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Prospective study of etiology, intervention, morbidity and mortality associated with sirs and mods following intra-abdominal infection and trauma

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Abstract
Multiple organ failure is a major cause of morbidity and mortality in the critically ill patient. The syndrome involves the progressive dysfunction of the physiological system in the presence of Major injuries and operations for intra abdominal sepsis. This study was aimed at studying the incidence of systemic inflammatory response syndrome (SIRS) and multiple-organ dysfunction syndrome (MODS) in intraabdominal infections due to various causes, traumatic and non traumatic, mortality and morbidity associated and various interventions done for the patients. This study followed 200 patients in over 3 years. The incidence of SIRS and MODS in intraabdominal infection was found to be 11% and it accounts for 36.8% for all trauma admission. Mortality rate associated with SIRS and MODS appears to be 22%. There was a stronger correlation between observed and predicted mortality rate in SIRS and MODS score, there by indicating their greater usefulness in predicting the outcome.

Keywords: Etiology, intervention, morbidity, sirs and mods, intra-abdominal infection and trauma

Introduction
Multiple organ failure is a major cause of morbidity and mortality in a critically ill patient. Emerging in the 1970s the concept of MOF was linked to modern developments in intensive care medicine [1]. Although an uncontrolled infection can lead to MOF [2], such a phenomenon is not always found. A number of mediators and the persistence of tissue hypoxia have been incriminated in the development of MOF [3]. The gut is has been cited as a possible motor of MOF [4].

Nevertheless our knowledge regarding the pathophysiology of MOF remains limited. Furthermore, the development of new therapeutic interventions aim at a reduction of the incidence and severity of organ failure/dysfunction to quantify the severity of illness [5].

Accordingly, it is important to set some simple but objective criteria to define the degree of organ dysfunction/failure [6].

Its mortality rate equals or exceeds 30 percent and increases progressively with the number of organ involved [7]. Furthermore the pathophysiology the of this syndrome and thus specific prophylaxis and treatment remains elusive. The disappointing results and recent clinical trials of anti–endotoxin antibodies emphasize the incomplete understanding of this problem [8].

The problem of inflammation and infection as a leading cause of organ dysfunction and failure is a major problem after injury or operation. When systemic inflammation response syndrome [SIRS] progress to multiple organ dysfunction syndrome [MODS], the mortality reach upto to 30 to 80 percent depending on the number of failed organ.

Sepsis, systemic inflammatory response syndrome (SIRS) and multiple-organ dysfunction syndrome (MODS) represent progressive stages of the same illness, in which a systemic response to an infection may lead to a generalized inflammatory reaction in organs remote from the initial insult and eventually to end-organ failure [9].

Multiple-organ dysfunction syndrome (MODS) is describe as syndrome of dysfunction of multiple organ systems in association with sepsis, shock or inflammation [10].

Multiple organ dysfunction syndrome and the systemic inflammatory response syndrome are expressions of an inappropriate, generalized inflammatory response to severe inflammatory stimuli, which may be bacterial or nonbacterial in nature.

The clinical signs and symptoms, morphologic alterations and changes in oxygen transport seem to be the direct effect of phagocyte activation [11].

Intra abdominal infection may be defined as clinical peritonitis with operative and microbiological proof of infection [12, 13].

It consists of a spectrum of pathologies namely, primary, secondary and tertiary peritonitis and intra abdominal abscess. In our environment, peritonitis is a common cause of death in emergency unit with the scourge of perforation, late representation of appendicular perforation and strangulated bowel being the key reasons [14, 15, 16]. Literature reports have tended to address these causative diseases rather than intra abdominal infection itself.

Plasma concentrations of procalcitonin (PCT), interleukin-6 (IL-6), protein complement 3a (C3a), leukocyte elastase (elastase), and the C-reactive protein (CRP) determined directly after the clinical onset of sepsis or systemic inflammatory response syndrome (SIRS) discriminate between patients suffering from sepsis or SIRS and predict the outcome of these patients.

Procalcitonin (PCT) and interleukin-6 (IL-6) are used to differentiate sepsis from non-infectious systemic inflammatory response syndrome (SIRS) [17].

Inflammatory changes after trauma depend on the severity and the distribution of the injury and can be modified by the medical treatment [18].

Aims and Objectives

1. To find the incidence of SIRS and MODS in various cases of intra abdominal infections and abdominal trauma admitted in our hospital.
2. To find the morbidity and mortality associated with SIRS and MODS in various cases of intra abdominal infections and abdominal trauma admitted in our hospital.

Material and Methods

This study was a prospective observational study to note incidence, interventions, morbidity and mortality associated with SIRS and MODS following trauma cases and intraabdominal infections. The study was carried out in a tertiary care centre over a period of 3 years after obtaining our Institution's Ethical Committee Approval for the same. In this prospective descriptive study 200 adult patients admitted in ward or trauma unit who met inclusion criteria, regardless of gender were included. All Adult patients of age 18 or more having trauma or intraabdominal infection potentially life threatening will be included in our study. Patients with severe head injuries (GCS 8 or less), less than 24 hrs. stay (due to immediate death or AMA discharge), very severe injury where patient is unlikely to survive, those with associated co-morbid conditions like CRF, cardiac failure, liver failure, pulmonary failure or coagulopathies. Immunocompromised patients, patients on chronic steroid or cancer chemotherapy and Pregnant Women were excluded from the study. These exclusion criteria were applied so as to concentrate on organ dysfunction arising as a consequence of SIRS and MODS. Severe head injury cases were eliminated due to their invariable grave outcome.

Informed written consent signed by patient (or legally acceptable relative or representative) was taken, primary demographic data was collected. The injury admission time interval or onset of abdominal pain-admission interval was noted. Detailed clinical examination and evaluation was done as per standard guidelines. Baseline investigations and special investigations was done in case as per the need.

Revised Trauma score

Coma Scale, systolic blood pressure and respiratory rate Value	GCS	SBP	RR
0	3	0	0
1	4-5	<50	<5
2	6-8	50-75	5-9
3	9-12	76-90	>30
4	13-15	>90	10-30

Revised trauma score (RTS) ranged from 0 (worst outcome) to 12 (best outcome). It was calculated in all patients on arrival

Injury Severity Score: This anatomical score assessing injury severity was calculated in all patients after complete evaluation of injuries.

Injury Severity Score = Sum of three highest abbreviated injury scale.

The possible range for ISS is from 0 (02+02+02) to 75 (52+52+52). Usually Injury severity score more than 15 is considered as major injury. In this study we included the patients with ISS of 25 or less with clinical assessment of a potentially life or limb threatening injury.

Assessment of SIRS and MODS

Baseline laboratory investigations for the presence of the MODS and clinical examination for SIRS were done for every patient.

SIRS score

Patients with systemic inflammatory response syndrome were scored as follows.

Table 2: SIRS score

Sirs Score	1	2	3
Body temperature (0c)	> 38	> 38.5	> 39 or < 36
Heart rate (/min)	> 90	> 110	> 130
Respiratory rate (/min)	> 20	> 24	> 28
WBC count (/cmm)	> 12000	> 16000	> 20000 or < 40000

SIRS score ranged from 0 to 12. By definition of SIRS, score of 2 or more was considered as state of SIRS. This score was calculated for all patients after initial resuscitation till 24 hours (day 1), on day 3 (48-72 hours) and day 6 (within 120-144 hours from admission).

MODS score

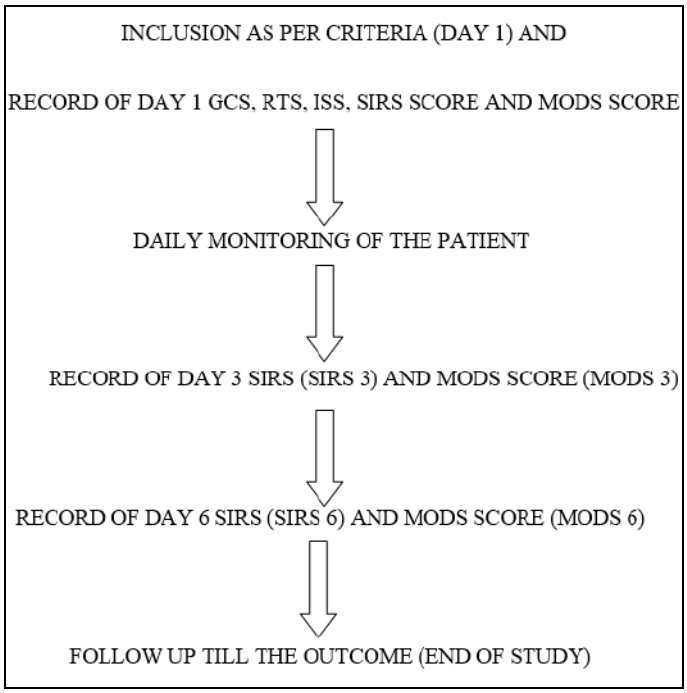
MODS	0	1	2	3	4
Pulmonary					
		< 400	< 300	< 200	< 100
PaO_2/FiO_2	> 400				
		221-301	142-220	67-141	<67
SaO_2/FiO_2					
Coagulation	> 150	< 150	< 100	< 50	< 20
Platelets					
Liver	< 1.2	1.2 –	2-5.9	6-11.9	> 12
Bilirubin		1.9			
CVS Hypotension	No Hypotension	MAP<70	Dopamine	Dopamine $\geq$ 5 or $\leq$ 0.1	Dopamine > 15 or > 0.1

Patients with multiple organ dysfunction were scored on following six organ systems as follows, and the total sum was considered the MODS score. Presence of MODS was confirmed by score ≥ 1.0 was no MODS. 1-2 was mild MODS and ≥3 was considered severe MODS.

The MODS score ranged from 0 (no organ dysfunction) to 24 (dysfunction of all 6 body systems). MODS score was calculated for all the patients on day 1 after initial assessment and resuscitation, day 3 and day 6.

The management was noted down, whether operative or conservative for each patient. The requirement of ventilator support, blood transfusion, platelet transfusion, and/or dialysis for uraemia was also noted down. The final outcome of the patients was also noted. There were three possible outcomes namely discharge, death or DAMA. The total hospital stay and total number of days spent in an ICU were also noted.

Flow Diagram for the study



Results and Discussion

Table 1: Etiology wise Distribution of Cases of Intra-abdominal Infection Due to Both Traumatic and Non Traumatic Etiology in Whome SIRS and MODS Develop

Causes	No. of Patients	Percentage
Acute pancreatitis	48	24.00%
Appendicular perforation	40	20.00%
Duodenal perforation	35	17.5%
Intestinal obstruction/gangrene obstruction/gangrene obstruction/gangrene	30	15.00%
Intestinal perforation	24	12.00%
Traumatic intestinal perforation	10	5.00%
Ruptured liver abscess	5	2.50%
Liver injury	4	2.00%
Splenic injury	2	1.00%
Mesenteric injury	2	1.00%

Table 2: Time of Arrival

Time	No. of Patients
Within 1 hr.	76
1-6 hrs.	64
After 6 to m24 hrs	48
After > 24 hrs	12
Total	**200**

Table 3: Etiology wise Morbidity Rate

Etiology	N3o. of Patients	No. of morbidity	Morbidity rate
Acute pancreatitis	48	29	60.41%
Appendicular perforation	40	21	52.50%
Duodenal perforation	35	20	57.14%
Intestinal obstruction/gangrene	30	20	66.67%
Intestinal perforation	24	18	75.0%
Traumatic intestinal perforation	10	7	70.0%
Ruptured liver abscess	5	3	60.0%
Liver injury	4	2	50.0%
Splenic injury	2	1	50.0%
Mesenteric injury	2	1	50.0%
Total	**200**	**122**	

Table 4: Etiology wise Mortality Rate

Etiology	No. of Patients	No. of Deaths	Morbidity rate
Acute pancreatitis	48	10	20.83%
Appendicular perforation	40	0	0%
Duodenal perforation	35	8	22.85%
Intestinal obstruction/gangrene	30	10	33.34%
Intestinal perforation	24	8	33.34%
Traumatic intestinal perforation	10	3	30.00%
Ruptured liver abscess	5	2	40.00%
Liver injury	4	1	25.00%
Splenic injury	2	1	50.00%
Mesenteric injury	2	1	50.00%
Total	200	44	

Table 5: Morbidity Rate with Etiological Group in Relation to SIRS Score

Cause of Peritonitis	SIRS Score								
	0 – 4			5 – 8			9 – 12		
	n	Morb.	MbR (%)	n	Morb.	MbR (%)	n	Morb.	MbR (%)
Acute pancreatitis	13	4	30.76	20	10	50.0	15	15	100
Appendicular perforation	10	1	10.0	30	20	66.66	0	0	
Duodenal perforation	10	0	0	15	11	73.33	10	9	90.0
Intestinal obstruction/ gangrene	3	0	0	15	9	60.0	12	11	91.66
Intestinal perforation	2	0	0	12	10	83.33	10	8	80.0
Traumatic intestinal perforation	0	0	0	5	2	40.0	5	5	100
Ruptured liver abscess	0	0	0	0	0	0	5	3	60.0
Liver injury	0	0	0	0	0	0	4	2	50.0
Splenic injury	0	0	0	0	0	0	2	1	50.0
Mesenteric Injury	0	0	0	0	0	0	2	1	50.0

Table 6: Morbidity with SIRS Score

SIRS Score	No. of Patients	No. of Morbidity	Morbidity rate
0 – 4	38	5	10.52%
5 – 8	97	62	63.91%
9 – 12	64	55	84.61%
Total	200	122	

Table 7: Mortality with SIRS Score

SIRS Score	No. of Patients	No. of Mortality	Mortality rate
0 – 4	38	0	0%
5 – 8	97	2	2.06%
9 – 12	65	42	64.61%
Total	200	44	

Table 9: Number of Patient Underwent Surgical Intervention

Etiology	No. of Patients	No. of patient underwent surgery	Name of Surgery	Percentage
Acute Pancreatitis	48	4	Necrosectomy	8.33%
Appendicular perforation	40	40	Appendectomy	100%
Duodenal Perforation	35	32	Primary closure	91.42%
Intestinal Obstruction/gangrene	30	15	Resection anastomosis	50%
		5	Colostomy	16.67%
Intestinal perforation	24	24	Primary closure	100%
Traumatic intestinal perforation	10	8	Primary closure	80%
Ruptured liver Abscess	5	3	Exploratory Laparotomy	60%
Liver injury	4	0	-	0%
Splenic injury	2	2	Splenectomy	100%
Mesenteric injury	2	2	Resection Anastomosis	100%
	200	135		

Table 10: Complication Distribution of Study Subjects

Complications	No. of Patients	Percentage
Chest infection	100	50.51%
Wound infection	72	36.36%
Deep seated infection (Pelvic abscess, sub diaphragmatic abscess)	12	6.06%
Burst Abdomen	7	3.53%
DIC	5	2.53%
Renal Failure	2	1.01%
Total	198	100.00%

Discussion

In our study etiology wise distribution of cases of intra-abdominal infection due to both traumatic and non traumatic etiology in whom sirs and mods develop was markedly shown as in table no. 1. Acute pancreatitis is the commonest cause (24.0%) followed by Appendicular perforation (20%), duodenal perforation (17.5%), intestinal obstruction/gangrene (15.0%), intestinal perforation (12.0%), traumatic intestinal perforation (5%), ruptured liver abscess (2.5%), liver injury (2.0%), splenic injury (1.0%) and mesenteric injury (1%).

In our study we got maximum number of cases in 4thto 5th decade. Age ranged from 18 to 76 years. Mean age 40 years. Out of 200 patients 132 were males and 68 were females with M:F =1.94:1.

In Table 2 The time duration between the initial insult and the presentation to the emergency department is shown.

In Table 3 etiology wise morbidity rate is shown. In our study morbidity rate in acute pancreatitis is 60.41%, appendicular perforation is 52.50%, duodenal perforation is 57.14%, intestinal obstruction/ gangrene is 66.67%, intestinal perforation is 75%, traumatic intestinal perforation is 70%, ruptured liver abscess is 60%, liver injury is 50%, splenic injury 50%, mesenteric injury is 50%.

In our study the etiology wise mortality rate as shown in table 4, for acute pancreatitis is 20.83%, for appendicular perforation 0%, for duodenal perforation 22.85%, for intestinal obstruction/gangrene 33.34%, for intestinal perforation 33.34%, for traumatic intestinal perforation 30%, for ruptured liver abscess 40%, for liver injury 25%, for splenic injury 50%, for mesenteric injury 50%.

Morbidity rate as per SIRS score 0 – 4 in relation to etiology is 30.76% in acute pancreatitis, 10% in appendicular perforation, 0% in duodenal perforation, intestinal obstruction/gangrene, intestinal perforation, traumatic intestinal perforation, ruptured liver abscess, liver injury, splenic injury and mesenteric injury.

Morbidity rate as per SIRS score 0 – 4 in relation to etiology is 30.76% in acute pancreatitis, 10% in appendicular perforation, 0% in duodenal perforation, intestinal obstruction/gangrene, intestinal perforation, traumatic intestinal perforation, ruptured liver abscess, liver injury, splenic injury and mesenteric injury.

Morbidity rate as per SIRS score 5 – 8 in relation to etiology is 50% in acute pancreatitis, 66.66% in appendicular perforation, 73.33% in duodenal perforation, 60% in intestinal obstruction/gangrene, 83.33% in intestinal perforation, 40% in traumatic intestinal perforation, 0% in ruptured liver abscess, liver injury, splenic injury and mesenteric injury.

Morbidity rate as per SIRS score 9 – 12 in relation to etiology is 100% in acute pancreatitis, 0% in appendicular perforation, 90% in duodenal perforation, 91.66% in intestinal obstruction/gangrene, 80% in intestinal perforation, 100% in traumatic intestinal perforation, 60% in ruptured liver abscess, 50% in liver injury, splenic injury and mesenteric injury.

As per table 6, In our study we observed that morbidity with SIRS score for 0-4 is 10.52%, for 5-8 is 63.91% and for 9-12 is 84.61%.

In our study we observed 198 complications in 122 patients. Some patient had more than one complication. Among them chest infection is the commonest complication (50.51%), followed by wound infection (36.36%), deep seated infection (6.06%), burst abdomen (3.53%), DIC (2.53%) and renal failure (1.01%).In our study 44 patients died due to septicemia and multiorgan failure and 10 patients were gone discharged against medical advice.

In our study average days of hospitalisation for acute pancreatitis is 17 days, appendicular perforation is 12 days, duodenal perforation is 14 days, intestinal obstruction/gangrene is 19 days, intestinal perforation is 20 days, traumatic intestinal perforation is 21 days, ruptured liver abscess is 18 days, liver injury is 22 days, splenic laceration is 18 days and mesenteric injury 20 days.

In our study average days of stay in ICU for acute pancreatitis is 6 days, appendicular perforation is 5 days, duodenal perforation is 6 days, intestinal obstruction/gangrene is 9 days, intestinal perforation is 9 days, traumatic intestinal perforation is 10 days, ruptured liver abscess i s 8 days, liver injury is 11 days, splenic laceration is 7 days and mesenteric injury 9 days.

In our study all the patients on the basis of SIRS score divided into three group, 0-4 [non infectious sirs], 5-8 [severe sepsis] and 9-12 [septic shock].

The morbidity rate for these group is 10.52%, 63.91% and 84.61% respectively.

The mortality for the 0-4 score is 0%, for score 5-8 is 2.06% and for score 9-12 is 64.61%.

Morbidity rate as per SIRS score 5 – 8 in relation to etiology is 50% in acute pancreatitis, 66.66% in appendicular perforation, 73.33% in duodenal perforation, 60% in intestinal obstruction/gangrene, 83.33% in intestinal perforation, 40% in traumatic intestinal perforation, 0% in ruptured liver abscess, liver injury, splenic injury and mesenteric injury.

Morbidity rate as per SIRS score 9 – 12 in relation to etiology is 100% in acute pancreatitis, 0% in appendicular perforation, 90% in duodenal perforation, 91.66% in intestinal obstruction/ gangrene, 80% in intestinal perforation, 100% in traumatic intestinal perforation, 60% in ruptured liver abscess, 50% in liver injury, splenic injury and mesenteric injury.

In our study we observed that Mortality rate as per SIRS score 0 – 4 is found to be 0% in all etiological groups.

Mortality rate as per SIRS score 9 – 12 in relation to etiology is 60% in acute pancreatitis, 0% in appendicular perforation, 80% in duodenal perforation, 75% in intestinal obstruction/gangrene, 80% in intestinal perforation, 60% in traumatic intestinal perforation, 40% in ruptured liver abscess, 25% in liver injury, 50% in splenic injury and mesenteric injury.

In our study mortality rate in SIRS score is 0% in 0-4 and 2.06% in 5-8 and 64.61 in our study MODS score is divided into 0-6, 7-12, 13-18 and 19-24.

Mortality rate as per MODS score 19-24 in relation to etiology is 100% in acute pancreatitis, 0% in appendicular perforation, 75%

in duodenal perforation, 100% in intestinal obstruction/ gangrene, 85.71% in intestinal perforation, 75% in traumatic intestinal perforation, 100% in ruptured liver abscess, 50% in liver injury, 100% in splenic injury and mesenteric injury. % in 9-12.

The patients in MODS were manage by both conservative and surgical intervention. Out of 200 patients 135 patients were underwent surgical intervention and 65 patients were managed conservatively. The indication for conservative management were 1. Haemodynamic instability 2. Isolated solid organ injury 3. Presence of comorbidities. Various non surgical interventions were 1. PCV transfusion, 2. PRP transfusion, 3. Ventilatory support 4. Dialysis.

Non operative management: All the patients were kept nil by mouth and were given iv fluids, Broad spectrum antibiotics, close monitoring of vitals, urine output and subjected to repeated abdominal examination. Haemoglobin and haematocrit were done twelve hourly to look for continuing interval haemorrhage.

In our study we observed 198 complication in 122 patient some patient had more than one complication among them chest infection is commonest 50.50%, 2nd commonest wound infection 36.37%, deep seated infection 6.06%, burst abdomen 3.53%, DIC 2.52% and renal failure 1.01%.

The average days of ICU stay is 8 days and average days of hospitalization are 16.10 day.

In our study of 200 patient 44 patients died due to multi organ failure and 10 patients underwent discharge against medical advice.

Conclusion

This study includes 200 consecutive patients of intraabdominal infections due to both traumatic and non traumatic etiology in whom SIRS and MODS developed. The incidence of SIRS and MODS in intraabdominal infection was found to be 11% and it accounts for 36.8% for all trauma admission in ICU.

Pancreatitis appears to be the most common cause of SIRS and MODS followed by appendicular perforation, duodenal perforation, intestinal obstruction/gangrene, intestinal perforation, traumatic intestinal perforation, ruptured liver abscess, liver injury, splenic injury and mesenteric injury.

Males are more commonly affected than females.

Age at presentation, delayed presentation to the emergency department associated injuries like head injury, chest injury, fracture of long bones and spine with associated comorbidities like diabetes mellitus, hypertension and asthma appear to be the factors affecting SIRS & MODS.

Mortality rate associated with SIRS and MODS appears to be 22%.

Rapid resuscitation of these patients is crucial.

There was a stronger correlation between observed and predicted mortality rate in SIRS and MODS score, there by indicating their greater usefulness in predicting the outcome.In all scoring system there was a linear increase in death rate with increase in scores. We observed that SIRS and MODS score, thereby can be use for assessment of outcome in patients with intra-abdominal infection and trauma.

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