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ASSESSMENT OF INTRA-ABDOMINAL PRESSURE AS AN INDEPENDENT PREDICTOR OF MORBIDITY AND MORTALITY IN ABDOMINAL TRAUMA PATIENTS

General Surgery

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ABSTRACT

Recognition of the widespread prevalence of elevated IAP and advances in the diagnosis of the IAH and ACS have led to significant improvement in the management and survival of the patients (1-3).

Patients and methods: The present prospective case control study, having 30 patients, was aimed at characterization of this entity in the commonly encountered acute surgical abdomen due to blunt abdominal trauma. The stress was laid upon the detection of the intra abdominal pressure in the patients and the effect of this entity upon the routinely available clinical and laboratory parameter of organ functions. Regarding the estimation of the intra abdominal pressure, we used only the intravesicular pressure as it is well accepted that the intravesicular pressure has got good correlation with the true intra abdominal pressure.

Results: The serial IAP estimation showed a significant decreasing trend on subsequent days in all groups, when the operated and the conservatively managed patients were combinedly studied. In this study, significant mortality was associated with IAP>15 cm of saline, APACHE II >8, blood urea >40 mg % and serum creatinine >1.4 mg%.

Conclusion : When the IAP and APACHE II scores were examined together, there was significant correlation demonstrated between the intra abdominal pressure and the APACHE II score at presentation (p=0.0022).

KEYWORDS

IAP, ACS, intravesicular, trauma

Introduction:

In the clinical management of injured or critically ill patients, now a days intra-abdominal pressure management is gaining increased attention which has led to exponential growth in research about intra-abdominal hypertension and abdominal compartment syndrome(1,2). It was realized that diagnosis of IAH or ACS is dependent upon the accurate and frequent measurement of IAP (3,4). Intra-abdominal pressure is the steady state pressure concealed within the abdominal cavity which is affected by body weight, posture, tension of abdominal muscles and movement of the diaphragm (5).

Compartment syndrome occurs when pressures increase within a fixed cavity of the body, leading to ischemia, muscle damage, and organ dysfunction. These "fixed" spaces are constrained by muscular and facial boundaries which may have limited compliance when they become swollen. (6) Abdominal compartment syndrome (ACS) is a very serious illness seen in critically ill patients. ACS results from the progression of steady state pressure within the abdominal cavity to a repeated pathological elevation of pressure above (> 20mmHg) with associated organ dysfunction. (7) The diaphragm is not a rigid barrier as a consequence of which pressure changes inside abdominal compartment invariably affects intra-thoracic pressures also. (8) The abdominal contents and abdomen itself behave as relatively non-compressive and primarily fluid in character, behaving in accordance to Pascal's law so the IAP measured at one point may be assumed to represent the IAP throughout the abdominal cavity (9,10,11).

Major adverse effects can be seen in renal, pulmonary, cardio-vascular, CNS and gastrointestinal systems (12). Commonly encountered acute surgical abdominal conditions are perforation peritonitis, acute intestinal obstruction and blunt abdominal trauma. Timely decompression has been shown to reverse all the adverse effects of increased intra-abdominal pressure.

Materials and methods

Methods

This is a prospective observational study, conducted at Rajendra Institute of Medical Sciences, Ranchi, Jharkhand over a period of about 2years, (November 2016 to October 2018).

Patients of acute surgical abdomen due to blunt trauma abdomen (30 patients) who underwent emergency laparotomy were included in the study.

Exclusion criteria

Patients with concurrent thoracic or lower urinary tract injuries, those with bladder dysfunctions, patients with preexisting cardiac failure ,patients with concurrent head injury and spinal injury

Evaluation

All the patients were evaluated by complete physical examination and resuscitated as per the need. Management was carried on, in the accepted standard way and relevant investigations were performed as and when required. Severity of the illness was assessed in each patient by the APACHE II severity of disease of disease classification system at presentation and subsequently.

The intra-vesicular pressure was measured in all the subjects by way of an indwelling Foley's catheter, attached to a hand held Saline manometer. The patient was put in a supine position for the measurement as intra abdominal pressure would increase by 2mm hg for every 20 degree of head tilt up.A pressure transducer was connected to the catheter and zeroed at the iliac crest in the mid axillary line. 50 ml of saline was then instilled into the bladder (1ml/kg) and 30-60 seconds allowed to escape (to permit detrusor relaxation before the measurement was taken). The measurement was made at the end of expiration and in the absence of active abdominal muscle contraction. After making sure that the bladder is empty, urinary drainage tube connected to the Foleys catheter was clamped. The needle was then connected to the manometer. The vertical height of the saline column in the manometer was recorded in centimeters.

All such measurements were recorded on three consecutive days as detailed below:

Day 1: the day of presentation or the immediate pre-operative day

Day 2: first post operative day or the subsequent day of the conservative management as applicable

Day 3: second postoperative day or the subsequent second day of the conservative management .

The intra abdominal pressure was correlated to the organ dysfunction, as below:

Renal system: urine output, blood loss, serum creatinine

Cardiovascular system: heart rate, blood pressure

Pulmonary system: respiratory rate,pH and SPO2

Statistical analysis: The observation was then statistically analysed

using the paired and unpaired 't' test. Chi-square test(with Yate's correction), Pearson's coefficient and the simple linear aggression analysis. For statistical analysis SPSS 16.0 was also used.

Results:
Age distribution of the study population**:** Overall, patients of age group 30-39 yrs were highest in number, followed by 20-29years. None of these patients are in the extremes, i.e. below 10 years and above 60 years. **Fig. 1**Sex distribution: Of the studied patients, 24 were males while 6 were females.Clinical outcome in various cases and the causes are summarized in **fig.2**.

Intra abdominal pressure: Initial intra-abdominal pressure ranged from 8 to 31 cm of saline with the mean of 14±4.44cm of saline.

The serial intra abdominal pressure estimation showed a significantly decreasing trend on three successive days of measurements. Paired't' test was used to study the difference (table 7).

The trend of intra-abdominal pressure can be represented as below
Day 1: 14.00±4.44 cm of saline
Day 2: 10.17±2.28 cm of saline
Day 3: 8.55±2.21 cm of saline

APACHE II score was calculated and categorized as shown in **Fig. 3**

On comparing mean APACHE II scores on the three consecutive days, it was seen on a decreasing trend as stated below:
Day 1 : 4.20±3.68
Day 2: 2.53±2.78
Day 3: 1.64±1.91

Outcome: Out of the 30 patients studied, 24 survived and 6 died.Comparison between the APACHE II score and the outcome is shown in **fig.4**.The maximum mortality was observed in patients with APACHE II score more than 12(100%, 1 out of 1), followed by the score group 8-12. The best outcome was from APACHE II group 0-4(94.1% survival, 16 out of 17)

Correlation of the intra-abdominal pressure:
The relationship between the presentation, intra-abdominal pressure and the abdominal girth, APACHE II score and the different organs functions were studied by way of the simple linear regression using the Pearson's correlation coefficient.

Discussion : Since the mid 1990s, it was known that IAH could develop without abdominal trauma (13) and numerous studies have measured IAP, examined its clinical outcomes and classifications. The present prospective case control study was aimed at characterization of this entity in the commonly encountered acute surgical abdomen due to blunt abdominal trauma. The stress was laid upon the detection of the intra abdominal pressure in the patients and the effect of this entity upon the routinely available clinical and laboratory parameter of organ functions. The organ systems studied were the renal, cardiovascular and the pulmonary systems. The clinical outcome was also analyzed. Now it is well accepted that the intravesicular pressure has got good correlation with the true intra abdominal pressure (14,15,16).

We analyzed the outcome with respect to the intra abdominal pressure. It was found that there was higher mortality in those patients, who had IAP >12 cm of saline.

The limitation of the above statement is that the intra abdominal pressure alone need not be the deciding factor. But patients' other clinical and laboratory parameters should also be taken into consideration and proceed accordingly. In patients of blunt abdominal trauma with intraperitoneal hemorrhage who have altered physiological status should be operated even if the intra abdominal pressure is not significantly raised. Decompression could be a laparotomy or even the insertion of a flank drain which could result in the dramatic relief from the raised intra abdominal pressure and the consequences there with .The latter could only be useful when the pneumoperitoneum or free fluid is the cause of raised intra abdominal pressure. When the trend of APACHE II score on successive days was studied it was observed that as the APACHE II score is higher than 8, the mortality also increased significantly .

When the IAP and APACHE II scores were examined together, there was significant correlation demonstrated between the intra abdominal pressure and the APACHE II score at presentation (p=0.0022).

Fig.1 table showing age distribution of study group

Age group(years)	No. of patients (%)
0-9	0
10-19	4(13.33)
20-29	7(23.33)
30-39	9(30)
40-49	6(20)
50-59	4(13.33)
60 and onwards	0

Fig 2. Table showing clinical findings on exploration:

Groups	Diagnosis	No. of patients	%
hollow viscus injury	ileal perforation only	1	33.33
	ileal and jejunal perforation	1	
	jejunal perforation only	7	
	jejunal transection	1	
solid organ injury	liver contusion	7	56.66
	liver laceration	5	
	splenic tear	4	
	splenic transection	1	
others	mesenteric tear	1	3.33
pelvic hematoma	retrocaecal laceration	2	6.66
	Total	30	100

Fig 3 . table showing APACHE II scores in patients

Score	No. of patients
0-4	17
4-8	7
8-12	5
>12	1
Total	30

Fig. 4 table showing APACHE II scores and their eventual outcome:

Score	Survived	Expired	Total
0-4	16	1	17
4-8	6	1	7
8-12	2	3	5
>12	0	1	1
Total	24	6	30

Fig 5: correlation table between IAP and various variables

Variables	Correlation coefficients
IAP-SBP	0.335#
IAP-DBP	0.134#
IAP-MBP	0.367*
IAP-RR	0.377*
IAP-pH	0.279#
IAP-PaO2	-0.436
IAP-SpO2	-0.262
IAP-BU	0.414*
IAP-S.Cr	0.314#

'-'negative correlation present
*positive correlation with 'p' value <0.05
#positive correlation with 'p' value >0.05

Abbreviations:
IAP: intra abdominal pressure
IAH: inra abdominal hypertension
ACS: abdominal compartment syndrome
RFT: renal function test
PCWP: pulmonary capillary wedge pressure
IVP: intra vesicular pressure
SBP: systolic blood pressure
DBP: diastolic blood pressure

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