Original Article

A Study Of Association Of Intra-Abdominal Pressure With Severity And Outcome In Patients Of Emergency Laparotomy

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Abstract

Introduction: The present study is done to study the association of intra-abdominal pressure with intra-operative findings and postoperative surgical complications in patients of emergency laparotomies so that timely and appropriate interventions can be planned and administered.

Methods: The study was done on 84 patients. The intra-abdominal pressure was measured indirectly by measuring the pressure within the urinary bladder via Foley's catheter.

Results: There was positive association between the higher grades of IAP and intra-abdominal contamination and gangrenous bowel, the mean value of IAP being 20.4 mmHg. A statistically positive association was also observed between preoperative IAP and post-operative complications, the mean IAP ≥19mmHg.

Conclusion: There is a significant positive association of raised pre-operative intra-abdominal pressure with intra-operative finding of gangrenous and edematous bowel and postoperative surgical complications.

Keywords: Intra Abdominal Pressure; Gangrenous bowel; Postoperative complications.

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Disclosures:

Ethical Clearance: Taken

Conflict of interest: None

Financial aid: None

How to cite this article:

Kurra A, Sukhadia M, Thomas NM, Sethi D, Sharma N. A study of association of intra-abdominal pressure with severity and outcome in patients of emergency laparotomy. J Soc Surg Nep. 2024;27(1):12-16.

DOI:

https://doi.org/10.3126/jssn.v27i1.71274

Introduction

The intra-abdominal pressure(IAP) is of profound significance in surgical practice and in critical care because of its effects on various organ systems of the body. The pressure concealed within the abdominal cavity is known as intra-abdominal pressure.[1]

The raised IAP is defined as intra-abdominal pressure more than 12 mmHg and Abdominal compartment syndrome (ACS) is considered at a value of more than or equal to 20 mmHg. Perforation peritonitis, gross ascites, intestinal obstruction, abdomino-pelvic traumas, laparoscopic surgeries, intra-abdominal hemorrhage, abdominal tumors, peritoneal dialysis[2,3] are some of the important causes of raised IAP and ACS.

Raised intra-abdominal pressure causing ACS is a major source of morbidity and mortality associated in emergency laparotomy patients. Hence, a close monitoring of intra-abdominal pressure and an early and goal-oriented management as well as surgical intervention in patients of ACS is essential for a successful outcome in a patient undergoing emergency laparotomy.

Normal Intra-abdominal pressure (IAP) is 0-5 mm Hg. Intra-abdominal pressure varies with position, body habitus and activity. Intra-abdominal pressure is measured in cm of water or mm of Hg. (1 mm of Hg = 1.36 cm of H_2O).[4] Intra-abdominal pressure of between 3 to 10 mm Hg is commonly observed post operatively without adverse effects. The World Society for Abdominal Compartment Syndrome (WSACS) classifies intra abdominal pressure in four grades. (**Table 1**)

Table 1. Grades of Intra-Abdominal Pressure (WSACS)

Grades of IAP	Bladder pressure (mmHg)
Grade I	12-15
Grade II	16-20
Grade III	21-25
Grade IV	>25

IAH develops following events that leads to an acute increase in the amount or volume of abdominal contents enough to cause pressure related organ dysfunction.[5]

The excess of pressure within the abdomen may be associated with significant cardiopulmonary and renal dysfunction and contributes to intestinal mucosal acidosis and bacterial translocation leading to complications such as sepsis, multiple organ failure, and death.[6] Once the pressure is brought down by various interventions, these physiological changes can be reversed.[6] The exact level of IAP at which decompression should be done is not established in the literature but significant cardiopulmonary dysfunction or oliguria in the presence of raised IAP is considered an indication for decompression.[7] Moderate elevations in IAP without significant cardiopulmonary compromise can be managed by fluid resuscitation, inotropic support, and diuretics. There are certain adverse consequences of IAH such as gut mucosal acidosis that can appear at low pressures long before the adverse physiologic consequences i.e. respiratory, cardiovascular, and renal become apparent, therefore IAH should be anticipated and prevented in high-risk patients.[3,8] Presently there is a great need to fully understand the clinical implications and management of this condition, which would have far reaching clinical implications in surgical patients.[9]

The purpose of study was to observe the association of IAP with intra-operative findings and postoperative surgical complications. Understanding of these associations along with other significant factors may help to determine timely and appropriate surgical interventions to deal with disastrous intra-operative findings such as gangrenous gut. This may also influence the surgical procedure to combat and reduce postoperative surgical complications aiming to reduce the morbidity in surgical emergencies and postoperative surgical complication.

Methods

An observational descriptive study was conducted on 84 patients with surgical emergencies at Department of General Surgery, Maharana Bhupal Government Hospital, Udaipur, during the period of one year after approval from institutional ethical committee. All the patients aged 18 years or above with signs and symptoms of acute abdomen such as pain abdomen, distension, tenderness, guarding, rigidity were included. Patients with penetrating abdominal injuries, pregnant female patients and those with urinary bladder rupture or stricture urethra [or patients in whom catheterization could not be done] were excluded from the study.

After applying all the inclusion and exclusion criteria and informed consent, the IAP was recorded on day 0, surgery was performed after initial resuscitation within 24 to 48 hoursand all the physical parameters (abdominal girth, pulse, BP, Oxygen Saturation by pulse oxymeter, urine output), hematological parameters (TLC, platelets, Hb, LFTs, RFTs, electrolytes) were recorded. All the patients underwent emergency laparotomy. The intra-operative findings of the visceral organs (bowel, liver spleen) were observed and recorded; postoperative surgical complications were noted.

Method of Intra Abdominal Pressure Measurement

The intra-abdominal pressure was measured indirectly by measuring the pressure within the urinary bladder via a Foley's catheter. First, the bladder was completely emptied and then 100ml normal saline was filled into the urinary bladder via the Foley's catheter. After that the tubing of the Urine collection bag was clamped and the Foley's catheter was connected to a CVP manometer. The level of symphysis pubis was taken as the zero reference level and the pressure was measured in centimeters of water at the end expiration. A conversion factor of 1.36 was used to

convert the cmH_2O into mmHg 10 and IAP was then graded according to WSACS classification.

Statistical Analysis

Statistical analysis was performed using SPSS version 18 software. Variables were assessed by mean and Standard Deviation and analyses was done using Chi-square test for categorical variables. P-value of less than 0.05 was considered as significant.

Results

This study was conducted on 84 patients after applying inclusion and exclusion criteria who underwent emergency surgeries. In this study mean age of presentation was 46.3±25.4 years with 64.5% males and 34.5% females. Majority of surgeries were performed on patients of perforation peritonitis, intestinal obstruction and blunt trauma abdomen. Intra operative findings were observed as gut oedema, amount of contamination , viability of gut and these findings along with IAP at presentation were assessed with respect to postoperative outcomes.

When pre-operative IAP was charted against intra-operative findings such as edematous and fragile gut and amount of contamination with bowel content or hemoperitonium, following observations were made- there is a significant association between gangrenous gut and higher grades of IAP (grade 2, 3 & 4). There is strong positive association between the amount of intra-abdominal contamination and severity of IAP. (**Table 2**)

Similarly major post-operative complications such as anastomotic leak, wound dehiscence, SSIs were seen in higher grades of IAP. (**Table 3**) There is a significant association between IAP grades and MODS (< 0.001), SSIs (0.003), W.D. (<0.001), A.L. (0.026). (**Table 3**)

Table 2. Association of pre operative IAP with intra operative findings

Intra op finding	IAP Grade						P-value
	0	I	II	III	IV	Total	
Edematous gut	10	18	28	4	11	71	0.076
Gangrenous gut	0	0	5	0	0	5	0.048
Congested liver	2	2	3	1	2	10	0.0473
Congested spleen	0	0	5	3	4	11	0.003
Contamination							
Mild	4	3	7	1	3	18	0.952
Moderate	10	13	13	4	5	45	0.007
Severe	0	3	5	1	9	18	0.001

Table 3. Association of IAP with post-operative complications.

Complications	IAP grade					Total	p-value
	0	I	II	III	IV		
MODS	0	1	4	2	12	19	<0.001
Surgical Site Infection	2	3	15	3	10	33	0.003
Wound Dehiscence	0	2	9	3	10	23	<0.001
Anastomotic Leak	0	0	6	2	4	12	0.026
Paralytic Ileus	0	0	3	1	1	5	0.308

When hospital stay duration was plotted against pre-operative IAP, it was observed that patients with higher IAP had statistically significant increased duration of hospital stay. (**Table 4**)

Table 4. Association of IAP with Hospital Stay.

Length of Hospital Stay	IAP Grade					p-value
	0	I	II	III	IV	
<15 days	11	6	6	1	1	0.001
15-25 days	4	11	10	1	3	
>25 days	0	2	11	3	6	
Total	15	19	27	5	10	

Similarly higher mortality was observed with higher grades of pre-operative IAP. The maximum death in the study was associated with IAP of Grade 4 which had a mortality rate of 33.33%. (Table 5)

Table 5. Association between IAP grade and Outcome

IAP grade	Outcome		Total
	Survived (%)	Death (%)	
0	15 [100%]	0	15
I	20 [100%]	0	20
II	27 [93.1%]	2 [6.89%]	29
III	5 [100%]	0	5
IV	10 [66.66%]	5 [33.33%]	15
Total	77	7	84

Combined Cut-off value of pre-operative IAP versus intra-operative finding or complications are shown in **Table 6** and **Table 7**.

Table 6. Combined Cut-Off Values Of IAP [Mean Value]

Edematous bowel	Gangrenous bowel
17.68	20.4

Table 7. Combined Cut-Off Values of IAP for Complications

SSI	Wound Dehiscence	Anastomotic Leak	Paralytiv Ileus	Ventilator
17.68	19.04	19.72	20.4	19.04

Discussion

IAH and ACS have potential consequences on almost all body systems particularly on cardiac, respiratory, renal and neurological systems. ACS/IAH affects perfusion to various organs and thus play significant role in prognosis of patients. IAH/ACS is relatively a newer concept. Our purpose of study was to observe and analyze the association of preoperative IAH /ACS and intra-operative findings such as intestinal oedema, fragility, viability, contamination (amount) and other solid organ conditions in surgical emergencies. In order to have better understanding of consequences IAH/ACS in surgical patients, post-operative complications were also studied and evaluated in relation to preoperative IAH/ACS. IAP have significant detrimental effect on intestinal mucosa leading to increase in permeability and loss of intestinal mucosal barrier and bacterial translocation and decrease blood flow in mesentric vein that leads to intestinal oedema and ischemia at higher IAP. Earlier studies were dedicated on the physiologic aspect of IAP but in this study our focus was on the consequences of IAP on GI system and postoperative surgical complications.

The study was done on 84 patients. The mean age in our study was 46.3 years. Males were affected more (65.4%) than females (34.6%). In this study, a statistical association between intra abdominal pressure and the intra-operative findings of the bowel and the solid viscera, abdominal contamination and the complications post surgery were observed. There is obvious significant association between IAP and contamination (intra-abdominal collection). Significant collection (≥1 liters) and higher grades of IAP indirectly predicts gravity of pathology i.e. bigger perforation, delayed presentation, gangrenous bowel, third space fluid loss and significant intra-abdominal haemorrhage (in BTA).

Aggressive resuscitation in surgical emergencies may lead to increase in IAP. An increase in IAP further decreases mesentric blood flow especially in patients of obstruction. They may act synergistically to cause mucosal ischemia. A statistical significant association was observed between gangrenous bowel and higher grades of IAP. In this study it was observed that mean value of IAP at which viability of intestines was found to be compromised and gangrene developed was 20.4 mmHg, corresponding to abdominal compartment syndrome. There were other findings such as oedematous and fragile bowel, congested solid organs presented in patients with higher IAP. These findings may lead to pertinent postoperative surgical complications. Hence, it can be inferred that initial IAP and its serial monitoring can be helpful in acute abdomen especially in cases of intestinal obstruction for timely and appropriate intervention.

Post-operative complications such as SSI, wound dehiscence, stoma retraction and anastomotic leakage were also observed and have significant association with preoperative raised IAP. The mean cut-off value was 19 mmHg for these patients. Anastomotic leak in these patients can be a disastrous complication leading to increase in morbidity. Increased preoperative IAP in these patients may act as an adjunct to determine the course of management including initial resuscitation and intraoperative appropriate procedures to be done.

It is safe to conclude that significant intra-operative findings and postoperative complications and morbidity could be predicted in higher IAP [close to ≥20mmHg] and ACS. With this high preoperative IAP goal oriented resuscitation is advised and prompt and appropriate interventions, along the course of sequential IAP monitoring in surgical emergencies.

In this study there was a statistically significant association between the duration of hospital stay and the grades of IAP along with higher postoperative complication rates and late resolution of symptoms.

Similar results were obtained in previous study done by Agrawal S and et al. [11] However in another study by Pritesh N et al, there was no statistical correlation present between intra-abdominal pressure and wound dehiscence.[12]

The mortality and morbidity profile of patients in surgical emergencies are of paramount significance and so is their prevention and attenuation. Multitudes of factors are responsible for varied outcomes in these emergency surgeries. Apart from the nature of pathology and co-morbidities, factors affecting types of intervention are to be considered. IAP and ACS could be such named factors which could adversely affect the outcomes. The present study suggests significance of IAP/ACS and its association with intra-operative findings and postoperative complications. However, due to limited study population and numerous factors such as preoperative nutrition status, delayed presentation of patients, initial presentation with shock and septicaemia, variable pathologies with multitudes of comorbidities acted as confounding factors and thus affects the outcome of patients.

Conclusion

It was observed in this study that intra-operative findings such as gangrenous, edematous and fragile gut with gross contamination were associated with high IAP close to ACS and in such cases rate of complications is high. Measurement of IAP at the time of presentation in abdominal surgical emergencies may help in prompt and appropriate intervention. Its measurement preoperatively may act as adjunct to predict various findings and outcomes and thus influence and determine the course of management and intervention thus may help surgeons to abate mortality, morbidity, grievous insults to GI organs.

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