Systemic Inflammatory Response Syndrome following Gastrointestinal Surgery

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ABSTRACT

Introduction: Systemic inflammatory response syndrome symptoms immediately after surgery have lately been regarded as potential warnings of impending post-operative complications and multiple organ failure. This study was conducted to find out the clinical significance of systemic inflammatory response syndrome in postoperative patients and to investigate the relationship between the duration of post-operative systemic inflammatory response syndrome and the post-operative morbidity and mortality.

Methods: Total 30 patients who received different gastrointestinal surgery and fulfilled the diagnostic criteria for systemic inflammatory response syndrome between 2006 and 2008 at Kathmandu Medical College Teaching Hospital were included. Patients were analyzed for preoperative physiologic status, surgical stress parameters, and postoperative status of systemic inflammatory response syndrome, complications, and end-organ dysfunction.

Results: Duration of systemic inflammatory response syndrome or positive criteria's number of systemic inflammatory response syndrome after surgery significantly correlated with surgical stress parameters (blood loss/body weight and operation time). Septic complications and prolongation of systemic inflammatory response syndrome were associated with multiple organ dysfunction syndrome and increased mortality.

Conclusions: Systemic inflammatory response syndrome is a useful criterion for the recognition of postoperative complications and end-organ dysfunctions. Early recovery from systemic inflammatory response syndrome may arrest the progression of organ dysfunction, thus reducing the mortality.

Keywords: *gastrointestinal surgery; multiple organ dysfunction syndrome; systemic inflammatory response syndrome.*

INTRODUCTION

Systemic inflammatory response syndrome (SIRS) is a clinical response to a nonspecific insult of either infectious or noninfectious origin.[1] Although diagnostic criteria were established via consensus rather than quantitative study, subsequent investigations have validated their usefulness in predicting groups of patients with an increased risk of mortality.[2-4]

The effects of surgical stress, anesthesia, postoperative pain, and subsequent resuscitation may affect the components of the SIRS score. Pittet et al. investigated the epidemiology of SIRS in the Surgical Intensive Care Unit (SICU) and found that the score was too sensitive, precluding its usefulness for prediction of outcome.[4] Baue et al. found that the development of SIRS correlated with an increase in the incidence of

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multiple organ dysfunction, longer hospital stays, and increased mortality.[5] Patients undergoing major surgical procedures are at high risk of postoperative infectious complications.[6]

The aim of this study was to investigate the relationship between the duration of postoperative SIRS and the postoperative morbidity and mortality in the patients after major gastrointestinal surgery.

METHODS

This is a retrospective study conducted from January 2006 to January 2008 in patients who were admitted to SICU after major gastrointestinal surgery and fulfilled all four criteria in definition of SIRS post-operatively (Table 1). Thirty patients fulfilled the criteria and were included in the study; among them 13 were male and 17 were female, age ranged from 19 to 74 years.

Table 1. Criteria for SIRS.

Temperature	**>38°C or <36°C**
Heart rate	>90 beats/min
Respiratory rate	> 20 breaths/min or PaCO2 <32 mmHg (4.3 k pa)
WBC count	>12000 cells/mm^3 or <4000cells/mm^3 or >10% immature(bands) forms

SIRS=systemic inflammatory response syndrome; WBC=white blood cell.

The criteria for inclusion were patients who had undergone major gastrointestinal surgery and fulfilled all the four criteria of definition of SIRS postoperatively. The Patients who already had two or more criteria for diagnosis of SIRS preoperatively, preoperative treatment with anti-inflammatory drugs, the existence of a preoperative infection or clinical inflammatory syndrome were excluded from the study. All clinical data were collected retrospectively for each patient. All clinical parameters like blood loss, requirement of transfusion, albumin level, pre-operative shock, peroperative cardiac arrest and cardiopulmonary resuscitation, peroperative use of ionotropes, thrombocytopenia, prolonged prothrombin time, post-operative complications, post-operative multi organ dysfunction syndrome (MODS) were noted (Table 2).

The relationship of duration of postoperative SIRS with these parameters and mortality were analyzed with multivariate analysis using Statistical Package for the Social Sciences.

Informed consent was taken from the patients and an ethical approval from IRC was taken for the study.

RESULTS

There were total 30 patients in the period of 24 months in our surgical ICU department who had undergone major gastrointestinal surgery and who fulfilled all four criteria of SIRS in the initial post-operative period. The cases were diagnosed and undergone the operation as shown in Table 2. There were 13 cases of malignancy including malignancy of cecum, rectum, stomach, pancreas and colon. Other cases were six with enteric perforation, five with perforated appendicitis, two with duodenal ulcer perforation, two with acute appendicitis undergone laparoscopic appendectomy, two with empyema gall bladder.

Table 2. Modified multiple organ failure score.

System	Score				
	-	1	2	3	4
Cardiovascular system (systolic blood pressure; mmHg)	>90	<90, fluid responsive	<90,fluid nonresponsive	<90, pH<7.3	<90, pH<7.2
Respiratory (FiO2/PO2)	>400	301-400	201-300	101-200	<101
Glasgow coma score	15	13-14	10-12	6-9	<6
Coagulation (platelet countX10^9/l)	>120	81-120	51-80	21-50	<21
Renal (Creatinine; umol/l)	<134	134-169	170-310	311-439	>439

FiO2=fraction of inspired oxygen; PO2=partial pressure of oxygen

Table 3. Type of the diseases and subsequent operation included in the study.

Name of disease	Name of operation	no.
Carcinoma caecum	Right extended hemicolectomy	3
Carcinoma rectum	Anterior resection	3
Carcinoma stomach	Subtotal gastrectomy	1
Carcinoma stomach	Total gastrectomy	2

Carcinoma pancreas	Whipple's operation	2
Carcinoma colon	Left hemicolectomy	1
Carcinoma transverse colon infiltrating stomach and ileum	Right extended hemicolectomy with partial gastrectomy with resection anastamosis of ileum	1
Enteric perforation	Exploratory laparotomy with resection anastamosis of ileum	6
Acute appendicitis	Laparoscopic appendectomy	2
Perforated appendicitis	Exploratory laparotomy with appendectomy	5
Duodenal ulcer perforation	Exploratory laparotomy and repair of duodenal ulcer perforation	2
Empyema gall bladder	Open cholecystectomy	2

Table 4. Correlation of different clinical parameters for SIRS 96 hours or more.

Name of operation	no.	SIRS for 96 hrs or more	Blood loss	Transfusion post-operatively	Albumin (g/dl)	Mortality
Right extended hemicolectomy	3	1	500 ml	4 unit	Normal	1
Anterior resection	3	2	500 ml 600 ml	4 unit 6 unit	<3 <3	1
Subtotal gastrectomy	1		300 ml	3 unit	Normal	
Total gastrectomy	2	1	400 ml 450 ml	3 unit 3 unit	<3 <3	1
Whipple's operation	2	1	600 ml 600ml	4 unit 4 unit	<3 <3	1
Left hemicolectomy	1	1	500 ml	3 unit	<3	1
Right extended hemicolectomy with partial gastrectomy with resection anastamosis of ileum	1	1	600 ml	4 unit	<3	1
Exploratory laparotomy with resection anastamosis of ileum	6	2	200ml 300ml	2 unit 3 unit	<3 Normal	2
Laparoscopic appendectomy	2		Minimal	Nil	Normal	
Exploratory laparotomy with appendectomy	5	1	200ml	Nil	Normal	
Exploratory laparotomy with repair of duodenal ulcer perforation	2		Minimal	Nil	Normal	
Open Cholecystectomy	2		100 ml	Nil	Normal	

Table 5. Duration of SIRS and mortality on different operation.

Name of operation	SIRS for 24 hrs	SIRS for 48 hrs	SIRS for 96 hrs or more	Mortality
Right extended hemicolectomy	1	1	1	1
Anterior resection	1	1	1	1
Subtotal gastrectomy	1			
Total gastrectomy	1		1	1
Whipple's operation	1		1	1
Left hemicolectomy			1	1
Right extended hemicolectomy with partial gastrectomy with resection anastamosis of ileum			1	1
Exploratory laparotomy with resection anastamosis of ileum	2	2	2	2
Laparoscopic appendectomy	1	1		
Exploratory laparotomy with appendectomy	3	1	1	
Exploratory laparotomy with repair of duodenal ulcer perforation	1	1		
Open Cholecystectomy	2			
Total	14	7	9	8

Among 30 patients (Table 3, 4), seven patients had SIRS for more than 48 hours and ultimately SIRS were controlled and they recovered. Nine patients had SIRS for more than 96 hours and only one patient survived from the group (Table 5). Eight of nine patients who had SIRS for more than 96 hours after major gastrointestinal surgery died after having multiorgan dysfunction. Majority of the patients had postoperative complications (Table 6).

Table 6. Relation of different clinical parameters and duration of SIRS and its significance.

Particulars	SIRS 24 hrs n = 14(46.67%)	SIR S 48 hrs n = 7(23.3%)	SIRS > 96 hrs n = 9(30%)	P value for SIRS > 96 hrs
Preoperative shock	-	(2)28	(2) 22	>0.05
Preoperative hypoproteinemia	(4)28	(2)28	(7) 77	>0.05
Preoperative transfusion	(1)7	(1)14	(3) 33	>0.05
Peroperative cardiac arrest and cardiopulmonary resuscitation	-	-	(2) 22	>0.05
Peroperative use of ionotropes	(1)7	(1)14	(2) 22	>0.05
Platelet decrease >3 times	-	(1)14	(5) 55	>0.05
Prolonged PT>1.5 times	-	-	(5) 55	>0.05
Postoperative complications	-	(1)14	(7) 77	<0.05
Postoperative Multiple Organ failure	-	-	(8) 88	<0.05
Mortality	-	-	(8) 88	<0.05

DISCUSSION

We frequently observed SIRS in major postoperative event. Major surgical stress, anesthesia, and postoperative pain can result in a systemic response (hyperthermia or hypothermia, leukocytosis or leukopenia, tachypnea and tachycardia) that can mimic acute inflammation, but the response should be short-lived if resuscitation is adequate. Therefore, a SIRS score obtained within 24 hours of ICU admission is a poor predictor of outcome.[8] However, this proinflammatory response seems to be pathological if it persists beyond 24 hours.[9] In this study, a continued SIRS for 96 hours and more after major gastrointestinal surgery, despite aggressive resuscitation, predicted an increased mortality. Moreover, it is not only the day two SIRS in isolation, but failure of the SIRS to decrease or indeed to increase during the second 48 hours (which indicates an ongoing or superimposed proinflammatory response) that is important. Haga et al,[10] in a retrospective study in patients after gastrointestinal tract surgery found that the duration of SIRS correlated with an adverse outcome. These authors examined a surgical stress parameter (blood loss indexed to body mass), operative time, and serum C-reactive protein concentrations and documented that surgery itself can lead to a proinflammatory state, as had been hypothesized.[8,11] Patients who recovered from early postoperative SIRS had a lower incidence of multi organ dysfunction than did those in whom SIRS persisted. We observed that SIRS (=4 criteria) continuing consecutively for more than two days had a higher incidence of both infectious and noninfectious postoperative copmplications, as well as a higher incidence of multi-organ dysfunction. Mia Talmor et al. agrees that persistent day correlates strongly with adverse outcomes.[12]

According to Mia Talmor et al., SIRS attributable to surgical stress and ICU resuscitation can be quantitated. Regardless of admission type, the mean SIRS score decreased by 0.8 points from day 1 to day 2 of the ICU stay, reflective of ICU resuscitation.[12] Pitet et al,[4] investigated the epidemiology of SIRS in a population of 170 surgical ICU patients. The SIRS criteria (≥2) were met by 93% of the patients, whereas only 8.2% died. We assumed that because very high sensitivity and poor specificity, SIRS did not identify those patients who died ultimately. So we included only those patients in ICU who had SIRS score of four fulfilling all four criteria in the diagnosis of SIRS.

Various factors have been investigated and analyzed in association with the development of complications after surgery. In addition, such factors as age, gender, operating time, volume of blood loss, the need for transfusion, and imbalance among the biological defense systems including nervous system, endocrine system, and immune system have all been considered as causes. Although cytokine measurements are important in diagnosing SIRS, they play a more important role in determining whether or not SIRS develops during the recovery from the surgical stress or is induced by various complications. However, it remains to be elucidated as to exactly when a diagnosis of SIRS in postoperative cases should be made. In those, should we regard the cases in which the diagnostic criteria were fulfilled on

the second day after surgery to be SIRS positive, since the circulatory dynamics such as instabilities in blood pressure and pulse are generally stabilized by Post-operative day two.[13]

The frequency of postoperative complications is considered to depend on the duration of SIRS, rather than the number of SIRS-related signs. In our study, all patients in whom the SIRS lasted for four days or longer developed postoperative complications.

Our findings support the current theories regarding the pathogenesis of SIRS and organ dysfunction syndrome popularized by Bone.[14,15] An elevated postoperative day one SIRS score may be secondary to a local pro-inflammatory coping reaction. However by post-operative day two if SIRS persists, it will result in an increased incidence of multi organ dysfunction and death. Barie et al.[16] indicates that clinically meaningful derangements are present and detectable very early in the course of critical illness. Sequential elements necessary for the development of SIRS or multi-organ dysfunction may occur within hours rather than days.[17] The importance of early, aggressive resuscitation is underscored, but the time window for successful intervention may be narrow. It can be hypothesized that failure to reduce SIRS score in 24 hours in the ICU would correlate with multi-organ dysfunction, ICU length of stay and mortality. Standard resuscitation ICU protocols and proper assessment of the resuscitation on time should be practiced. Importance and impact of resuscitation on the systemic inflammatory response should be highlighted.

CONCLUSIONS

Prolonged post-operative SIRS is associated with increased post-operative complications, multi-organ dysfunction and mortality. Further multicentre, well designed randomized, double blind clinical trials in critically ill patients with prolonged postoperative SIRS are required.

Conflict of Interest: None.

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