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Compatibility of Local Staging (T) Colorectal Cancer in Multi-Slice Computed Tomography (MSCT) with Histopathology: a Retrospective Study

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Abstract

Early staging of local tumors is very important in determining the prognostic and in the maximum therapeutic management.

Aims : The purpose of this study was to analyse the compatibility of local staging (T) of colorectal cancer on Multi-Slice Computed Tomography (MSCT) examination with histopathology.

Methodology: retrospective analytic observation design. The study sample was 34 colorectal cancer patients that met the research inclusion criteria. The research data were analysis by gamma coefficient test with a significance level of 0.05.

Results: the majority of patients were 45-65 years old (50%) and male (58.8%). 25 of 34 cases (73.5%) had the same local MSCT and histopathological staging, namely 18 of 19 cases of T3 (94.7%) and 7 of 14 cases of T2 (50%). 1 in 34 cases (2.9%) was under-staging, and 8 out of 34 cases (23.5%) was over-staging. The characteristics of colorectal cancer in the MSCT findings were a solid mass (70.6%), unclear boundaries (55.9%), irregular shape (91.2%), having mass morphology (85.3%), measuring 5-10 cm (55.9%), homogeneous enhancement pattern (70.6%), not invading surrounding organs (94.1%), located in the rectosigmoid (29.4%), and well-differentiated adenocarcinoma (67.6%). Statistical test obtained the results = 0.005 (≤ 0.05) with a gamma coefficient value of 0.787. The T3 sensitivity and specificity tests were 94.7% and 46.7%, respectively, with an accuracy of 73.5%, and the T2 sensitivity and specificity tests were 50.0% and 95.0%, with an accuracy of 76.5%.

Scientific Novelty: the reliability of MSCT as a local staging (T) determinant of colorectal cancer.

Conclusion: there is a significant agreement between local staging (T) colorectal cancer results from the msct examination and histopathological examination results with positive correlation properties and very strong correlation strength. Colonography MSCT examination can be an option to obtain maximum sensitivity of local stage T2 of colorectal cancer.

Keywords: Colorectal Cancer, Local Stage, Multislice Computerized Tomography, MSCT.

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Introduction

Colorectal cancer is one of the leading causes of cancer death worldwide. Colorectal cancer has become the fourth mortal cancer in the world with nearly 900,000 deaths annually [1]. Colorectal carcinoma is the fourth most common type of cancer in men after prostate and lung and bronchial cancer, and the third most common type of cancer in women after breast and lung or bronchial cancer [2]. The worldwide incidence of colorectal cancer is expected to increase to 2.5 million new cases by 2035 [1]. In Indonesia, deaths from colorectal cancer are around 4.0% with 4.4% new cases and 14.34% prevalence per 100,000 population at five years [3]. The results of the National Health Research-Basic Health Research (Riskesdas) of the Indonesian Ministry of Health in 2018 found that the prevalence of cancer in Indonesia increased from 1.4% in Riskesdas 2013 to 1.49% in Riskesdas 2018 [4].

Research Problem

Early determination of local tumor staging is important in order to determine early prognostic and neoadjuvant therapy before resection. A local tumor staging assessment with the AJCC staging system showed tumor invasion of T1 (submucosa), T2 (muscularis propia), T3 (invading the muscularis propia into serous tissue or pericolorectal fat), and T4 (invading surrounding tissues and organs) [5]. An early reporting of appropriate local staging to clinicians will assist in more optimal preoperative planning [6]. Appropriate preoperative colorectal cancer therapy can also result in a lower recurrence rate than postoperative therapy [7].

Research Focus

Colorectal cancer is diagnosed based on clinical, laboratory, radiological, and histopathological findings. MSCT is proving to be one of the excellent radiological modalities for staging colorectal carcinoma which helps in proper surgical planning and further patient management [8]. Histopathology also plays an important role in local tumor staging of colorectal cancer [5]. Not much is known about the suitability of local colorectal cancer staging on MSCT and histopathology in post-resection patients (surgical staging) who have not received previous chemo-radiation therapy.

Research Aim

The purpose of this study was to analyse the suitability of local staging of colorectal cancer on multi-slice computed tomography (MSCT) with histopathology, especially in post-resection patients (surgical staging) who had not received previous chemoradiation therapy.

Research Questions

1. What are the characteristics of colorectal cancer sufferers based on age, gender, multi-slice computerized tomography (MSCT) examination results, and histopathological examination results?
2. What is the local staging for colorectal cancer based on the results of multi-slice computer tomography and histopathology examinations?
3. Is there suitability in determining local staging between multi-slice computer tomography (MSCT) and histopathological examination in colorectal cancer?

Research Methodology

General Background

The study design was a retrospective analytic observation to evaluate the compatibility of the of the multi-slice computed tomography (MSCT) examination and the expertise of histopathological examination results in the local staging of colorectal cancer in the medical record. The study sample was colorectal cancer patients who underwent a multi-slice computed tomography (MSCT) examination which had been operated on and histopathologically proven to be diagnosed with colorectal cancer. The sample size of 34 cases that have been taken met the inclusion criteria and exclusion criteria. The inclusion criteria: 1) Having local preoperative MSCT staging examination results at the radiology installation, 2) not receiving preoperative chemo-radiation therapy (before surgical staging), 3) having undergone surgery and being histopathologically proven to have colorectal cancer, 4) having MSCT scan time interval (early stage) and histopathological examination ± 6 months. The exclusion criteria: 1) Abdominal MSCT was found with intra-abdominal infection reading the results, 2) Abdominal MSCT was found to show intra-abdominal ascites.

The independent variables were abdominal MSCT examination, axial, coronal, and sagittal sections. The dependent variable was the histopathological examination, namely the expertise of macroscopic and microscopic readings of colorectal tumors obtained from surgical biopsies that have been read by anatomical pathologists.

Data Analysis

The research data were univariately analysed to present data based on frequency and presentation, and the bivariate analysis was carried out using the Gamma Coefficient statistical test using the IBM SSPS Statistics 20 software to analyse the staging of colorectal cancer based on the findings of the multi-slice computed tomography (MSCT) and histopathological examination results with a significant level of 0.05. This research was conducted at the Diagnostic Radiology Installation of the Integrated Diagnostic Center Building, RSUD Dr. Soetomo Surabaya, Indonesia in August – September 2022.

Research Results

The results of this study found several characteristics of colorectal cancer patients, the characteristics of colorectal cancer on MSCT radiology imaging, and the results of the local staging (T) statistical test for colorectal cancer on MSCT examination with the results of histopathological examination (Table 1-4).

Table 1. Characteristics of colorectal cancer patients by age and sex (n=34)

No	Patient Characteristics		
1	**Age**	**f**	**%**
	<44 years old	7	20.6
	45-54 years old	10	29.4
	55-65 years old	7	20.6
	66-74 years old	7	20.6
	75-90 years old	3	8.8
	Total	34	100.0
2	**Gender**	**f**	**%**
	Male	20	58.8
	Female	14	41.2
	Total	34	100.0

Source: own development of the authors

Table 1 shows that the majority of colorectal cancer patients who met the inclusion criteria and became the study sample were middle age (middle age) 45-54 years as many as 10 people (29.4%). Some patients were in late adulthood <44 years, namely 7 people (20.6%) and patients aged 75-90 years old as many as 3 people (8.8%), and male sex 20 people (58, 8%)

Table 2. Characteristics of colorectal cancer based on the results of the Multi-Slice Computed Tomography (MSCT) examination (n=34)

No	Cancer Characteristics		
1	**Component**	**f**	**%**
	Solid	24	70,6
	cystic	0	0
	Necrotic	0	0
	Solid + Necrotic	10	29,4
	Total	34	100
2	**Tumor border**	**f**	**%**
	clear boundaries	15	44.1
	unclear boundaries	19	55.9
	Total	34	100.0
3	**Tumor shape**	**f**	**%**
	Regular	3	8.8
	Irregular	31	91.2
	Total	34	100.0
4	**Tumor morphology**	**f**	**%**
	Mass	29	85.3
	Asymmetrical wall thickening	5	14.7
	Total	34	100.0
5	**Tumor size**	**f**	**%**
	<2 cm	5	14.7
	2-5 cm	6	17.6
	5-10 cm	19	55.9
	>10 cm	4	11.8
	Total	34	100.0
5	**Location of the tumor**	**f**	**%**
	Caecum	2	5.9

	ascending	6	17.6
	Transverse	4	11.8
	Descendants	3	8.8
	Sigmoid	5	14.7
	Rectosigmoid	10	29.4
	rectum	4	11.8
	Total	34	100.0
6	**Enhancement Pattern**	**f**	**%**
	Homogeneous	24	70.6
	Heterogeneous	10	29.4
	Total	34	100.0
7	**Invade surrounding organs**	**f**	**%**
	Yes	0	0
	No	34	100
	Total	34	100.0
8	**Types of Colorectal Cancer (conclusion of histopathological examination results)**	**f**	**%**
	Adenocarcinoma Well Differentiated	23	67.6
	Adenocarcinoma Moderate Differentiated	5	14.7
	Adenocarcinoma Poorly Differentiated	1	2.9
	Mucinous adenocarcinoma	4	11.8
	Signet Ring Cell	1	2.9
	Total	34	100.0

Source: own development of the authors

Table 2. shows that the cancer components in colorectal cancer patients who met the inclusion criteria were mostly solid 24 cases (70.6%), not demarcated 19 cases (55.9%), irregular shape 31 cases (91, 2%), had mass morphology 29 cases (85.3%), measuring 5-10 cm 19 cases (55.9%), located in the rectosigmoid 10 cases (29.4%), homogeneous Enhancement pattern 24 cases (70.6%), did not invade surrounding organs 32 cases (94.1%), and the type of well-differentiated adenocarcinoma was 23 cases (67.6%)

Table 3. Analysis of the local staging of colorectal cancer Gamma Coefficients based on the results of MSCT examination with histopathology (n=34)

MSCT staging	**Histopathological Staging**					Koefiseien Gamma	Approx. Sig. (Nilai p)
	pT1	pT2	pT3	pT4	Total		
T1	0	0	0	0	0	0.787	0.005
T2	0	7	1	0	8		
T3	1	7	18	0	26		
T4	0	0	0	0	0		
Total	1	14	19	0	34		

Table 3. shows that a total of 18 of 19 cases (94.7%) had T3 stage, 7 of 14 cases (50%) had T2 stage, 1 of 34 cases (2.9%) under-staging T2 to T3, and 8 of 34 cases (23.5%) over-staging T3 against T2 and T1. Most of the cases 25 out of 34 (73.5%) had the same local staging. The results of the statistical test of conformity obtained by the Gamma coefficient of 0.787 and Approx. Sig. (p-value) = 0.005 (p 0.05). The test results showed that there was a significant correspondence or correlation between the local stage of colorectal cancer on the MSCT examination results and the results of histopathological examination. The nature of the correlation is positive with the strength of the correlation being very strong (0.787). This study shows that radiological imaging with MSCT is reliable in determining local staging (T) of colorectal cancer which is supported by histopathological examination evidence.

Table 4. Analysis of the sensitivity, specificity, and accuracy of the local staging of T2 and T3 colorectal cancer based on the results of MSCT examination with histopathology (n=34)

		Histopathological Staging		**Total**
		pT2	Not pT2	
MSCT staging	T2	7	1	8
		50.0%	5.0%	23.5%
	Not T2	7	19	26
		50.0%	95.0%	76.5%
	Total	14	20	34
		100.0%	100.0%	100.0%
		pT3	Not pT3	
MSCT	T3	18	8	26

staging		94.7%	53.3%	76.5%
	Not T3	1	7	8
		5.3%	46.7%	23.5%
	Total	19	15	34
		100.0%	100.0%	100.0%

Table 4 shows that the sensitivity and specificity of T2 colorectal cancer staging are 50.0% and 95.0%, respectively, with an accuracy of 76.5%. The sensitivity and specificity of local T3 staging of colorectal cancer were 94.7% and 46.7%, respectively, with an accuracy of 73.5%.

Discussion

American Cancer Society (2020) stated that colorectal cancer is generally detected in at-risk individuals who are on average 50 years of age or older with a higher prevalence in older age groups and a greater incidence in men compared to women [9]. In general, the risk of getting colorectal cancer in individuals is 1 in 20 people (5%) where the risk is higher in men than women [10].

According to the American Cancer Society, men have about a 30% higher risk of developing colorectal cancer than women. The reasons for the gender disparity are not fully understood and are thought to be related to differences in exposure to risk factors such as smoking, alcohol, dietary patterns, and sex hormones [11]. The incidence of colorectal cancer can rapidly increase with age, approximately doubling and increasing by about 30% in the 55-year-old and older group [12]. However, the American Cancer Society recommends screening for colorectal cancer in patients starting at the age of 45 years [13]

Characteristics of colorectal cancer on MSCT examination were when CT showed eccentric bowel wall thickening of more than 2 cm, intratumoral calcifications, and heterogeneous enhancement were seen along with large areas of hypoattenuation, indicating the type of mucinous adenocarcinoma or adenocarcinoma. However, if CT findings show long bowel wall thickening and target markings, especially in the rectum or in young patients, signet-ring cell carcinomas should be considered [14]. This study proves that one case of signet-ring cell carcinomas was found in a young patient < 40 years of age. The majority of all colorectal cancers with more than 90% being adenocarcinomas [15]. Adenocarcinoma is the most common type of colorectal cancer found in up to about 98% of tumor histological examinations [16], [17].

Colorectal cancer usually begins with the non-cancerous proliferation of mucosal epithelial cells. These growths are known as polyps and can gradually grow before becoming cancerous. The most common form is an adenoma or polyp originating from granular cells, whose function is to produce mucus that lines the large intestine. Only about 10% of all adenomas develop into invasive cancer, although the risk of cancer increases as polyps grow larger. Invasive cancers arising from these polyps are known as adenocarcinomas and account for 96% of all colorectal cancers [18]. The pathogenesis of colorectal cancer is multiphasic, ranging from the earliest dysplastic lesions called aberrant crypt foci to adenomatous polyps to invasive cancer. This progression of carcinogenesis is referred to as the adenoma-carcinoma sequence [19].

Most colorectal cancer patients have tumors on the left side, especially the rectum and rectosigmoid with histopathological results being adenocarcinoma [20]. The rectum and rectosigmoid have a greater tendency to develop colorectal carcinoma. Having a function as a transit or gathering place for feces and defecation function is thought to be strongly associated with the risk of cancer in the rectum and rectosigmoid. Obesity, a sedentary lifestyle, and consumption of red meat, alcohol, and tobacco are considered factors driving the growth of colorectal cancer [18]. Unhealthy dietary intake hurts the population of microflora and intestinal inflammation, causing changes in fecal flora and changes in bile salt degradation or protein and fat breakdown that increase the risk of colorectal carcinoma. A low-fiber diet also causes solid stool concentrations and increases fecal transit in the rectum and rectosigmoid. This condition causes the contact between carcinogenic substances contained in feces from unhealthy foods with the colon and rectum mucosa to be much longer so that the risk of developing cancer increases [2].

This study found that there was a significant concordance between the local staging of colorectal cancer on the results of the MSCT examination and the results of histopathological examination with a general level of conformity reaching 73.5%. The nature of the positive correlation with the strength of the correlation is very strong (0.787). The results of this study are following the results of the study which found that there was consistency in local staging (T) assessment based on abdominal CT scans and histopathology [21]. Another study using conventional MSCT in assessing local staging (T3) of colorectal cancer also reported an accuracy rate (T) of 79%-94% [22].

This study also found that the sensitivity and specificity of local staging T3 and T2 were T3 = 94.7% sensitivity and 46.7% specificity, 73.5% accuracy rate, and T2 = 50.0% sensitivity and 95.0% specificity, with an accuracy rate of 76. ,5%. The results of this study indicate that local staging examination with MSCT in colorectal cancer has a good level of sensitivity and specificity as well as a good level of accuracy. The results of this study are following the results of the study which found that the MSCT examination for local T3 staging had good sensitivity and specificity, namely 88.2%, and specificity of 93.8% [23]. Another study also found that local staging at T3 had a sensitivity and specificity

of 94.7% and 46.7% [24]. However, local staging for T2 on MSCT examination in this study was found to have lower sensitivity than local staging T3 sensitivity (T2 sensitivity = 50%) but has an accuracy rate of 76.5%.

MSCT has become one of the mainstay modalities in the diagnosis and staging of colorectal cancer that can be used to assess the location and extent of the primary tumor, involvement of adjacent organs, regional and distant lymph node enlargement, and the presence or absence of metastatic disease [25]. In the local staging of colorectal cancer, abdominal MSCT is widely used and recommended for the evaluation of the local tumor infiltration, allowing in most cases to differentiate between tumors confined to the bowel wall and those that extend beyond the bowel wall, as well as infiltration of adjacent structures [24]. MSCT provides further information regarding pericolic abnormalities associated with the lesion, presence of lymph nodes, infiltration of adjacent viscera, and presence of distant metastases [26].

However, the MSCT examination also has limitations. The American College of Radiology states that a limitation of MSCT examination is its inability to complete the lining of the intestinal wall, as a result of which T3 and T4 lesions are assessed more accurately than T2 lesions [27]. The results also prove that MSCT has a better sensitivity to detect colon cancer with tumor invasion outside the intestinal wall or T3 and T4. The accuracy in predicting T3 and T4 lesions was significantly higher than in predicting T1 and T2 lesions [28]. MSCT Colonography is an option that has proven to overcome the limitations of MSCT examination and is a valid tool for identifying primary and synchronous colonic lesions such as T1 and T2. MSCT plus colonoscopy has a much higher diagnostic accuracy of 93.5%. MSCT is a valuable diagnostic tool that can effectively minimize the missed diagnosis rate of primary tumors when combined with colonoscopy [29]

This study found that the MSCT examination of colorectal cancer was over-staging 23.5% and under-staging 2.9%. The MSCT examination study also found 22.1% over-staging and 22.8% under-staging [28], 17.7% over-staging and 9.5% under-staging [21]. Accurate preoperative colorectal cancer staging is very important for patients to receive neoadjuvant therapy before resection. Inaccurate staging, especially under-staging, can lead to poor resection margins and oncological results and may not be optimal for therapeutic measures [30]. Meanwhile, over-staging can benefit because it allows for early chemotherapy treatment [31]. More than 10% of over-staging is relevant to any method of therapy, however, it remains a concern and challenge because it must consider avoiding over-treatment [32].

The under-staging is the finding that local staging pT on histopathological examination is higher than local radiological staging. The under-staging is a condition where residual tumor (R) is found on histopathological examination. R0 means no proven residual tumor, R1 residual tumor is microscopically visible, and R2 residual tumor is seen macroscopically [30]. This study found that under-staging was found 2.9% with the location of the tumor in the rectosigmoid. The incidence of under-staging with R1 resection in the treatment of colorectal cancer can occur in 10 and 15% of cases [30]. The under-staging can lead to positive resection due to the presence of residual tumor found in about 0.1% of the margin, and this condition can be prevented by neoadjuvant treatment and can occur concerning the distance from the anal verge: the lower the position of cancer, the higher the probability of having a positive resection [30]. While overstaging on MSCT examination can be caused by various factors. The interpretation of pericolon fat stranding as a benign desmoplastic reaction is considered a sign of tumor invasion (neoplastic). Fat stranding is a sign of increased fat attenuation (in the mesentery, omentum, retroperitoneum, or subcutaneous fat) which can be irregular, reticular, linear, or reticulonodular appearance which is often associated with neoplastic diseases such as colorectal carcinoma. Another sign that directs fat stranding due to a neoplastic process is the presence of a shouldering sign, namely an abrupt change in the caliber of the colorectal lumen due to an intraluminal thickening or tumor. Meanwhile, fat stranding due to the inflammatory process can be characterized by the presence of a degree of fat stranding that is heavier than the degree of colorectal wall thickening [21]. Peritumoral fibrosis, inflammation, and/or congestive changes can also cause over-staging [31]. The over-staging may occur mainly due to the presence of desmoplastic peritumoral inflammation. The over-staging remains a challenge in MSCT examination as well as challenges encountered in examinations with other radiological modalities [27].

Conclusions

There is a significant concordance between the local staging (T) of colorectal cancer on the results of the MSCT examination and the results of histopathological examination with a positive correlation and very strong correlation strength. The sensitivity and specificity of local T3 staging were 94.7% and 46.7%, with an accuracy of 73.5%, and the sensitivity and specificity of local T2 staging were 50.0% and 95.0%, respectively, with an accuracy of 76.5%.

Implications

The MSCT examination is one of the most accurate types of radiological diagnostic examination which can be an option in determining local staging of T3 and T4 colorectal cancer. These findings recommend MSCT colonography examination as an option to obtain better maximum local sensitivity of T2 and T1 staging of colorectal cancer.

Research Limitations

This study is only limited in identifying the suitability of local staging (T) for colorectal cancer between the results of the MSCT examination and the results of histopathological examination. Other considerations in determining the diagnosis of colorectal cancer require further research.

Statement of Ethics

This study received ethical approval from the Hospital Health Research Ethics Committee. Dr. Soetomo Surabaya with the number Letter of Exemption Ref.No: 1056/LOE/301.4.2/IX/2022.

Conflict of Interest Statement

The authors declare that there is no conflict of interest in this work

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None

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