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Original Article

Onset factors of infective and non-infective complications in perioperative gastrointestinal cancer patients

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Abstract. [Purpose] This study aimed to examine the causes of post-surgical infective and non-infective complications and to examine the possibility of physical therapy for preventing postoperative complications in gastrointestinal cancer patients. [Participants and Methods] The study participants were 119 perioperative gastrointestinal cancer patients [69 males and 50 females, aged 62.2 ± 11.2 years (mean ± standard deviation)] classified into three groups according to whether they had infective complications, non-infective complications, or the absence of complications. Data on onset factors for complications, basic information, surgical information, biochemical data, respiratory function, physical function, physique, and body composition were collected from a previous study. [Results] In the group with onset factors of infective complications, blood loss, the C-reactive protein level on the third postoperative day, and the forced expiratory volume % in 1 second were found to be significant explanatory variables. In the group with onset factors of non-infective complications, surgical time was detected as a significant explanatory variable. [Conclusion] In gastrointestinal cancer patients, surgical information affected the onset of infective and non-infective complications. However, only infective complications had the onset factors of postoperative immune response and preoperative respiratory function. Preoperative physical therapy may be an option for the prevention of postoperative complications in gastrointestinal cancer patients.

Key words: Perioperative gastrointestinal cancer patient, Infective and non-infective complications, Onset factor

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INTRODUCTION

Gastrointestinal cancer patients have poor postoperative quality of life and survival rate owing to the onset of postoperative complications[1, 2)]. The incidence of postoperative complications was about 30% and the mortality rate was about 3–4%[3, 4)]. In particular, the onset of infective complications, such as leakage, increases the postoperative mortality rate[5)].

The onset factors of postoperative complications in gastrointestinal cancer patients were reported as basic information[6–8)], surgical information[6, 7, 9–11)], biochemical data[12–17)], respiratory function[16)], physical function[18, 19)], physique, and body composition[6–8, 20, 21)] based on the previous study. As per a previous study, pre- and postoperative evaluations were important for the prevention of postoperative complications in gastrointestinal cancer patients. These onset factors of postoperative complications included factors related to physical therapy[6–8, 18–21)]. It is possible that physiotherapy may contribute to a decrease in the postoperative complications in gastrointestinal cancer patients.

This study aimed to collect data regarding the onset factors of postoperative complications based on the previous study to examine the causes of postoperative infective and non-infective complications in gastrointestinal cancer patients.

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PARTICIPANTS AND METHODS

The present study used a cross-sectional study design. Total 189 perioperative gastrointestinal cancer patients who had recently undergone surgical treatment participated in the study after providing informed consent. The inclusion criteria were as follows: a perfect score on the Functional Independence Measure before the surgery and at the time of returning home after discharge from the hospital. The exclusion criteria were as follows: bone metastasis, receipt of neoadjuvant therapy, and missing data. Seventy patients were excluded based on these exclusion criteria, and the remaining 119 patients (69 males and 50 females, mean age 62.2 ± 11.2 years) completed the study. This study was approved by the ethics committee of the International University of Health and Welfare Mita Hospital (5-15-1). Perioperative gastrointestinal cancer patients were classified into 3 groups as per the infective or non-infective complications or the absence of complications during follow-up observation for 1 month postoperatively. The criteria used to define the infective complications were the same as those in a previous study[22]. (1) Wound infection was defined as the presence of pus, either discharged spontaneously or requiring drainage. Wound infection was present in a subgroup of patients with perineal infection after gastrointestinal cancer surgery. (2) Intra-abdominal abscess was verified with surgical drainage or image-guided aspiration of pus. (3) Leakage was defined as radiologically verified fistula or that diagnosed using relaparotomy. (4) Pneumonia was defined by a body temperature >38.5 °C and a positive radiography result, requiring antibiotic treatment. (5) Septicemia was defined by clinical symptoms combined with a positive blood culture. The non-infective complications were defined as adverse events corresponding to postoperative complication criteria according to the Clavien-Dindo classification[23], but not previously defined infective complications.

Data regarding the onset factors of postoperative complications were collected based on previous studies[6–8, 18–21]. Data on basic information (age, gender, cancer stage, and comorbidity), surgical information (surgical site, surgical procedure, operation time, blood loss, red cell concentrates, and fresh frozen plasma), preoperative biochemical data (serum-albumin, platelet, white blood corpuscles, neutrophil, lymphocyte, estimate glomerular filtration rate, C-reactive protein [CRP]), CRP of postoperative day 3 [CRP-POD3], and preoperative respiratory function (forced expiratory volume % in 1 second [FEV1.0%]) were collected from the electronic medical records. Physical function (isometric knee extension force, and 6-minute walking distance) and physique (body mass index) were measured by a physical therapist before the surgery. Body composition (skeletal muscle index, visceral fat area) was assessed using abdominal computed tomographic scanning image of third lumbar level shot before surgery.

All the data were analyzed using IBM SPSS Statistics 24.0 for Windows. The unpaired t-test and χ^2 test were used to compare each onset factor of postoperative complications between each group. The logistic regression analysis (forward-backward stepwise selection method) was used to examine the onset factors of infective and non-infective complications. The explanatory variables were the onset factors of postoperative complications that showed significant difference between each group in the previous analysis. The object variables were as follows: infective complications group (1) versus non-complication group (0), non-infective complications group (1) versus non-complication group (0).

RESULTS

The onset factors of postoperative complications in each group are shown in Table 1. The infective complications group had a significant difference in the surgical procedure, operation time, blood loss, red cell concentrates, fresh frozen plasma, serum-albumin, CRP-POD3, FEV1.0%, six-minute walking distance, body mass index, and visceral fat area compared with the non-complication group. The non-infective complications group had significantly different operation time, blood loss, red cell concentrates, fresh frozen plasma, and CRP-POD3 than the non-complication group.

Based on the results of logistic regression analysis, in the group with onset factors of infective complications, blood loss (β: 0.002, p: 0.004, odds ratio: 1.002, 95% CI: 1.001–1.003), CRP level on POD3 (β: 0.180, p: 0.001, odds ratio: 1.197, 95% CI: 1.081–1.326), and forced expiratory volume % in 1 second (β: −0.101, p: 0.022, odds ratio: 0.904, 95% CI: 0.829–0.985) were detected as significant explanatory variables. In the group with onset factors of non-infective complications, surgical time (β: 0.007, p: 0.000, odds ratio: 1.007, 95% CI: 1.002–1.012) was identified as significant explanatory variables.

DISCUSSION

The onset factors of infective and non-infective complications were commonly affected by the related factors of surgical invasion. Surgically invasive in vivo is to maintain life by maintenance and replacement of body fluids and avoidance of hypoxia by increasing cardiac output[24]. A secure supply of oxygen to the biotissue is necessary for the immune reaction accompanying surgical invasion[25]. When biotissue causes oxygen debt, various malfunctions occur and cause postoperative complications[26, 27]. Therefore, the degree of surgical invasion is a factor that affects all postoperative complications in gastrointestinal cancer patients. In the infective complications group, only CRP-POD3 and FEV1.0% were detected as the onset factors in gastrointestinal cancer patients. Postoperative CRP elevation is believed to be a representative index that captures the immune response during the restoration of damaged cells and prevention of pathogen invasion after surgical invasion[28].

Table 1. Onset factors of postoperative complications

	Infective complication n =23	Non-infective complication n=17	Non-complication n=79
Age (years)	63.2 ± 12.0	65.4 ± 8.2	61.2 ± 11.5
Gender (n/%)			
Male	15/65	12/71	42/53
Female	8/35	5/29	37/47
Cancer stage (n/%)			
I	10/43	6/35	30/38
II	2/9	4/24	17/22
III	6/26	7/41	24/30
IV	5/22	0/0	8/10
Comorbidity (n/%)			
Hypertension	4/17	3/18	16/20
Dyslipidemia	1/4	0/0	5/6
Diadetes mellitus	2/9	1/6	9/11
Heat disease	3/13	2/12	3/4
Lung disease	1/4	2/12	4/5
Orthopedic disease	1/4	0/0	2/3
Cerebrovascular disease	1/4	1/6	1/1
Surgical site (n/%)			
Stomach	5/22	4/24	16/20
Liver	3/13	2/12	4/5
Colon	7/30	4/24	36/46
Rectum	8/35	7/41	23/29
Surgical procedure (n/%)*			
Laparoscopic	14/61	14/82	70/89
Laparotomy	9/39	3/18	9/11
Operation time (minutes)*†	371.7 ± 151.9	332.9 ± 190.7	242.6 ± 77.0
Blood loss (ml)*†	715.0 ± 1,022.2	430.9 ± 669.3	117.4 ± 353.1
RCC (ml)*†	340.9 ± 754.9	197.6 ± 557.9	21.3 ± 140.2
FFP (ml)*†	187.8 ± 530.3	162.4 ± 481.8	12.2 ± 108.0
Biochemical data			
Alb (mg/dl)*	4.1 ± 0.5	4.3 ± 0.2	4.4 ± 0.4
Plt (10^4/μl)	22.4 ± 9.5	22.4 ± 6.8	23.5 ± 6.8
WBC (/μl)	6,117.8 ± 2,534.1	6,256.5 ± 1,527.2	6,241.3 ± 1,876.9
Neut (/μl)	3,858.5 ± 2,309.9	3,919.4 ± 1,340.7	3,996.9 ± 1,670.3
Lymp (/μl)	1,693.3 ± 390.0	1,750.4 ± 523.8	1,752.8 ± 572.0
eGFR (ml/min/1.73 m^2)	74.4 ± 18.9	72.6 ± 12.5	76.6 ± 15.7
CRP (mg/dl)	0.9 ± 3.2	0.2 ± 0.2	0.2 ± 0.6
CRP (POD3) (mg/dl)*†	15.5 ± 9.0	10.9 ± 5.9	7.6 ± 4.3
FEV1.0% (%)*	74.6 ± 7.6	75.7 ± 9.5	79.4 ± 7.1
Body mass index (kg/m^2)*	24.9 ± 6.0	23.6 ± 3.1	22.5 ± 3.3
Skeletal muscle index (cm^2/m^2)	38.7 ± 11.3	35.6 ± 8.7	35.4 ± 8.5
Visceral fat area (cm^2)*	142.6 ± 117.1	108.3 ± 82.9	87.9 ± 64.1
IKEF (Nm/kg)	4.2 ± 1.7	4.4 ± 1.3	4.5 ± 1.6
6MWD (m)*	502.8 ± 91.5	526.3 ± 86.8	546.3 ± 92.4
Contents of complication (n)	Infection: 16 Abscess: 2 Leakage: 4 Pneumonia: 1 Septicemia: 0	Ileus: 2 Anastomotic stenosis: 2 Gastrointestinal dysfunction: 4 Fungus infection: 1 Hepatic dysfunction: 1 Postoperative hypertension: 1 Tachyarrhythmia: 1 Atelectasis: 1 Hoarseness: 1 Fall: 1 Acute urinary retention: 2	
Length of stay (days)	28.1 ± 13.4	24.0 ± 13.4	14.3 ± 4.2

The values of age, operation time, blood loss, RCC, FFP, biochemical data, FEV1.0%, body mass index, skeletal muscle index, visceral fat area, IKEF, 6MWD and length of stay are shown as mean ± standard deviation. Other items are presented as percentages or numbers of cases.

RCC: red cell concentrates; FFP: fresh frozen plasma; Alb: serum albumin; Plt: platelet; WBC: white blood corpuscles; Neut: neutrophil; Lymp: lymphocyte; eGFR: estimate glomerular filtration rate; CRP: C-reactive protein; POD: postoperative day; FEV1.0%: forced expiratory volume % in one second; IKEF: isometric knee extension force; 6MWD: six-minute walking distance.

*$p<0.05$ (Infective complication versus Non-complication), †$p<0.05$ (Non-infective complication versus Non-complication).

Most of the infectious complications in the gastrointestinal cancer patients in our study were wound infections. This suggests the presence of immunodeficiency associated with wound infection. Preoperative FEV1.0% is related to the expiratory flow rate and volume at voluntary maximal cough for sputum expectoration[29]. It suggests that the maximum cough power to spontaneously reflect the risk of exposure to infection causes.

From the above, infective and non-infective complications in gastrointestinal cancer patients were related to common factors that reflected the degree of surgical invasion. In addition, infective complications only were related to the degree of postoperative immune response and preoperative respiratory function. This study is suggested that the possibility of preoperative physical therapy in prevention of postoperative complications in patients with gastrointestinal cancer. Future studies are necessary to verify the effect of preoperative respiratory rehabilitation on the prevention of infectious complications.

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