

Role of Intra Vesicle Pressure Monitoring in Patients of Blunt Traumatic Acute Abdomen- A Study of 52 Cases

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Abstract

Intra-abdominal hypertension (IAH) has prevalence of at least 50% in critically ill patients and has been identified as independent risk factor for death¹. Yet, many of members of critical care team and surgical team do not assess for intra-abdominal hypertension and are unaware of the consequences of untreated intra-abdominal hypertension. Because most of the data is obtained from anecdotal reports, animal studies, and retrospective or small prospective human studies from the surgical literature. We conducted a prospective study in tertiary care centre, with 52 patients, who presented in emergency set up with blunt trauma to abdomen. Among all of them, 'Intra Vesicle Pressure' was serially measured which is an indirect measurement of 'Intra-Abdominal Pressure' (IAP). This study emphasizes on importance of clinical monitoring (all vital parameters and IAP) of potential patients and utility of surgical decompression on basis of increased IAP, based on which adverse effects of IAH and rather its occurrence can be prevented.

Keywords: Intra-Abdominal Pressure (IAP); Intra Vesicle Pressure; Intra-Abdominal Hypertension (IAH); Abdominal Compartment Syndrome (ACS); Blunt trauma abdomen

Introduction

The concept of IAH (Intra-Abdominal Hypertension) was proposed in late 1800s, forgotten after World War I, and rediscovered near end of 20th century [1]. In 2004, a group of international physicians and surgeons formed the World Society of Abdominal Compartment Syndrome (WSACS) [2]. It has presented evidence based guidelines, definitions and recommendations² for IAP, IAH

and Abdominal Compartment Syndrome (ACS). IAP is steady-state pressure within abdominal cavity [2].

IAH is sustained or repeated pathological elevation of IAP of 12 mm of Hg or more [2].

ACS is sustained IAP greater than 20 mm of Hg (with or without Abdominal Perfusion Pressure < than 60 mm of Hg), associated with new organ dysfunction or failure [2-4]. WSACS categorizes conditions that cause ACS as primary (surgical), secondary (medical) and recurrent [4].

Even slight increase and sustained increase in intra-abdominal pressure above baseline, as low as 10 mm Hg, has deleterious effects on end-organ function, impairing neurologic, cardiac, respiratory, gastrointestinal, hepatic, and renal homeostasis. Measuring intra-vesicle pressure (i.e. indirect, non-invasive, near accurate method of measurement of IAP) and monitoring other vital parameters periodically in surgical cases with traumatic acute abdomen helps in early decision of surgical intervention and subsequently decreases mortality and morbidity. We conducted a clinical study of 52 patients and emphasize that measurement of intra vesicle pressure is near accurate, non-invasive method of measurement of IAP.

Aims and Objectives:

1. To know utility of meticulous clinical assessment along with measurement of IAP in cases of traumatic acute abdomen in decision making to proceed with either operative or conservative management to salvage patients.
2. To emphasize that measurement of intra vesicle pressure is near accurate, non-invasive method of measurement of IAP.
3. To understand the various treatment modalities for prevention of Intra-Abdominal Hypertension and Abdominal Compartment Syndrome.

Materials and Methods

Institutional Ethics Committee approval was obtained before starting the study. A prospective cohort study was carried out within the given period and following procedures were followed. As per institutional protocols, complete physical examination was carried out in cases of traumatic acute abdomen. Parameters like 1.Body temperature, 2.Heart rate, 3.Blood pressure, 4.Respiratory rate, 5.Abdominal girth, 6.Urine output, 7.Intravesiclepressures (indirect measurement of intra-abdominal pressure) were noted. Relevant traumatic history was taken. FAST (Focused Assessment by Sonology in Trauma) was carried out in all the patients. Patients having exclusively abdominal trauma and having raised intra-abdominal pressure, were registered in the study, with well informed consent taken in his or her local language or from first degree relatives in case of unconscious patients.

At the time of hospital admission, all the above mentioned 7 clinical parameters were noted and monitored at 0th, 1st, 2nd, 3rd, 4th, 6th, 8th, 10th, 12th, 24th and 48th hour of admission. Patients, who were in need of surgical

decompression (on basis of 2 consecutive findings of raised IAP in case of solid organ injury and all cases with hollow organ perforation), underwent emergency exploratory laparotomy, majority within 2-4 hours from hospital admission. In all operated patients, IAP was measured intra-operatively by indirect method of intra vesicle pressure measurement, after approximating the fascio-aponeuroticocutaneous structures temporarily (just with help of towel clips) just before closing abdomen actually and then decision was taken whether to close abdomen or proceed with laparostomy. Patients, who were in need of assisted ventilation, were managed with mechanical ventilator. Post-operative clinical outcome was measured in terms of recovery and mortality.

Measurement of Intra Vesicle Pressure: The whole procedure was carried out under aseptic precautions (as shown in image 1 and with use of material as shown in Image 2). In already inserted per-urethral Foleys catheter (assuming and assuring empty urinary bladder, 50 ml of Normal Saline (NS) was instilled into bladder, sterile transparent tubing was attached to it &, held vertically at 90° at pubic symphysis. The length of vertical normal saline column was measured when steady. It is calculated as Intra vesicle pressure in terms of 'cm of water' and was calculated in terms of 'mm of Hg' with help of following formula-
1 cm of water = 0.736 mm of Hg

After completion of this procedure, Foleys catheter was reconnected to urosac.

Inclusion Criteria

All surgical patients, during August 2013 to September 2015, with age above 12 years, having acute blunt trauma to abdomen, with intra-abdominal pressure raised above 10 mm of Hg in 2 consecutive readings.

Exclusion Criteria

- patients with age less than 12 years
- patients with traumatic acute abdomen due to penetrating injury
- patients with urinary bladder injury
- cases with poly trauma
- patients in whom ACS is secondary (like already operated cases).

Sample Size

52 patients

Image 1:

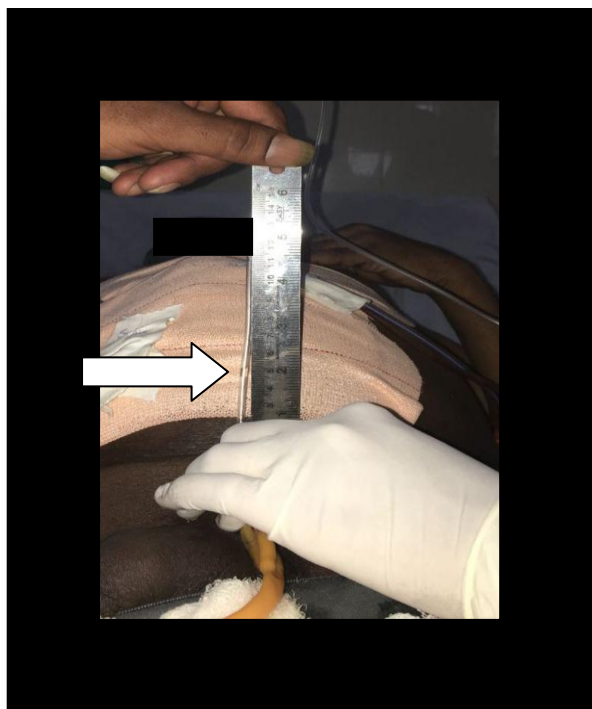


Image 2:



Material needed to measure intra vesicle pressure

Observations and Results

In our study, we observed that out of 52 patients, 35 had solid organ injury while 17 had hollow organ perforation. There was no co-relation between sex and occurrence of IAH and ACS. 40 patients had etiology of road traffic accident, 8 had indoor accidents and 4 had work place (e.g. in factories) accidents. The most populous age group was 21-40 yrs, followed by 41-60 yrs. The least populous age group was above 61 yrs. It proves that most of the traumatic abdomen cases occur in 21-40 yrs age group as road traffic accidents are more common in young age group.

Analysis was carried out using appropriate statistical tools- paired t-test, ANOVA test, Fischer's exact test.

We observed direct proportion between heart rate and IAP. All patients with increased IAP (more than 10 mm of Hg) showed increase in heart rate proportionately. All solid organ injury patients which were managed conservatively (19 patients of total 35) showed proportionate decrease in heart rate with IAP which was found statistically significant. Also inverse relation between IAP and blood pressure was observed. A direct proportion

between respiratory rate and IAP was observed. 3 patients with increased IAP needed assisted ventilation due to respiratory distress. We observed inverse proportion between urine output and IAP. In all 47 recovered patients (18 conserved and 29 operated), when abdominal girth decreased below the value at admission, IAP also decreased proportionately. Surgical abdominal decompression had helped in all operated patients to get statistically significant decrement of IAP during initial post-operative hours. As the clinical conditions improved, IAP also decreased subsequently (measured by indirect method of intra vesicle pressure).

Considering deaths among 52 patients, 3.84 % were with 'solid organ injury' and 9.61% were with 'hollow organ perforation'. Among all cases with 'Solid organ injury': 94.3 % recovered while 5.7% died i.e.; 35 patients who had solid organ injury: 2 patients died (1 was conserved while 1 underwent surgery). Out of all 17 cases with 'hollow organ perforation': 14 recovered while 3 patients died as all of them had gross peritoneal faecal contamination. In total 19 cases with acute abdomen which were managed conservatively, death was seen in only 1 patient while 33 cases that underwent surgery, 4 patients died and the rest 29 recovered uneventfully.

Discussion

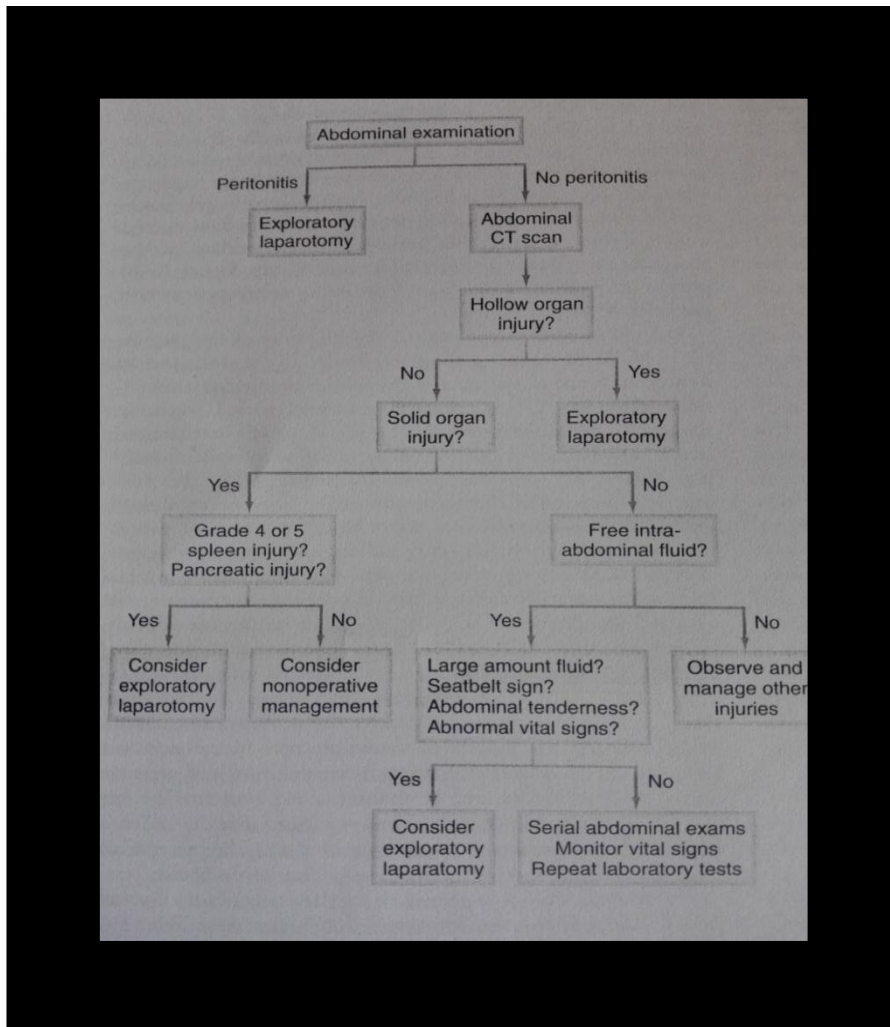
Advanced Trauma Life Support (ATLS) has presented safe approach to initial assessment and management of traumatic patients. ATLS gives three important concepts-

- a. Treat the greatest threat to life first
- b. Lack of definitive diagnosis should not delay the application of an indicated urgent management

c. An initial, detailed history is not essential to begin the evaluation of patient with acute injuries

In detailed systemic examination of abdomen, ATLS proposed evaluation with help of FAST and Computed Tomography scan with intravenous contrast. It has provided an algorithm for evaluation and management of blunt abdominal trauma as shown in Figure 1.

Figure 1:



DCS (Damage Control Surgery) consists of stoppage of bleeding and peritoneal contamination by catching the bleeders, packing the abdomen, confirming hemostasis, closure of perforations, resection of non-viable bowel segment and primary anastomosis or stomies as per patient's intra-abdominal and systemic condition.

In our study, we found that there was no age or sex co-relation with occurrence of IAH and ACS in acute traumatic abdomen cases.

Monitoring of routine vital parameters like heart rate, blood pressure, respiratory rate, abdominal girth, and urine output held great value in management of conserved or operated patients with acute traumatic abdomen. The cases which underwent surgery were operated within a mean of 3.6 hours of admission.

All liver and spleen injury cases up to grade 3 on AAST (American Association for the Surgery of Trauma) injury scale were managed successfully with non-operative management.

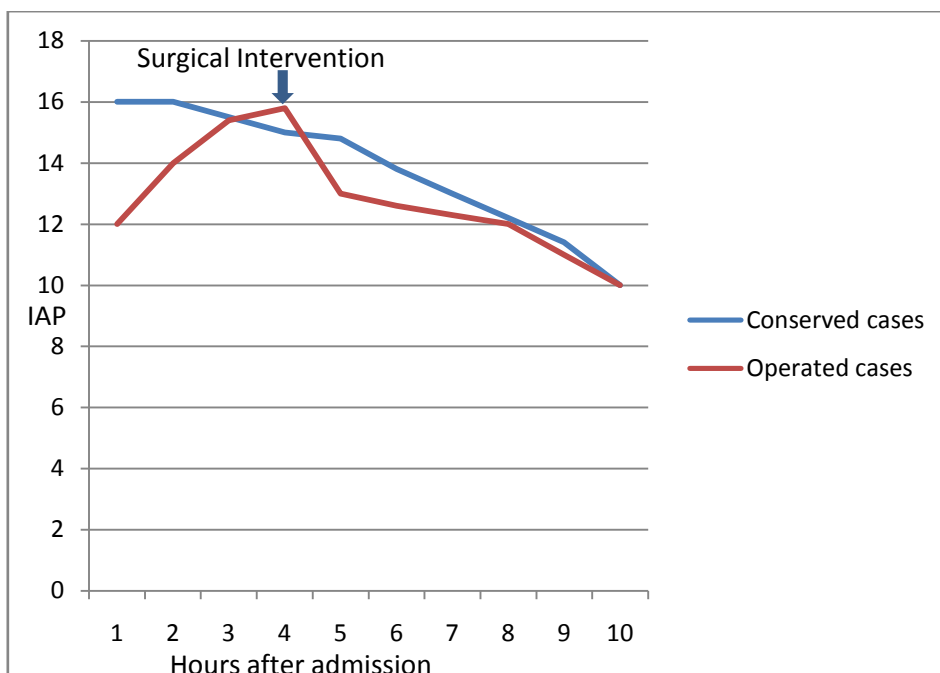
In scenario of solid organs injury, patients which showed impending signs and sequels of raised IAP, early surgical decompression of abdomen was performed in the form of DCS. Any of the clinical signs like tachycardia, drop in blood pressure or urine output, tachypnoea, distention of abdomen and increase in IAP were considered as signs of impending IAH. Indirect measurement of IAP by 'intra vesicle' method proved near accurate assessment of IAP because all these patients showed clinical improvement after surgery.

All hollow organ perforation cases were operated after initial stabilization and tackled with primary closure of

perforation, resection and anastomosis and stoma construction accordingly. In our study, in none of the cases abdomen was getting closed under tension and mean of that measured pressure was 13.3 mm of Hg with average 2.8 mm of Hg drop in IAP at admission and hence none of the case was laparostomised.

Surgical abdominal decompression had helped in all operated patients to get statistically significant decrement of IAP during initial post-operative hours (as shown in Graph 1).

Graph 1:



In mortality data of our study, solid organ injuries group was found to have lesser mortality as compared to hollow organ injury group. It was probably due to added

secondary peritonitis and its systemic effects in those cases. In group of solid organ injury, patients which were managed conservatively were found to have equal mortality than those managed with operative management.

Outcomes of our study in brief:

Blunt trauma to abdomen (52 patients)					
Trauma to solid organ (35 patients)				Trauma to hollow organ with perforation (17 patients)	
Conservatively managed (19 patients)		Surgically intervened (16 patients)		Surgically intervened (all 17 patients)	
Recovered	Death	Recovered	Death	Recovered	Death
18	1	15	1	14	3

Our study emphasizes on importance of clinical monitoring of all vital parameters and IAP (by measuring Intra Vesicle Pressure) in all traumatic abdomen cases, utility of early surgical decompression in cases showing rise in IAP within 4 hours of admission which were managed non-operatively to start with.

Ivatury et al. [24] conducted a retrospective study of 70 patients admitted to a level I trauma centre with life-threatening abdominal trauma; all had IAP measurements. In this study, he could prove that when IAP rises above 10 mm Hg, cardiovascular changes occurs leading to decrease in cardiac output due to an increase in after load and a reduction in preload and proportionately heart rate rises. Our study also showed similar results, statistically comparable with study by Ivatury et al. [24]. He demonstrated that increase in IAP may affect chest wall and lung mechanics, increasing the possibility of reduction in FRC and hence requiring mechanical ventilation in many cases. He demonstrated that abdominal perimeter is an inaccurate way for assessing increasing IAP with sensitivity of only 50% to 60%.

Comparing our study with this study, this study had included all trauma centre patients but our study included blunt traumatic abdomen patients selectively. In our study, we were able to prove subsequent and proportionate decrease in IAP with decrease in abdominal girth of patients though we do not recommend abdominal girth monitoring as the sole parameter for diagnosing increase in IAP. Urine output monitoring should be done carefully to recognize impending IAH along with intra vesicle pressure monitoring. We strongly recommend measurement of '*intra vesicle pressure*' as the near accurate, non-invasive method of measurement of IAP for diagnosing impending IAH. This

will help in early surgical intervention (laparotomy / laparostomy) and prevent further complications of ACS.

To summarize, surgeons and other health care workers should meticulously monitor vital parameters and IAP, because IAH and ACS is likely to develop in acute traumatic abdomen. Early surgical intervention in form of laparotomy or laparostomy prevents development of IAH and ACS. Though prevention of trauma offers the best measure to avoid them.

Conclusion

IAP should be measured and monitored by any standard available method, with all aseptic precautions, in all cases with traumatic acute abdomen. Intra Vesicle Pressure measurement method provides indirect, non-invasive, simple and near accurate method of IAP measurement. Along with IAP, patients should be monitored meticulously for simple parameters like heart rate, blood pressure, respiratory rate, abdominal girth, urine output because variations in these parameters can predict the impending IAH and ACS before actual rise in IAP. Hence by this study we have proposed that monitoring of IAP and other vital parameters holds a great value in management of acute traumatic abdomen with good clinical outcome.

Before development of IAH and ACS, the potential candidates should be offered surgical decompression at proper time. Also, measurement of Intra Vesicle Pressure just before closing abdomen holds great value to prevent IAH and ACS and their systemic adverse effects due to closure of abdomen under tension and also will minimize incidence of laparostomies and its' complications.

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