

“INTRAABDOMINAL HYPERTENSION AND ABDOMINAL COMPARTMENT SYNDROME IN EMERGENCY LAPAROTOMY PATIENTS IN TERTIARY CARE RURAL HOSPITAL”

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Article Info: Received 27 August 2019; Accepted 20 September. 2019

DOI: <https://doi.org/10.32553/ijmbs.v3i9.615>

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Conflict of interest: No conflict of interest.

Abstract

Background: Although initially recognized over 150 years ago, the patho-physiologic implications of elevated intra-abdominal pressure (IAP) have essentially been rediscovered only within the past two decades. The aim of the study was to evaluate the incidence, morbidity and mortality of intra abdominal hypertension and abdominal compartment syndrome in emergency laparotomy patients in tertiary care rural hospital.

Method: IAP measurement was done in all patients undergoing emergency laparotomy with manometry technique (U tube technique) using per- urethral foley's catheterization.

Results: Our study population was a group of patients who underwent laparotomy for various indications which included traumatic as well as non-traumatic causes. In total, 104 patients, with 30 females and 74 males were included in the study population who fulfilled the study criteria. The mean \pm SD age in our study were 40.2 \pm 13 years with 20-30yrs being the most common age group. Most of the studies on IAH and ACS analyse either trauma or ICU patients. Little has been reported on ACS in general surgical population. Our study population was a group of patients who underwent laparotomy for various indications which included traumatic as well as non traumatic causes, hence a predominance of general surgical patients.

Conclusions: Findings suggest that the incidence of ACS in our study is 3.84 % and found to be more common in trauma patients. There is significant association between increased Intra-abdominal pressure at 6 and 24 hours after laparotomy and organ dysfunction. The total mortality rate in ACS group was 75%. There is significant association between increased Intra-abdominal pressure and mortality.

Introduction

Acute Compartment Syndromes as a result of increased pressure in the myofascial compartment of extremities are well recognised. Once diagnosed, treatment by compartment decompression is necessary to avoid complications. In recent years compartment syndromes associated with raised intraabdominal pressure has been recognised and treated by decompression. Effect of increased IAP in various organ systems has been studied over the past centuries. Historically, some effect of raised IAP were reported as far back as nineteenth century. In 1911, the literature was reviewed by Emersonⁱ. It was noted that if IAP was raised above the range of 19-33 mmHg in small animals (cats & guinea pigs) then death from respiratory failure ensued. He also concluded that

excessive IAP diminishes venous return to the heart, resulting in cardiovascular failureⁱⁱ. In 1948, Grossⁱⁱⁱ noted that closing the abdominal wall in neonates with large omphaloceles was frequently followed by respiratory and cardiovascular failure and subsequently death. It was postulated that this was due to 'abdominal crowding'. Bradley and Bradley^{iv} measured renal plasma flow and glomerular filtration rate and monitored pressures in the inferior vena cava and renal veins while manipulating IAP, and concluded that decreased renal plasma flow and GFR are seen with increased IAP. Baggot^v in 1951 described the clinical effects of abdominal wound closure under tension after dehiscence. He also noted the similarly high mortality was associated with analogous procedures in adults with high tension

repairs of acquired abdominal wall defect. More recently with increasing number of laparoscopic procedures, the adverse effects of raised IAP, particularly on the cardiovascular system have been widely reported^{vi}.

IAH has been identified as a continuum of pathophysiologic changes beginning with regional blood flow disturbances and culminating in frank end-organ failure and the development of ACS. Previously present, but significantly under-appreciated, IAH and ACS are now recognized as common occurrences in the intensive care unit (ICU) setting.

In 2004, a consensus conference was convened by the World Society of the Abdominal Compartment Syndrome^{vii} (WSACS) create evidence-based definitions for IAH and ACS.

Intra-Abdominal Pressure (IAP):

IAP is defined as "*the steady-state pressure concealed within the abdominal cavity*". The normal IAP is 0-5 mmHg in healthy patients. The abdomen can be considered a closed box with walls either rigid (costal arch, spine, and pelvis) or flexible (abdominal wall and diaphragm) behaving in accordance to Pascal's law. The elasticity of the walls and the character of its contents (volume of viscera, ascites, space-occupying lesions) directly determine the IAP. IAP increases with inspiration (diaphragmatic contraction) and decreases with expiration (diaphragmatic relaxation). The mean IAP in critically ill adults is approximately 5-7 mmHg.

Intra-Abdominal Hypertension (IAH) :

IAH is sustained or repeated pathological elevation of IAP of 12 mmHg or greater. A modification of the original Burch et al. grading system is appropriate to stratify patients with elevated IAP and guide clinical treatment^{viii}.

IAH is graded as follows:

- Grade I: IAP 12-15 mmHg
- Grade II: IAP 16-20 mmHg
- Grade III: IAP 21-25 mmHg
- Grade IV: IAP >25 mmHg

Abdominal Compartment Syndrome (ACS)

ACS is the natural progression of pressure-induced end-organ changes. ACS is defined as a sustained IAP >20 mmHg (with or without an APP <60 mmHg) that is associated with new organ dysfunction/failure. The

generally accepted "*triad*" of ACS is: (a) a pathological state caused by an acute increase in IAP above 20 mmHg which (b) adversely affects end-organ function or can cause serious wound complications, and in which (c) abdominal decompression has beneficial effects⁸.

Abdominal Perfusion Pressure (APP): Directly analogous to the concept of cerebral perfusion pressure is abdominal perfusion pressure (APP). Abdominal perfusion pressure (APP), calculated as mean arterial pressure (MAP) minus IAP (APP = MAP - IAP) has been proposed as a more accurate predictor of visceral perfusion and a potential endpoint for resuscitation^{ix}. A target APP of at least 60 mmHg has been demonstrated to correlate with improved survival from IAH and ACS^{9,x}.

Incidence

The incidence of IAH in our study was 57.69% at admission and 4.8% at 6 hours post-op. The incidence of post-op ACS was 3.84% in the general population, 8.8% in trauma patients, and 2.8% in non-trauma patients.

The incidence of IAH and ACS reported by various studies ranges from 2 to 78% and 0.5 to 36%, respectively, and depends on the population and the values used to define these entities^{xi}. The lower incidence observed was because this study includes low risk as well as high-risk patients, whereas most of the previous studies confined data collection to high-risk patients. While the latter approach ensures a good yield of patients with ACS, it may result in a very high incidence compared with that seen clinically in the general population overall. By measuring the IAP prospectively in all patients, this study obtained true overall incidence. Also, an incidence of 3.84% in general population is significant enough to warrant further investigation in this group.

Morbidity and mortality

Cheatham *et al.* had found that elevated IAP alone does not have sufficient sensitivity or specificity to be useful as a predictor of mortality^{xii}. But in our patients, elevated IAP pre-op, post-op at 6 hours and 24 hours was found to independently predict the occurrence of death ($P < 0.001$).

The mortality rate in pre-op IAH group was found to be 5% while that in ACS group was 75%. The mortality associated with ACS as shown in literature is 100%¹¹ compared, supporting the view that ACS, if left

untreated, is having a high mortality rate indicating that a patient of ACS is salvageable only till the organ dysfunction is in a reversible phase.

MATERIALS AND METHODS

Study design

This was a prospective observational study conducted in Department of General Surgery, MGIMS, Sevagram, over a period of 12 months from August 2015 to July 2016

Inclusion Criteria: all the patients above the age of 18 yrs requiring emergency laparotomy.

Exclusion Criteria:

1. Pregnant patients
2. Patients in whom urethral catheterization was not possible and having SPC.
3. Patient not willing for surgical intervention.
4. Patients refusing consent for participation in study

Study Area: Patients reporting to emergency department of MGIMS, Sevagram during the study period.

Method

IAP measurement was done in all patients undergoing emergency laparotomy with manometry technique (U tube technique) using per-urethral foley's catheterisation.

Interpretation

Grading of intra-abdominal hypertension¹¹

1. Grade I: 12–15 mm Hg;
2. Grade II: 16–20 mm Hg;
3. Grade III: 21–25 mm Hg; and
4. Grade IV: >25 mm Hg.

The term “abdominal compartment syndrome” was used when IAH was associated with at least one newly developed organ system dysfunction.

Organ system derangement¹¹

Cardiovascular system

1. Blood pressure <80 mm Hg systolic or
2. heart rate > 100/minute or

Respiratory system

1. Respiratory rate > 24/minute or
2. SpO₂ < 90% or
3. the patient requires ventilatory support

Renal

1. serum creatinine > 1.5 mg% or
2. urine output <500 ml/24 hour

Statistical methods used:

Mann-Whitney U test is used for comparison between IAP and multiple variables.

RESULTS AND DISCUSSION

Our study population was a group of patients who underwent laparotomy for various indications which included traumatic as well as non-traumatic causes. In total, 104 patients, with 30 females and 74 males were included in the study population who fulfilled the study criteria.

The mean ± SD age in our study were 40.2±13 years with 20-30yrs being the most common age group. Most of the studies on IAH and ACS analyse either trauma or ICU patients. Little has been reported on ACS in general surgical population. Our study population was a group of patients who underwent laparotomy for various indications which included traumatic as well as non traumatic causes, hence a predominance of general surgical patients.

Table 1: Comparisons of various variables in different studies are depicted in the following table:

Variables	Meldrum et al ¹⁴	Shehtaj Khan et al ¹¹	Hong et al ¹³	Our study
Mean age (years)	39 ± 9	34.78±14.9	42	40.2±13
Sex				
Male: Female (%)	70: 30	76:24	72:28	71.2:28.8
Incidence of ACS (%)	-	3.05%	11%	3.84%
Mean IAP				
Before laparotomy (mm Hg)	27 ± 2.3	18.0± 4.8	-	13.1±1.04
After laparotomy (mm Hg)			-	
	14 ± 4.6	6.0±1.7		7.1±1.34

Incidence of ACS in our study is comparable to Shehtaj Khan et al¹¹ study(3.84% vs 3.05%) but Hong et al^{xiii} had found increased incidence(11%). This can be explained on the basis of population selected for the study. Their patients were predominantly of trauma patients. Incidence of ACS in trauma patient in our study is 8.82%.

In the trauma group (34 patients, 32.7%), the injury mechanics was blunt in 15 (44.11%) and penetrating in 19 (55.88%) patients. Three (8.8%) patients underwent packing. Meldrum et al.^{xiv} reported 60% blunt injuries and packing in 67% cases. This reflects the demographic variations in the study population. In developed countries, road traffic accidents are the most common cause of trauma, hence higher incidence of blunt injuries in their study.

Table 2: Percentage distribution of the sample according to IAH grade

IAH grade		Count	Percent
Pre OP	No IAH	44	42.3
	Grade I	59	56.7
	Grade II	1	1.0
0 hr	No IAH	104	100.0
6 hr	No IAH	99	95.2
	Grade I	1	1.0
	Grade II	2	1.9
	Grade III	2	1.9
24 hr	No IAH	101	97.1
	Grade II	3	2.9

The mean± SD IAPs before and after laparotomies were 13.1± 1.04 mm Hg and 7.08 ± 1.34 mm Hg, respectively, in the patients who had IAH at

admission. The mean (SD) IAPs in the study group of Sugrueet al.^{xv} before and after decompressions were 16.6 (9.4) mm Hg and 10.3 (3.1) mm Hg, respectively. Meldrum et al.¹⁴ reported higher values of IAP (SD) pre- and post-op: 27 (2.3) and 14 (4.6) mm Hg, respectively. This can be explained by the observation that in our study, 41.3% of the patients had perforation peritonitis and 24 % of patient had intestinal obstruction leading to elevated IAP which, after decompression and removal of liters of fluid and gas, returned to normal level immediately.

At 6 hours post-op, five patients were found to have IAH. Of these four had one or more newly developed organ system failure and hence a diagnosis of ACS was made in them. The IAP at this point was found to have significant detrimental effect on all the organ systems.

Abdominal compartment syndrome remains a major cause of mortality and morbidity despite aggressive management with advanced supportive care, and decompressive laparotomy. Most of the studies on IAH and ACS analyze either trauma or ICU patients. Little has been reported on ACS in general surgical population. Our study population was a group of patients who underwent emergency laparotomy for various indications predominantly non traumatic general surgical patients 70 out of 104 (67.30%) and traumatic 34 out of 104 pts (32.7%). The mean ± SD age in our study was 40.2±13 years.

Table 3: Comparisons of various variables in different studies are depicted in the following table:

Variables	Meldrum et al ¹⁴	Shehtaj Khan et al ¹¹	Hong et al ¹³	Our study
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CONCLUSION:

The study findings are as follows:

1. Incidence of ACS in our study is 3.84 % and found to be more common in trauma patients.
2. There is significant association between increased Intra-abdominal pressure at 6 and 24 hours after laparotomy and organ dysfunction (e.g. cardiopulmonary and renal dysfunction).
3. The total mortality rate in ACS group was 75%.
4. There is significant association between increased Intra-abdominal pressure and mortality.

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