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Original Research Article

The correlation between elevated procalcitonin levels and poor short-term clinical outcomes in patients with resectable colorectal cancer

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ABSTRACT

Background: Elevated procalcitonin (PCT) levels reflect systemic inflammation, a common condition in colorectal cancer (CRC) that is associated with unfavorable prognosis. Inflammatory responses may negatively affect postoperative recovery and quality of life. This study aimed to evaluate the correlation between increased PCT levels and short-term clinical outcomes in patients with resectable CRC.
Methods: A prospective observational study was conducted at Dr. Moewardi General Hospital, Surakarta, from November 2022 to November 2023. Fifty patients with resectable CRC who underwent pre-operative PCT testing were included. Short-term clinical outcome was assessed using the SF-36 questionnaire, categorizing patients into good (score >50) and poor (score≤50) quality of life groups. The relationship between PCT levels and clinical outcomes was analyzed using the Spearman rank correlation test.
Results: The mean PCT level was 0.54±1.15 ng/ml, with a median of 0.09 ng/ml. Patients with poor quality of life had significantly higher mean PCT levels (1.61±2.55 ng/ml) compared to those with good quality of life (0.08±0.05 ng/ml). A strong and statistically significant correlation was found between elevated PCT levels and poor short-term clinical outcomes (r=0.795; p=0.001). Higher PCT levels were also significantly associated with all eight SF-36 domains, including physical functioning, role limitations, bodily pain, and general health.
Conclusions: Increased PCT levels are strongly correlated with poorer short-term clinical outcomes in patients with resectable CRC. PCT may serve as a useful biomarker for monitoring inflammation and predicting postoperative quality of life.

Keywords: Procalcitonin, Colorectal cancer, Inflammation, Clinical outcome, Quality of life

INTRODUCTION

Colorectal cancer (CRC) is a global health problem and ranks as the third most common cancer worldwide and the second leading cause of cancer-related mortality.[1] The incidence of CRC has been increasing, particularly in developing countries.[2] Standard of care for early-stage CRC is surgical resection, which offers a high potential for cure; however, even with successful surgery, patients often experience postoperative complications and a decline in short-term quality of life.[3]

Procalcitonin (PCT) is a widely recognized biomarker for systemic inflammation and bacterial infections. Its levels are known to be elevated in various inflammatory conditions, including malignancies.[4,5] In cancer patients, chronic inflammation is a key component of tumor progression and is associated with a poorer prognosis and reduced quality of life.[6]

Therefore, an increased PCT level could reflect a state of persistent inflammation, which may negatively impact a patient's recovery and clinical outcome.[7]

While PCT is well-established as a marker for sepsis and postoperative complications, its role as a prognostic indicator for short-term clinical outcomes in resectable CRC patients has not been extensively studied.8 Understanding the relationship between elevated PCT levels and patient outcomes in this specific group is crucial for identifying high-risk individuals and implementing targeted interventions to improve their recovery. This study aims to evaluate the correlation between increased PCT levels and poor short-term clinical outcomes in patients with resectable CRC.

METHODS

This study employed a prospective observational analytic design conducted at the Department of Surgery, Dr. Moewardi General Hospital, Surakarta, from November 2022 to November 2023. Ethical clearance was obtained from the hospital's ethics committee. The target population was adult patients with resectable CRC who underwent PCT testing. A total of 50 patients who met the inclusion and exclusion criteria were enrolled using a purposive sampling technique. Inclusion criteria included adult patients aged ≥18 years and those diagnosed with resectable CRC scheduled for surgical resection. Patients with a history of radiotherapy or chemotherapy, those on long-term corticosteroid therapy, and patients diagnosed with stage IV CRC were excluded. The independent variable was PCT levels, measured from patient medical records, while the dependent variable was short-term clinical outcome, assessed using the validated SF-36 quality of life questionnaire. Clinical outcomes were categorized as "good" (score >50) or "poor" (score≤50). Confounding variables included age, sex, body mass index (BMI), and comorbidities. Data were analyzed using SPSS 26.0. Descriptive statistics were used to present the baseline characteristics, and the Spearman rank correlation test was performed to determine the relationship between PCT levels and clinical outcomes. A $p<0.05$ was considered statistically significant.

RESULTS

This study included 50 patients with resectable CRC. The cohort consisted of 27 women (54.0%) and 23 men (46.0%), with a mean age of 54.90±13.01 years. The most common comorbidity was hypertension (12.0%). Based on the SF-36 questionnaire, 70.0% of patients reported a good quality of life, while 30.0% reported a poor quality of life. The detailed baseline characteristics are presented in Table 1.

The mean PCT level for all subjects was 0.54±1.15 ng/ml (median 0.09 ng/ml, range 0.02-7.58 ng/ml). The distribution of PCT levels is shown in Table 2.

There was a clear distinction in PCT levels between the two quality of life groups. Patients with a poor quality of life had a mean PCT level of 1.61±2.55 ng/ml (median 0.32 ng/ml), whereas patients with a good quality of life had a mean PCT level of 0.08±0.05 ng/ml (median 0.06 ng/ml).

A strong and significant correlation was found between increasing PCT levels and poor short-term clinical outcomes in patients with resectable CRC (Spearman's $r=0.795$, $p=0.001$). This relationship was consistent across all eight SF-36 sub-indicators, with a significant negative correlation between PCT levels and physical functioning ($r=0.708$, $p<0.001$), physical limitations ($r=0.736$, $p<0.001$), bodily pain ($r=0.654$, $p<0.001$), and general health ($r=0.736$, $p<0.001$). This correlation is visually represented in Figure 1, while the relationships with SF-36 sub-indicators are shown in Table 3.

The correlation between patient characteristics and clinical outcomes is presented in Table 4.

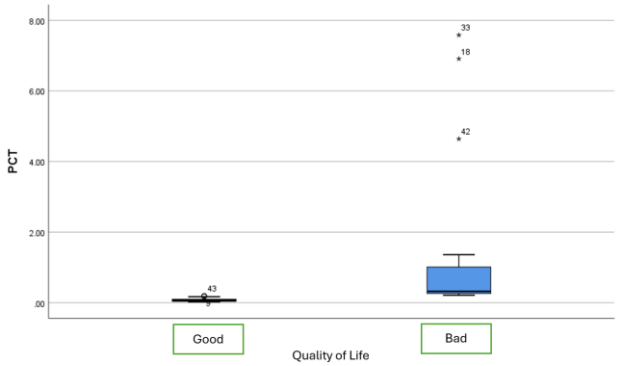

Figure 1: Boxplot of PCT level comparison between patients with poor and good quality of life.

Table 1: Baseline characteristics of study subjects.

Characteristics	N	Median (min-max)
Gender		
Man	23	46.0%
Woman	27	54.0%
Age (in years)	54.90±13.01	57.0 (22-79)
<60	29	58.0%
>60	21	42.0%
BMI (kg/m^2)		
Underweight	14	28.0%
Normoweight	16	32.0%

Continued.

Characteristics	N	Median (min-max)
Overweight	7	14.0%
Obese	13	26.0%
Comorbidities		
Diabetes	2	4.0%
Hypertension	6	12.0%
There isn't any	42	84.0%
Quality of life		
Bad	15	30.0%
Good	35	70.0%

Table 2: Description of procalcitonin levels as an inflammatory indicator in patients with resectable CRC.

Variables	N	Median (min-max)
PCT	0.54±1.15	0.09 (0.02-7.58)
PCT<0.05	9	18.0%
PCT≥0.05-0.5	35	70.0%
PCT≥0.5-2.0	3	6.0%
PCT≥2.0-10.0	3	6.0%

Table 3: Relationship between PCT levels and SF-36 questionnaire indicators (Quality of life).

Indicator SF-36 questionnaire	PCT						R	P
	N	Mean	±SD	Median	Min	Max		
Physical function								
No limits	12	0.06	±0.03	0.06	0.02	0.11	0.708	<0.001*
A little limiting	24	0.40	±1.53	0.07	0.02	7.58		
Very limiting	14	1.18	±2.02	0.32	0.21	6.91		
Physical limitations								
There isn't any	36	0.29	±1.25	0.06	0.02	7.58	0.736	<0.001*
There is	14	1.18	±2.02	0.32	0.21	6.91		
Body pain								
Light	19	0.08	±0.05	0.06	0.02	0.19	0.654	<0.001*
Currently	18	0.51	±1.76	0.09	0.02	7.58		
It hurts so much	13	1.25	±2.09	0.31	0.21	6.91		
General health								
Good	36	0.29	±1.25	0.06	0.02	7.58	0.736	<0.001*
Bad	14	1.18	±2.02	0.32	0.21	6.91		
Vitality								
Quite problematic	40	0.30	±1.19	0.07	0.02	7.58	0.578	<0.001*
Always having problems	10	1.48	±2.35	0.31	0.21	6.91		
Social function								
Seldom	1	0.09	-	0.09	0.09	0.09	0.655	<0.001*
Sometimes	36	0.29	±1.25	0.06	0.02	7.58		
Almost always	9	1.61	±2.46	0.30	0.21	6.91		
Always having problems	4	0.44	±0.18	0.42	0.24	0.66		
Emotional limitations								
No	36	0.29	±1.25	0.06	0.02	7.58	0.736	<0.001*
Yes	14	1.18	±2.02	0.32	0.21	6.91		
Mental health							0.651	<0.001*
Never had a problem	18	0.08	±0.05	0.06	0.02	0.19		
Rarely problematic	18	0.50	±1.77	0.07	0.02	7.58		
Always having problems	14	1.18	±2.02	0.32	0.21	6.91		

*Description: r=Spearman rank correlation test (1-tailed) ; *significant at p<0.05

Table 4: Correlation of patient characteristics with clinical outcomes in patients with resectable CRC.

Quality of life	PCT levels						R	P value
	N	Mean	Elementary school	Median	Minimum	Maximum		
Good	35	0.08	0.05	0.06	0.02	0.19	0.795	0.001*
Bad	15	1.61	2.55	0.32	0.21	7.58		

*Description: r=spearman rank correlation test (1-tailed) ; *significant at p<0.05.

Table 5: Analysis of factors associated with delayed treatment in breast cancer patients using alternative medicine.

Variables	Bivariate				Multivariate			
	OR	95% C.I		P value	Adj OR	95% C.I		P value
		Lower	Upper			Lower	Upper	
Age>50 years	4.799	2.112	10.906	<0.001*	4.590	1.938	10.872	0.001*
Tabib	1.179	0.724	1.918	0.508	-	-	-	-
Distance 5-10 km	0.676	0.412	1.110	0.122	0.788	0.464	1.337	0.337
Poor knowledge	5.379	1.989	14.547	0.001*	5.708	2.048	15.913	0.001*

*Significant at p<0.05.

DISCUSSION

This study reveals a significant and strong correlation between elevated PCT levels and poor short-term clinical outcomes in patients with resectable CRC.[8] This finding aligns with the growing body of evidence supporting the role of PCT as a marker beyond just bacterial infection, extending to systemic inflammatory states in cancer patients.[9,10] While PCT is a classic biomarker for sepsis, our results suggest that in the context of resectable CRC, even moderately elevated PCT levels may reflect an underlying inflammatory burden that negatively impacts patient recovery and quality of life.[11]

The mean PCT level in patients with a poor quality of life was significantly higher (1.61 ng/ml) than in those with a good quality of life (0.08 ng/ml). This pronounced difference underscores the clinical relevance of PCT as an indicator of a patient's overall biological stress and inflammatory response, which can be triggered by the surgical procedure itself or by persistent tumor-related inflammation.[12] This aligns with recent studies that associate a heightened systemic inflammatory response with increased morbidity and a poorer long-term prognosis in CRC patients.[13,14]

The strong correlation observed between PCT levels and all eight domains of the SF-36 questionnaire further reinforces its utility. This suggests that the biological impact of elevated PCT levels is not confined to a single clinical parameter but affects multiple facets of a patient's life, including physical function, pain, and mental health. This multidimensional effect highlights the need for a comprehensive approach to patient care that includes monitoring inflammatory markers to anticipate and manage potential declines in quality of life.

Our findings also contrast with some previous studies that found socioeconomic factors, such as the income and education, to be primary determinants of patient outcomes. In this study, patient characteristics like age, sex, BMI, and comorbidities did not show a significant correlation with clinical outcomes, suggesting that PCT may be a more sensitive and specific marker for short-term outcome prediction in this patient population.[15]

This study has some limitations. The single-center design and relatively small sample size may limit the generalizability of our findings. Furthermore, a long-term follow-up is needed to determine whether the correlation between PCT and short-term outcomes extends to long-term survival and quality of life. Future research should also compare PCT with other inflammatory biomarkers, such as C-reactive protein (CRP), to identify the most effective and reliable predictor for clinical outcomes in resectable CRC patients.

CONCLUSION

This study found a significant and strong correlation between increased PCT levels and poor short-term clinical outcomes in patients with resectable CRC. Specifically, the higher the PCT level, the worse the patient's quality of life as measured by the SF-36 questionnaire. This suggests that PCT is not only an indicator of inflammation and infection but also a useful tool for monitoring the overall inflammatory status that can impact patient recovery and well-being. Our findings support the use of PCT as a valuable prognostic biomarker to help clinicians identify patients at risk for a poor short-term outcome and to guide more personalized patient care strategies.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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