

A prospective study of abdominal pressure in cases of acute abdomen

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Abstract

Aim and objectives: Intraabdominal hypertension is a graded phenomenon and can evolve to the end stage abdominal compartment syndrome. The aim of this study was to know incidence of raised IAP in patient with acute abdomen admitted in ICU. To study if there is any difference in the prognostic ability of IAP max and IAP mean. To study the feasibility of an inexpensive indigenous method to commercially available device for IAP measurement. **Methodology:** This was a prospective study of 50 patients of either sex and any age of acute abdomen admitted in surgical ICU and who needed indwelling bladder catheterization. And every 6hrly intra abdominal pressure measurement done. **Results and Observations:** In this prospective study, we studied 50 patients of acute abdomen admitted in the Surgical ICU. IAH Maximum IAP measurements showed an incidence of IAH of 60% with ACS in 12%, while mean IAP values resulted in a lower incidence of 48% with ACS in 8%. This reflects that mean IAP values seem to down grade intra-abdominal pressure measurements and may result in some cases of IAH or ACS being missed. Therefore IAP max was better than IAP mean for predicting outcome. We used two sets of equipments to measure the IAP by the intra-vesical route. Both the equipments used have been approved as well validated methods for IAP measurement with none being better than the other. **Conclusion:** The incidence of IAH differed in relation to whether mean or maximal IAP values were used to define. Amongst IAP max and IAP mean, IAP max should be considered because IAP mean with reading taken 6 hourly can underestimate the incidence of IAH and ACS. The indigenous method of measurement of intra-abdominal pressure was effective and quiet inexpensive as well.

Key Words: IAP- intra-abdominal pressure, IAH- intra-abdominal hypertension, ACS-abdominal compartment syndrome.

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INTRODUCTION

Intra-abdominal hypertension (IAH) is a graded phenomenon and can evolve to the end-stage abdominal compartment syndrome (ACS), which is an all or none phenomenon.¹ IAH² is a clearly defined cause of organ dysfunction in patients after emergency abdominal surgery, a disease process like intestinal obstruction, pancreatitis, peritonitis or blunt abdominal trauma. It is also recognized in patients in intensive care units after elective surgical procedures, liver transplantation,

massive fluid resuscitation for extra abdominal trauma and severe burns. ACS is defined as an “Acute increase in the intra-abdominal pressure (IAP) resulting in alteration in respiratory mechanism, hemodynamic parameters and renal and cerebral perfusions.”² ACS occurs when IAP is abnormally raised in association with increasing organ dysfunction.³ The ACS is not a disease and as such it can have many causes and it can develop within many disease processes. Manifestation of ACS includes progressively marching events in the form of abdominal distension, followed by an increase in the peak airway pressure leading to dyspnoea, oliguria followed by anuria and development of intracranial hypertension which turns fatal. The development of IAH and ACS is of extreme importance in surgical practice and care of critically ill patients, because of the impact of increased IAP on end-organ function. This study endeavors this often-neglected phenomenon. The aim of this study was to prospectively study the incidence of raised IAP in patients with acute abdomen admitted in the intensive care unit (ICU). To study if there is any difference in the prognostic ability of IAP max and IAP mean. To study the feasibility of an

inexpensive indigenous method to commercially available device for IAP measurement. The permission and approval to perform this study was obtained from the Ethical and scientific Committee of hospital.

MATERIALS AND METHOD

This was a prospective study of 50 consecutive cases of acute abdomen admitted in a Surgical ICU and who needed indwelling bladder catheterisation over an eighteen month period.

Sample Size:

P= 38 %. (4). Confidence level =95%. Absolute precision=E=15% Point.

$$n = Z^2 * P * (1-p) / E^2 = 40.23 = 41$$

The minimum sample size determined from the above given formula⁵ is 41. We have taken a number of 50 patients for our study. The detailed clinical history was recorded as per the proforma followed by clinical examination n IAP was measured every 6 hourly. All the patient of Acute abdomen with perforation, peritonitis, bowel gangrene, or acute pancreatitis, Patients with blunt abdominal trauma, Patients with a distended abdomen and signs and symptoms consistent with Abdominal Compartment Syndrome(ACS) example: a. Oliguria b. Hypoxia c. Hypotension d. Unexplained acidosis were included in study. Patient with Bladder dysfunction in old age patients, Bladder surgery, Pregnancy, Neurogenic bladder were excluded from study.

Data Acquisition

Intra-abdominal pressure (IAP) measurement was obtained in all patients of acute abdomen admitted in Surgical ICU. The readings were being taken at 6 hourly intervals. IAP max (the highest daily value) was considered for main analysis. IAP mean (mean of the four daily values) was also calculated and employed in analysis. The IAP measurements were discontinued when patient had recovered or expired. The observations were tabulated and results studied

RESULTS AND OBSERVATIONS

Table 1: Age and sex wise distribution of cases in study group

Age (yrs)	Male	Female	Total
≤ 20	7	2	9
21 – 40	22	4	26
41 – 60	4	1	5
>60	5	5	10
Total	38	12	50

Chi-square = 4.82, P>0.05

This table shows demographic data of age and sex distribution in study subjects. Study group consisted of 38 male i.e. 76% and 12 female i.e.24%. Age wise distribution showed maximum number of subjects of the age group between 21 to 40 years. i.e. 26 subjects,

followed by 10 subjects in age group > 60 years then 9 age group <20 and 5 in age group 41 to 60 years, with males more than or equal to females in each group. There was no statistically significant difference in the age and sex distribution.

Table 2: Diagnosis wise distribution of cases in study group

Diagnosis	No of cases	Percentage
Abdominal trauma	18	36
Perforative peritonitis	13	26
Intestinal obstruction	6	12
Pancreatitis	6	12
Bowel ischemia	4	8
Other *	3	6
Total	50	100

*Peritoneal carcinomatosis in 2 patients and pseudo-obstruction in 1 patient

Table 3: IAP Max and IAP Mean wise distribution of cases in study group

Grade	Pressure in mmHg	IAP Max (%)	IAP Mean (%)
0	<12	20 (40)	26 (52)
I	12-15	16 (32)	13 (26)
II	16-20	8 (16)	7 (14)
III	21-25	4 (8)	3 (6)
IV	>25	2 (4)	1 (2)
Total		50 (100)	50 (100)

This table shows that when intra-abdominal pressure IAP max was considered, 30 patient had IAH out of which 16 patient had IAP of grade I, 8 patient of grade II, 4 of grade III, and 2 of grade IV. When IAP mean considered, then result showed that 24 patient had IAH out of which 13 patient had IAP of grade I, 7 patients of grade II, 3 patient of grade III and 1 patient of grade IV. The incidence of IAH (defined as IAP > 12mmHg) was 48 % (24 patients) with 4 patient having IAP > 20 when IAP mean was used. However when IAP max was used, the incidence of IAH was 60 % (30 patients) with 2 patients showed IAP > 20. The incidence of IAH differed with respect to whether mean or maximal IAP values were used. With the use of IAP max incidence of IAH was greater as compared to IAP mean.

Table 4: Method used and distribution of cases in study group

Method use	No of cases	Percentage
I	27	54
II	18	36
Both	5	10
Total	50	100

We have used method I that was measurement of IAP by using transducer setup with a specimen port of urine drainage bag in 60% of cases and method II that is measurement of IAP by using Abviser Autovalve intra-abdominal pressure monitoring device in 40% of cases. Initially in 5 cases both methods were used to compare and no significant difference was found in the reading. The reading with assembled device were equally accurate

as Adviser. So further use of method 1 was continued without any hesitation in non-affording patients.

DISCUSSION

Intra-abdominal pressure (IAP) is the steady-state pressure within the abdominal cavity. So sustained increase in intra-abdominal pressure lead to intra-abdominal hypertension. Intra-abdominal hypertension (IAH) can affect all body systems and IAH has been proposed as the initial fall of the dominoes on the pathway of multisystem organ failure. Intra-abdominal hypertension (IAH) is a graded phenomenon and can evolve to the end-stage Abdominal compartment syndrome (ACS), which is an all or none phenomenon.¹ Abdominal compartment syndrome occurs when intra-abdominal pressure is abnormally raised in association with increasing organ dysfunction.³ The development of intra-abdominal hypertension and abdominal compartment syndrome is of extreme importance in surgical practice and care of critically ill patients, because of the impact of increased IAP on end-organ function. In this prospective study, we studied 50 patients of acute abdomen admitted in the Surgical ICU.

Age and Sex Incidence

Our study group consisted of 38 (76%) male patients and 12(24%) female patients. Age wise distribution showed maximum number of subjects in the age group between 21-40 years. Details of age and sex-wise distribution are shown in Table No.1

Diagnosis-wise distribution of cases

The clinical profile in this study included abdominal trauma (n=18/50, 36%), perforative peritonitis (n= 13/50, 26%), intestinal obstruction (n= 6/50, 12%), acute pancreatitis (n= 6/50, 12%), bowel ischemia (n= 4/50, 8%), and other causes (n=3/50, 6%) like ascites due to peritoneal carcinomatosis, and pseudo-obstruction as shown in Table No.2 Intra-abdominal pressure (IAP) measurement was done in all these patients. The readings were taken at 6 hourly intervals. IAP max (the highest daily value) was considered for analysis. IAP mean (mean of the four daily values) was also calculated and analysed.

Incidence of Intra-abdominal hypertension (IAH)

As shown in Table No.3, out of the 50 patients who were recruited in the study, 30 developed Intra-abdominal hypertension (i.e. an incidence of 60%) when IAP max was the parameter considered. Out of these 30 patients, 6 developed abdominal compartment syndrome. Considering the total no. of cases 12% (n=6/50) developed abdominal compartment syndrome (ACS). If IAP mean is considered the incidence of IAH was 48% i.e. 24 patients developed intra-abdominal hypertension out of 50. And out of these 24 cases 4 developed abdominal compartment syndrome. When extrapolated to

the total no. of cases 8% (n=4/50) developed abdominal compartment syndrome. The incidence of IAH in our study was similar to that observed by Vidal *et al*⁹ where the incidence of IAH, according to IAP max and IAP mean was 64% and 54% respectively. Various other studies have reported an incidence of IAH between 31 and 59%.^{9,10, 11, 12, 13-17} The incidence of ACS was 12% according to IAP max and 8 % according to IAP mean in our study and was similar to that reported by Vidal MG *et al* 12%⁽⁹⁾, Malbrain ML *et al* 8.2%¹¹, and Balogh Z *et al* 12%¹⁴.

IAP max and IAP mean – What is better

In our study, as seen in Table No.3, and also evidenced from literature, the incidence of IAH differed in relation to whether mean or maximal IAP values were used to define IAH. Maximal IAP measurements showed an incidence of IAH of 60% with ACS in 12%, while mean IAP values resulted in a lower incidence of 48% with ACS in 8%. This reflects very well in the fact noted by Malbrain *et al* ⁽¹¹⁾ that mean IAP values seem to down grade intra-abdominal pressure measurements and may result in some cases of IAH or ACS being missed. The accuracy of mean IAP values could be improved by increasing the frequency of IAP measurement per day, which approximates to continuous monitoring. So we feel that ideally a continuous monitoring of IAP is better and the IAP max value during this monitoring is a much better predictor of ACS. However, this may not be practically possible with the current bladder pressure monitoring techniques.

Equipments for measurement of IAP

Many authors in the management of IAH/ACS have strongly recommended that all critically ill patients should have IAP closely monitored as clinical examination of abdomen has been shown to be grossly inaccurate in assessment of IAH/ACS.^{18,19} The use of bladder pressure measurement as a proxy for early detection of IAH has been widely demonstrated to be effective. The gold standard method of convenience and accuracy is measurement via a urinary bladder catheter. In our study we used two sets of equipments to measure the IAP by the intra-vesical route as shown in Table No.4. The first equipment which we used was by using a transducer setup attached to the specimen port of the special urine drainage bag. The greatest advantages of the transducer technique include the lack of necessity of any specialised equipment, easy availability, cost-effectiveness, and equal effectivity. Once the initial setup is completed, the system remains closed, with a minimal risk for urinary tract infection. The only drawback is that if the urine drainage bag remains accidentally clamped after a measurement has been obtained, urinary drainage will get obstructed with the danger of recording it as 'zero'

urine output in the hands of an untrained nurse. The second equipment used was the Abviser Autovalve IAP monitoring device. It is a sterile, non-invasive disposable monitoring device that creates a safe, efficient, standardized monitoring system with proven clinical reproducibility and accuracy. In this device the autovalve automatically deflates after a short time so accidental obstruction of urinary drainage is prevented. This eliminates clamping and turning of stopcocks making it easy to use. As it is a closed system with a syringe sleeve it helps to reduce the risk of catheter associated urinary tract infections.¹ The only drawback of this device is that it is quiet expensive. While there are various techniques to measure IAP, the intra-vesical measurement of IAP has evolved as the standard. Both the equipments described above have been approved as well validated methods for IAP measurement with none being better than the other.¹⁰³

CONCLUSION

This study has shown that the incidence of Intra-abdominal hypertension in acute abdomen patients admitted in surgical ICU was 60% with 12% developing ACS when IAP max was considered. Amongst IAP max and IAP mean, IAP max should be considered because IAP mean with reading taken 6 hourly can underestimate the incidence of IAH and ACS. The measurement of intra-abdominal pressure by using urine drainage bag with specimen port was effective and quiet inexpensive as well. With these findings, it would be advisable to adopt IAP measurement as a routine measure for all critically ill patients in the ICU as it can be extremely useful in identification and /or treating cases of ACS.

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