cancer.*

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บทนำ : *มะเร็งลำไส้ใหญ่เป็นมะเร็งที่พบบ่อยสำหรับมะเร็งทางเดินอาหาร โดยในประเทศไทยมะเร็งลำไส้ใหญ่พบมากเป็นอันดับสามของมะเร็งในผู้ชายและอันดับห้าของมะเร็งในผู้หญิง และมีแนวโน้มว่าจะมีอุบัติการณ์เพิ่มขึ้น การตรวจทางพยาธิวิทยาเป็นมาตรฐานสำหรับการวินิจฉัยมะเร็งลำไส้ใหญ่ แต่จำเป็นต้องได้มาจากการผ่าตัด ฉะนั้นการตรวจเอกซเรย์คอมพิวเตอร์เป็นการตรวจที่ไม่ก่อให้เกิดการบาดเจ็บ และสามารถประเมินก่อนการผ่าตัดได้ โดยเฉพาะการแบ่งระยะของมะเร็งลำไส้ใหญ่ก่อนการผ่าตัด จึงมีความจำเป็นสำหรับการวางแผนตัดสินใจให้เคมีบำบัดก่อนการผ่าตัด*

วัตถุประสงค์ : *เพื่อหาค่า agreement สำหรับการแบ่งระยะของมะเร็งลำไส้ใหญ่เปรียบเทียบระหว่างการตรวจเอกซเรย์คอมพิวเตอร์กับการตรวจทางพยาธิวิทยา และค่าความแม่นยำของการแบ่งระยะของมะเร็งลำไส้ใหญ่*

รูปแบบการทำการวิจัย : *การวิจัยเชิงพรรณนาแบบย้อนหลัง*

สถานที่ทำการศึกษา : *ภาควิชารังสีวิทยา คณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย*

วิธีการศึกษา : *ศึกษาภาพถ่ายเอกซเรย์คอมพิวเตอร์ก่อนการผ่าตัดของผู้ป่วยจำนวน 178 คน ที่ได้รับการวินิจฉัยว่าเป็นมะเร็งลำไส้ใหญ่จากการตรวจทางพยาธิวิทยาที่ได้มาจากการผ่าตัดลำไส้ใหญ่ตั้งแต่วันที่ 1 มกราคม 2550 ถึง วันที่ 31 ธันวาคม 2552 ที่โรงพยาบาลจุฬาลงกรณ์*

ผลการศึกษา : *ค่า agreement ของการแบ่งระยะของมะเร็งปฐมภูมิทางพยาธิวิทยากับเอกซเรย์คอมพิวเตอร์อยู่ในเกณฑ์ดี โดยมีค่า agreement ของรังสีแพทย์ทั้ง 2 ท่านอยู่ในเกณฑ์ดีเยี่ยม ความแม่นยำเฉลี่ยของการแบ่งระยะของมะเร็งลำไส้ใหญ่ประมาณร้อยละ75.84 สาเหตุของการประเมินของมะเร็งปฐมภูมิระยะที่ 2 จากเอกซเรย์คอมพิวเตอร์สูงกว่าความเป็นจริง คือ การพบ pericolonic fat stranding ซึ่งเป็นผลจาก desmoplastic reaction ที่เกิดขึ้นรอบเนื้องอก และสาเหตุของการประเมินของมะเร็งปฐมภูมิระยะที่ 3 สูงค่ากว่าความเป็นจริง มีสาเหตุมาจาก abut adjacent organ จำนวน 4 ราย, abut peritoneum จำนวน 6 ราย, ascites จำนวน 1 ราย และ colonic perforation จำนวน 2 ราย ในขณะที่ทุกกรณีของ*

การประเมินของมะเร็งปฐมภูมิระยะที่ 3 ต่ำกว่าความเป็นจริง คือ การไม่พบ pericolonic fat stranding และกรณีของการประเมินของมะเร็งปฐมภูมิระยะที่ 4 ต่ำกว่าความเป็นจริง คือ preserved fat plane ระหว่างก้อนมะเร็งและอวัยวะข้างเคียง ค่า sensitivty, NPV และ accuracy สูงสุด คือ มะเร็งปฐมภูมิระยะที่ 4 (ร้อยละ 86.4, 97.8 และ 89.9 ตามลำดับ) ค่า specificity สูงสุดคือ มะเร็งปฐมภูมิระยะที่ ≤ 2 และค่า PPV สูงสุด คือ มะเร็งปฐมภูมิระยะที่ 3 ค่า agreement ของการแบ่งระยะของมะเร็งลุกลามต่อมน้ำเหลืองระหว่างการตรวจทางพยาธิวิทยากับการตรวจทางเอกซเรย์คอมพิวเตอร์มีค่าต่ำมาก ความแม่นยำของการวินิจฉัยจากเอกซเรย์คอมพิวเตอร์ในการแบ่งระยะของมะเร็งลุกลามต่อมน้ำเหลือง คือ ร้อยละ 32.27 ค่า sensitivity สูงสุด คือ มะเร็งลุกลามต่อมน้ำเหลืองระยะที่ 0 ค่า specificity, PPV และ accuracy สูงสุด คือ มะเร็งลุกลามต่อมน้ำเหลืองระยะที่ 2 และค่า NPV สูงสุด คือ มะเร็งลุกลามต่อมน้ำเหลืองระยะที่ 1

สรุป : *การเอกซเรย์คอมพิวเตอร์ยังคงถูกใช้ในการประเมินผลก่อนการผ่าตัดมะเร็งลำไส้ใหญ่ การศึกษาการแบ่งระยะของมะเร็งลำไส้ใหญ่จากเอกซเรย์คอมพิวเตอร์พบว่าเป็นที่น่าพอใจสำหรับมะเร็งปฐมภูมิ แต่การตรวจเอกซเรย์คอมพิวเตอร์ยังอยู่ในระดับต่ำ สำหรับการประเมินการลุกลามของมะเร็งไปยังต่อมน้ำเหลือง ความแม่นยำเฉลี่ยของการแบ่งระยะของมะเร็งลำไส้ใหญ่ประมาณร้อยละ 75.84*

คำสำคัญ : *การแบ่งระยะของมะเร็งลำไส้ใหญ่, การตรวจเอกซเรย์คอมพิวเตอร์เทียบกับการตรวจทางพยาธิวิทยาของมะเร็งลำไส้ใหญ่, การตรวจเอกซเรย์คอมพิวเตอร์ของมะเร็งไส้ใหญ่.*

Colonic cancer is a common malignancy of the gastrointestinal tract.[1] Cancers of the colon and rectum are rare in developing countries, in contrast to the high incidence rates in European countries, North America, Australia and Japan. However, the incidence in Japan and Thailand is rising, probably due to the acquisition of Western lifestyle.[2] In Thailand, colonic cancer is the third in frequency in males after liver and bile duct and lung cancers, and the fifth in females after cancer of the breast, cervix, liver and bile duct, and lung.[2,3] The highest incidence is seen in Bangkok.[2] The number of cases of colorectal cancer in both genders is increasing and will probably exceed that of lung cancer in the next decade.[2] Incidence rate is increased with age.[3]

Pathologic tumoral (T) and nodal (N) staging is gold standard for colorectal cancer staging. However, it is followed by post-operative procedure. Computed tomography (CT) is noninvasive and preoperative assessment. The sensitivity of CT in detection of primary colon cancer is variable, and depending on the size of the tumor.[1] Colonic carcinoma staging by CT scan is controversial. CT is limited for the detection of small tumors or lesions less than 3 – 5 mm in diameter.[1] Other limitations of CT staging include an inability to definitively identify nodes that contain tumor or to determine the exact depth of tumor invasion through the wall. However, CT and endoluminal ultrasound are better than manual examination, barium enema, or fiberoptic techniques.[4]

Preoperative CT is very useful imaging modality for planning treatment especially adjustment of chemotherapy. The role of chemotherapy for T2 colon cancer following surgery is controversial. Chemotherapy is the standard treatment for T3 colon cancer, according to guidelines from the National Comprehensive Cancer Network (NCCN). Colon cancer stage T2N0 does not need adjuvant chemotherapy. As for stage T3N0 without high risk may or may not need adjuvant chemotherapy. The stage T3N0 with high risk should be given adjuvant chemotherapy.[5] Same as in rectal cancer guideline, cancer stage T2N0 do not need adjuvancet chemotherapy but stage T3N0 should receive adjuvant chemotherapy.[6] Differentiation between T2 and T3 colon cancer is important for judgment of chemotherapy.

For nodal staging, when colonic cancer spreads outside the colon, cancer cells are often found in nearby lymph nodes. If cancer cells have reached these nodes, they may spread to other lymph nodes or other organs.[7]

The purpose of our study was to compare between CT findings and pathologic findings of colorectal cancer in tumoral and nodal staging including sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and accuracy of CT in colorectal cancer.

Meterial and Methods

Patient Population

From January 1, 2007 to December 31, 2009, 548 patients with proved pathology of colorectal cancer from surgical specimens at King Chulalongkorn Memorial Hospital (KCMH) were enrolled. Among these patients, 370 were considered ineligible for the study because of no abdominal multi-detected computed tomography (MDCT) available in the picture archive and communication systems

(PACS), no intraluminal contrast material, history of previous chemotherapy and/or previous surgery. The remaining 178 patients were included (89 men and 89 women with age range of 18 - 99 years and mean age of 64 years ± 13).

This study has been approved by the Ethics Committee of the Faculty of Medicine, Chulalongkorn University.

Histological data were recorded by an experienced pathologist. The time between surgery and abdominal MDCT scan were 1 to 176 days (mean 34 ± 37 days).

CT Protocol

Abdominal MDCT was done with 16 slices CT scanner (Somatom sensation 16 Siemen medical system, Erlangen Germany). The CT parameters were as follows: 5-mm collimation, table speed of 1.0 pitch and reconstruction of the data at 5-mm intervals. Bowel opacification was archived with ingestion of 750 ml of 2% diluted water soluble iodinated contrast media 90 -120 minutes before imaging, followed by 500 - 1000 ml diluted water soluble contrast material via the rectum; then, ingestion of 500 ml of water 5 minutes before imaging.

The contrast enhanced CT imaging were obtained at 85 - 95 seconds for portovenous phase after starting an intravenous injection of 100 ml of iodinated contrast medium (either iohexol 300 mgI/ml or meglumine ioxitalamate 350 mgI/ml) via power injector at the rate of 2 ml/second.

CT Image Analysis

Two experienced gastrointestinal radiologists retrospectively reviewed the CT findings from PACS independently. They were blinded from the pathology of the tumor and nodal staging.

Primary Tumor (T) [4,8]

Colorectal wall invasion was analyzed according to a modified tumoral (T) classification. The readers considered only three T stages (≤ T2, T3 or T4) instead of normal four T-stages as reported in the TNM system. T1 and T2 tumors were combined to be one T stage ≤ T2. This classification was used due to known limitations of CT that cannot distinguish T1 and T2 lesions. ≤ T2 lesions were defined as focal colonic wall thickening ≥ 5 mm or colonic mass without extracolonic mass or pericolonic fat stranding (Figure 1).

T3 lesions were defined as round or nodular tumor with extracolonic mass, or pericolonic fat stranding (Figure 2).

T4 lesions were defined as loss of the fat plane between the colon and adjacent organs or perforation to the visceral peritoneum (Figure 3).

Regional Lymph Nodes (N) [9, 10]

Lymph nodes were defined as: N0 if there was no metastasis of pericolonic lymph nodes. In stage of N1, equal to or less than 3 pericolonic lymph nodules with the size equal to or greater than 1 cm in short axis diameter, or a cluster of 3 pericolonic lymph nodules of any size were present. In stage of N2, four or more pericolonic lymph nodules were identified.

Image Analysis

Multiplanar reconstruction (MPR) techniques was used in all patients. The tumor size was measured at the colorectal wall thickening by a caliper tool on

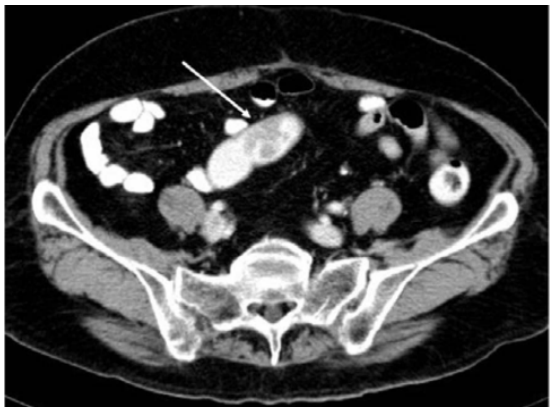

Figure 1. ≤ T2 : The abdominal MDCT scan reveals a focal colonic wall thickening ≥ 5 mm (white arrow) without pericolonic fat stranding at the sigmoid colon.

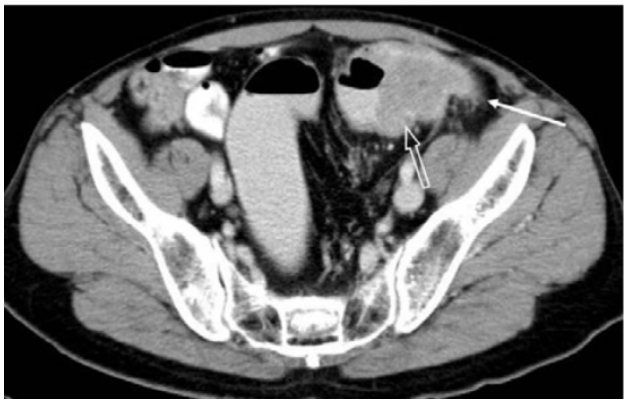

Figure 2. T3 : The abdominal MDCT scan reveals a polypoid colonic mass (open arrow) with pericolonic fat stranding (white arrow) at the sigmoid colon.

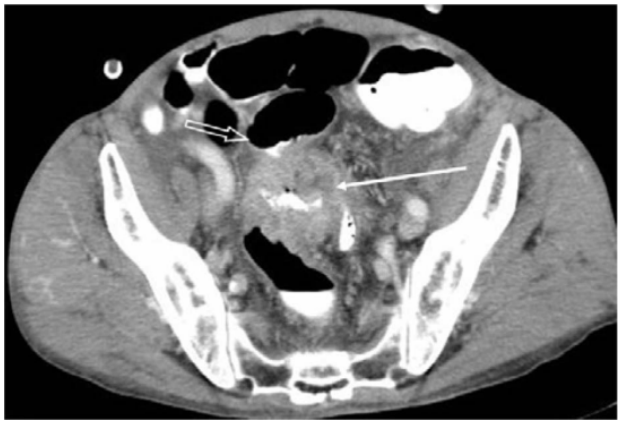

Figure 3. T4 : The abdominal MDCTscan reveals an asymmetrical circumferential colonic wall thickening (white arrow) with loss of the fat planes between the colon and small bowel (open arrow), representing directly invaded small bowel.

PACS. Adjacent organ invasion was interpreted by the loss of the fat plane between colorectum and adjacent organs or peritoneum or perforation to the visceral peritoneum. Regional lymph node metastases were measured in short axis diameter.

Statistical Analysis

The sample size was calculated by PASS program from www.ncss.com. Comparison between CT findings and pathological finding was used in agreement with Weighted Kappa test. Weighted Kappa analysis was performed in http://faculty.vassar.edu/lowry/kappa.html. Interobserver agreement was also evaluated by weighted Kappa analysis.

Result

The location of the tumor was described in Diagram 1. The most common location was the sigmoid colon in 92 cases (52%) followed by the rectum in 39 cases (22%), the ascending colon in 15 cases (8%), the splenic flexure in 9 cases (5%), the hepatic flexure in 7 cases (4%), the descending colon in 7 cases (4%), the transverse colon in 6 cases (3%) and the cecum in 3 cases (2%).

The pathological tumoral staging included stage 1 in 4 cases (2%), stage 2 in 18 cases (10%), stage 3 in 134 cases (76%) and stage 4 in 22 cases (12%) (Diagram 2).

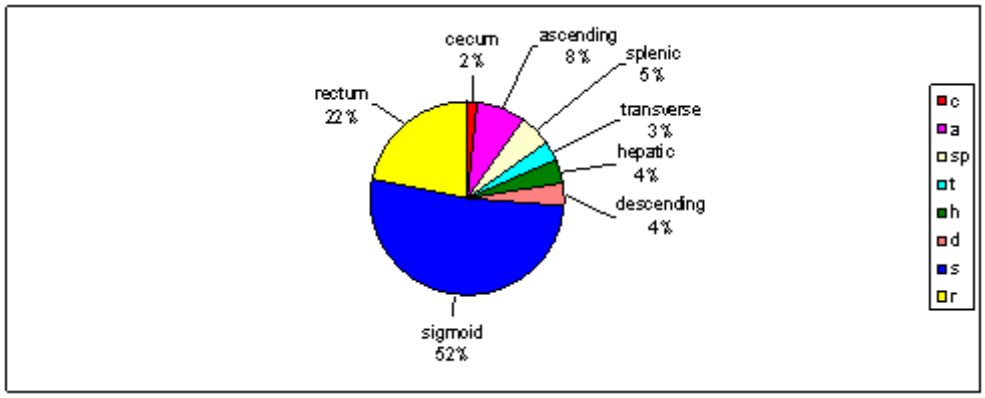

Diagram 1. Pie chart reveals percentage of location of the tumor; c: cecum; a : ascending colon; sp : splenic flexure; t : transverse colon; h : hepatic flexure; d : descending colon; s : sigmoid colon; and, r : rectum

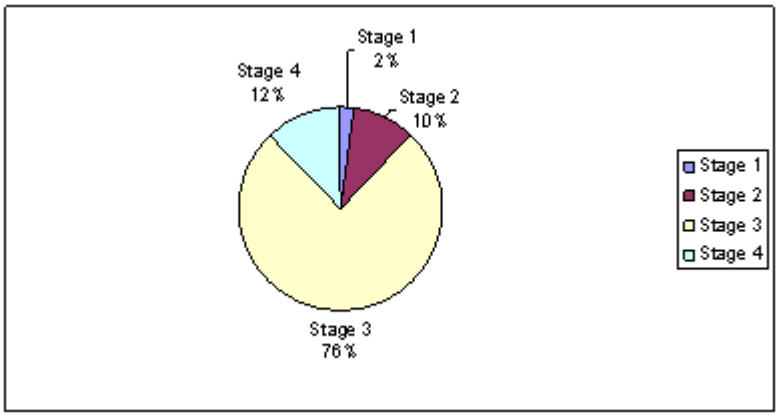

Diagram 2. Pie chart reveals percentage of pathological tumoral stage of the cancer.

The pathologic nodal staging was stage 0 in 69 cases (38%), stage 1 in 42 cases (24%) and stage 2 in 67 cases (38%) (Diagram 3).

Agreement of CT for T staging was good with pathological staging. Interobserver agreement for CT staging of T stage was excellent (Table 1).

The overall accuracy of CT in tumoral staging was 75.84% (135 of 178 cases).

The highest sensitivity, NPV and accuracy are stage T4 (86.4%, 97.8% and 89.9%, respectively). The highest specificity is stage T≤2 (92.3%). The highest PPV is stage T3 (90.3%) (Table 2). There were 15 patients of overstaging by CT.

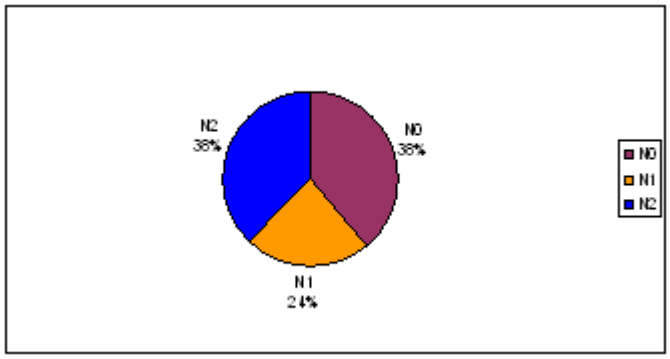

Diagram 3. Pie chart reveals percentage of pathological nodal stage of the cancer.

Table 1. Kappa values of each condition.

Stage	Weighted Kappa value (K)
T stage	0.5052
N stage	0.1249
T stage of radiologist 1 and 2	0.765
N stage of radiologist 1 and 2	0.6097

(K > 0.75 - excellent agreement, 0.40 < K < 0.75 - good agreement , K < 0.40 - poor agreement)

Table 2. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of each tumoral stages.

Stage	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
≤2	54.5	92.3	50.0	93.5	87.6
3	79.1	75.0	90.3	50.8	75.8
4	86.4	90.4	55.9	97.8	89.9

In all there were 2 cases with overstaging by CT scan with pathological stage ≤T2 by two radiologists and revealed pericolonic fat stranding. Pathologic reports of all these case are mitoses, necrosis, mucin producing area, and desmoplastic reaction around the sheet of tumor (Figure 4a and 4b).

The cause of overstaging by CT scan with pathologic stage T3 by two radiologists were 13 cases. There were adjacent organ involvement in 4 lesions (Figure 5), peritoneal involvement in 7 cases (Figure 6), and colonic perforation in 2 cases.

There were 10 patients with understaging by CT. Eight patients with understaging by CT scan with pathologic stage T3 showed no pericolonic fat stranding (Figure 7). Two cases of understaging by CT scan with pathologic stage T4 showed preserved fat plane between mass and adjacent organs (Figure 8).

Agreement of CT for N staging with pathological staging was poor. However, inter-observer agreement for CT staging of N stage was good (Table 1). The overall accuracy of correct N stage from CT scan was 32.27% (61 of 178 cases).

The highest sensitivity is stage N0 (63.8%). The highest specificity, PPV and accuracy are stage N2 (99.1%, 83.3% and 64.6%, respectively). The highest NPV is stage N1 (74.6%). (Table 3).

Incorrect nodal CT staging or incorrect tumoral CT staging were tumor extention mimic lymph node enlargement (Figure 9) or lymph node mimic tumor extension (Figure 10a and 10b).

The duration CT scan and the operation less than 90 days (1 - 89 days) in 164 cases. The overall accuracy of CT in tumoral staging in this group was 75.6% (124 of 164 cases) and in nodal staging was 35.4% (58 of 164 cases).

The duration between CT scan and the operation more than 90 days (95 - 176 days) in 14 cases. The overall accuracy of CT in tumoral staging in this group was 78.6% (11 of 14 cases) and in nodal staging was 21.4% (3 of 14 cases).

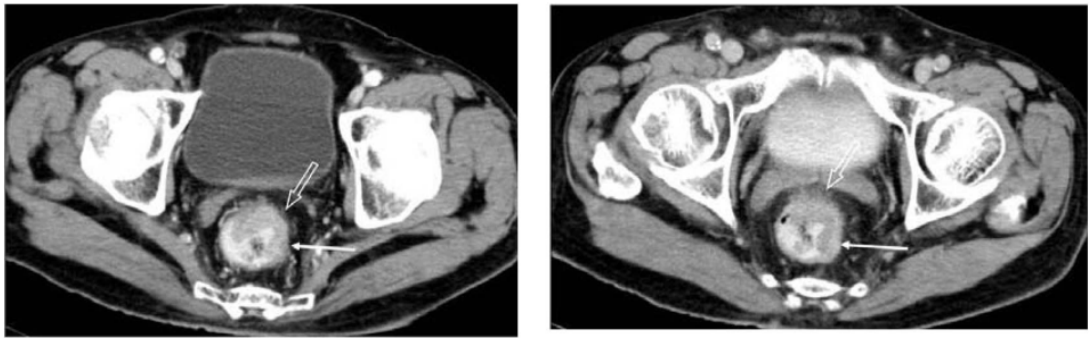

Figure 4a and 4b. The abdominal MDCT scan of a 77 year-old male patient demonstrated an focal rectal wall thickening (white arrows) with pericolonic fat stranding (open arrows), suggested stage T3. Pathology reported stage T2 with mitoses, necrosis, mucin producing area and desmoplastic reaction around the sheet of tumor.

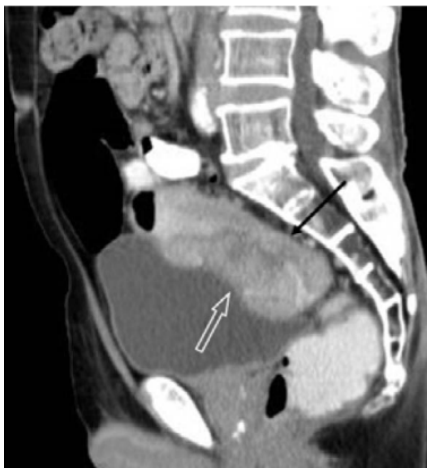

Figure 5. The abdominal MDCT scan of a 63-year-old male patient revealed loss of fat plane between the tumor (black arrow) and urinary bladder (open arrow), suggested stage T4. Pathologist reported stage T3.

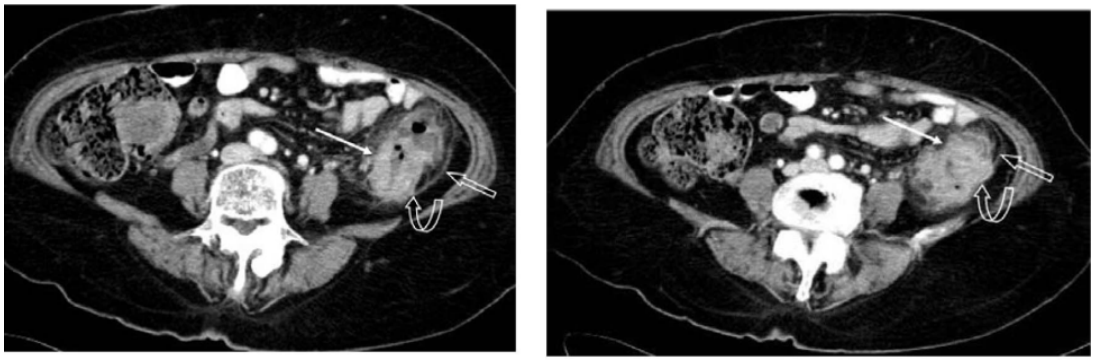

Figure 6a and 6b. The abdominal MDCTscan of a 68 year old male patient revealed loss of fat plane (curve arrows) between tumor (white arrows) and adjacent peritoneum (open arrows), suggested stage T4. Pathologist reported stage T3.

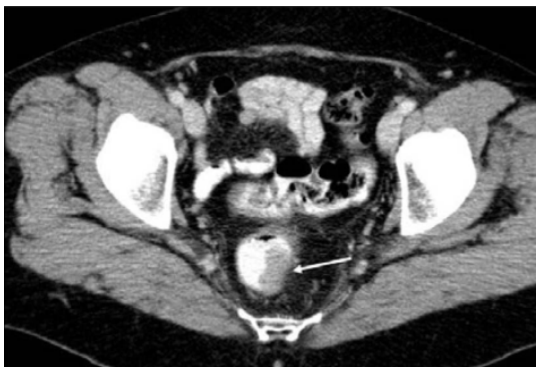

Figure 7. The abdominal MDCT scan of a 59 year-old female patient revealed a focal rectal wall thickening (white arrow) without perirectal fat stranding, suggested stage T2. Pathologist reported stage T3.

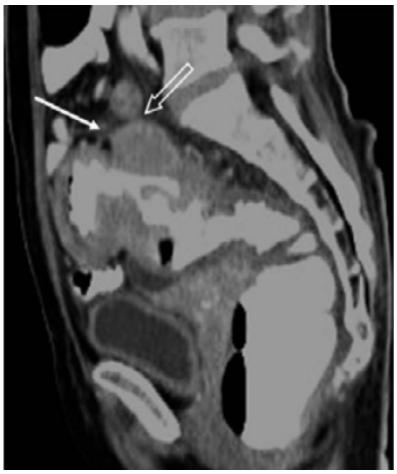

Figure 8. The abdominal MDCT scan on sagittal veiw of a 68 year-old female shows a colonic mass (white arrow) at sigmoid colon with pericolonic fat stranding. There is no obliterated fat plane (open arrows) between the tumor and collapsed small bowel, suggested stage T3. Pathologist reported stageT4 with small bowel involvement.

Table 3. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of each nodal stages.

Stage	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
0	63.8	68.8	46.3	70.0	57.3
1	59.5	52.2	22.5	74.6	46.6
2	7.5	99.1	83.3	64.0	64.6

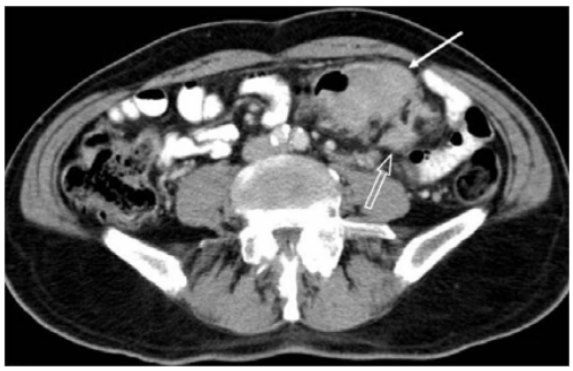

Figure 9. The abdominal MDCT scan of a 73 year-old male patient revealed an asymmetrical colonic wall thickening at sigmoid colon (white arrow) with adjacent oval shape nodule (open arrow), suggested stage T2N1. Pathology reported stage T3N0.

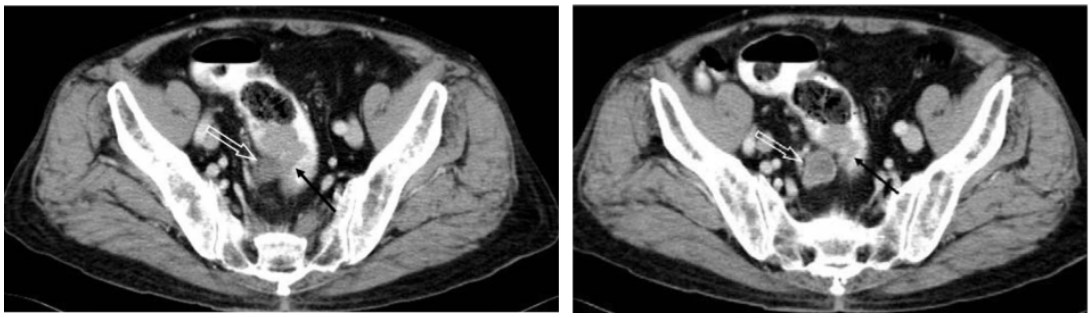

Figure 10a and 10b. The abdominal MDCT scan of a 79-year-old male revealed a colonic mass (black arrow) with extracolic mass (open arrow), suggested stage T3N0. Pathologist reported stage T2N1.

Discussion

Agreement of colorectal carcinoma staging by abdominal MDCT scan correlated with pathologic staging are good with excellent interobserver agreement. The overall accuracy of tumoral staging was 75.84%. There were greater than studies of Hundt W et al.[11] Balthazar EJ et al.[12], and Smith NJ. et al.[13]

The CT scan of overstaging with pathologic T2 were pericolonic fat stranding which were desmoplastic reaction around the sheet of tumor on pathology. The desmoplastic reaction is indistinguished between fibrosis alone and tumor cell contained fibrosis causing overstaging.[4] The CT scan overstaging with pathologic stage T3 were abut peritoneum, abut adjacent organ, and perforation. All causes of tumoral overstaging are identifed of obscured fat plain between lesion and adjacent organ. The vascular or lymphatic congestion, inflammation, or obliterated fat plane from severe cachexia are the causes of overstaging.[4] The perforation was cause of obliterated fat plane, while the CT scan was non-distinguished between inflammatory cell or tumoral cell.

Causes of understaging by CT scan with pathologic stage T3 were no demonstrable pericolonic fat stranding; same as the causes of understaging with pathologic T4 because the fat plane was preserved. CT scan is not sensitive to detect the microscopic extension.[4]

Sensitivity, specificity, and accuracy of tumoral staging by CT scan in our study were lower than that of the study from Kanamoto T *et al*.[14] The reason is possibly that the patients in their study had the bowel well prepared with subsequent air-filled colon. CT scans were obtained immediately after endoscopy.

The highest sensitivity, NPV and accuracy in our study were stage T4 because there was gross abnormality while stage T3 was a microscopic extension.

For nodal staging, poor agreement because from that criteria of cluster lymph nodes is unclear.

Nodal staging in the study of Kanamoto T *et al*.[14] was performed with the area under the receiver operating characteristic curve, the short/long axis diameter ratio, short-axis diameter, long-axis diameter, and CT attenuation, results higher sensitivity, specificity, and accuracy for nodal metastasis diagnosis by CT scan than our study.

In our study, the high criteria is causing highest specificity, PPV and accuracy, but low sensitivity of stage N2.

Chamadol N *et al*.[15]study used the criteria of lymph node involvement that a single node more than 5 mm in size or an abnormal cluster of normal sized nodes had high sensitivity because of smaller diameter than our study.

This means that using CT scan to the demonstrated metastatic node by size alone is not enough. The morphology of the lymph node is an important part as well. Brown G., et al[16] report that the size of the positive nodes were equal to or lesser than that of normal or reactive nodes in the same specimen. Benign reactive hyperplasia causes enlarged nodes.[17] CT scan for N staging is limited to distinguish between micrometastases and reactive nodal hyperplasia.[17]

In this study, the difference between the overall accuracy of the patients with the duration between the CT scan and operation less and more than 90 days may be because the size of the population vary different. Results can not be concluded that the difference real or not.

Conclusion

CT scan is useful in preoperative evaluation of colorectal cancer. Colorectal cancer staging from the CT scan in our study is considered satisfactory for tumoral staging but too low to determine nodal staging. The overall accuracy of correct T staging by CT scan was 75.84%.

References

1. Horton KM, Abrams RA, Fishman EK. Spiral CT of colon cancer: imaging features and role in management. Radiographics 2000 Mar; 20(2): 419-30
2. Khuhaprema T, Srivatanakul P. Colon and rectum cancer in Thailand: an overview. Jpn J Clin Oncol 2008 Apr; 38(4): 237-43
3. Srivatanakul P, Attasara P, Sriplung H. Cancer incidence and leading sites. In: Khuhaprema T, Srivatanakul P, Attasara P, Sriplung H, Wiangnon S. Cancer in Thailand. Vol. V, 2001 - 2003. Bangkok: In press, 2010: 3-9
4. Thoeni RF, Laufer I. Polyps and colon cancer. In: Gore RM, Levine MS. eds. Textbook of Gastrointestinal Radiology. 3rd ed. Philadelphia: Saunders Elsevier, 2008: 1121-66
5. National Comprehensive Cancer Network. Colon cancer version 2.2011 [online]. 2010[cited 2010 Nov 25]. Available from: http://www.nccn.org/professionals/physician_gls/PDF/colon.pdf
6. National Comprehensive Cancer Network. Rectum cancer version 2.2011 [online]. 2010[cited 2010 Nov 25]. Available from: http://www.nccn.org/professionals/physician_gls/PDF/rectal.pdf
7. Charnsangavej C, Dubrow RA, Varma DG, Herron DH, Robinson TJ, Whitley NO. CT of the mesocolon. Part 2. Pathologic considerations. Radiographics 1993 Nov; 13(6): 1309-22
8. Thoeni RF, Moss AA, Schnyder P, Margulis AR. Detection and staging of primary rectal and rectosigmoid cancer by computed tomography. Radiology 1981 Oct;141(1): 135-8

9. The 7th edition of the American Joint Committee on Cancer (AJCC): Colon and rectum cancer [online]. 2010[cited 2010 Dec 4]. Available from: http://www.cancerstaging.org/staging/index.html
10. Filippone A, Ambrosini R, Fuschi M, Marinelli T, Genovesi D, Bonomo L. Preoperative T and N staging of colorectal cancer: accuracy of contrast-enhanced multi-detector row CT colonography—initial experience. Radiology 2004 Apr; 231(1): 83-90
11. Hundt W, Braunschweig R, Reiser M. Evaluation of spiral CT in staging of colon and rectum carcinoma. Eur Radiol 1999; 9(1): 78-84
12. Balthazar EJ, Megibow AJ, Hulnick D, Naidich DP. Carcinoma of the colon: detection and preoperative staging by CT. AJR Am J Roentgenol 1988 Feb; 150(2): 301-6
13. Smith NJ, Bees N, Barbachano Y, Norman AR, Swift RI, Brown G. Preoperative computed tomography staging of nonmetastatic colon cancer predicts outcome: implications for clinical trials. Br J Cancer 2007 Apr; 96(7): 1030-6
14. Kanamoto T, Matsuki M, Okuda J, Inada Y, Tatsugami F, Tanikake M, Yoshikawa S, Narabayashi I, Kawasaki H, Tanaka K, et al. Preoperative evaluation of local invasion and metastatic lymph nodes of colorectal cancer and mesenteric vascular variations using multidetector-row computed tomography before laparoscopic surgery. J Comput Assist Tomogr 2007 Nov; 31(6): 831-9
15. Chamadol N, Ninpiethoon T, Bhudhisawasd V, Pairojkul C. The role of CT scan in preoperative staging of colorectal carcinoma. J Med Assoc Thai 2005 Dec;88(12):1847-53
16. Brown G, Richards CJ, Bourne MW, Newcombe RG, Radcliffe AG, Dallimore NS, Williams GT. Morphologic predictors of lymph node status in rectal cancer with use of high-spatial-resolution MR imaging with histopathologic comparison. Radiology 2003 May; 27(2): 371-7
17. Meyers MA. Staging of gastrointestinal cancers. In: Meyers MA, ed. Dynamic Radiology of the Abdomen: Normal and Pathologic Anatomy. 5th ed. New York: Springer-Verlag, 2000: 265-86