

Original Research Article

Role of intra-abdominal pressure monitoring in the management of patients with blunt injury abdomen

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ABSTRACT

Background: Blunt injury abdomen is associated with significant morbidity and mortality in spite of improved recognition, diagnosis and management. The aim was to study the role of intra-abdominal pressure (IAP) monitoring in the management of patients with blunt injury abdomen.

Methods: Hospital based prospective observational study in 77 patients who presented to emergency medicine department with blunt injury abdomen for over a period of 22 months. Age ≥ 18 years, patients with acute blunt injury abdomen are included in study.

Results: Our study population (77 patients) were a group of patients who presented with blunt injury to abdomen, out of which 66 were male (85.70%), 11 were female (14.30%). Most common age group involved in our study was 20-30 years, mean time of presentation to the hospital was 7.40 hours. SBP, DBP, SpO₂ decreased significantly as IAP increases. P. R., R. R. increased significantly as IAP increases. U/O decreased significantly as IAP increases. Sr. Cr, B.U. increased significantly as IAP increases. Surgical abdominal decompression had helped in all operated patients to get statistically significant decrement of IAP during initial post-operative hours. 12 patients required ventilator support in surgically intervened group. Mean duration of hospital stay was 8.025 days. Mortality rate in our study was 3.9%.

Conclusions: Before development of intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS), the potential candidates should be offered surgical decompression at proper time.

Keywords: Intra-abdominal pressure, Intra-abdominal hypertension, Abdominal compartment syndrome

INTRODUCTION

Trauma has been called the neglected disease of modern society, despite its close companionship with man. Trauma is the leading cause of death and disability in developing countries and the most common cause of death under 45 years of age.¹

Trauma is the second largest cause of disease accounting for 16% of global burden. The WHO estimates that by

2020, trauma will be the first or second leading cause of years of productive life lost for the entire world population.² Pre-hospital transportation, initial assessment, thorough resuscitative measures and correct diagnosis are of utmost importance in trauma management.² World over injury is the 7th cause of mortality and abdomen is the third most common injured organ. Abdominal injuries require surgery in about 25% of cases. 85% of abdominal traumas are of blunt character.³

Abdominal trauma can result in the increase of IAP for a variety of reasons including the accumulation of blood or free fluid in the peritoneal cavity, oedema of the intestinal wall, retroperitoneal hematoma or abdominal packing for haemorrhage control. Therefore the continuing hepatic haemorrhage and increasing amounts of bloody ascites found in failed non operative management can lead to an elevation in IAP. In 2004, a group of international physicians and surgeons formed the world society of abdominal compartment syndrome (WSACS). It has presented evidence based guidelines, definitions and recommendations for IAP, IAH and ACS. IAP is steady-state pressure within abdominal cavity. Normally IAP is approximately 5-7 mm Hg.⁴ IAH is sustained or repeated pathological elevation of IAP of 12 mm of Hg or more. ACS is sustained IAP greater than 20 mm of Hg (with or without abdominal perfusion pressure less than 60 mm of Hg), associated with new organ dysfunction or failure. 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.⁵

Measuring intra-vesicle pressure (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. Nontherapeutic laparotomies have significantly reduced with proper and timely applications of imaging methods in blunt abdominal trauma (BAT) patients along with physical examination. Unrecognized abdominal injury is a frequent cause of preventable death after trauma. Non operative management (NOM) is the treatment of choice for BAT since last few decades because of increased evidence of surgery related complications.

Repeated clinical examination supplemented with modern imaging and laboratory investigations play a key role in reaching therapeutic decisions, thus preventing unnecessary laparotomies. IAP should be measured and monitored by any standard available method, with all aseptic precautions, in all cases of blunt injury abdomen. Along with IAP, patients will be monitored meticulously for simple parameters like heart rate, blood pressure, respiratory rate, urine output because variations in these parameters can predict the impending IAH and ACS before actual rise in IAP. Despite the increase in awareness and guideline recommendations, there remains some resistance to adopting regular screening and monitoring practices. Increased attention to IAP, along with changes in the clinical management of critically ill or injured patients, have led to an exponential growth in research relating to IAH and ACS in recent years.⁶ Therefore, by monitoring the intraabdominal pressure we would be able to identify patients with increased intra-abdominal pressure and by intervening prevent the morbidity and mortality related to IAH and ACS.

METHODS

Hospital based prospective observational study in 77 patients who presented to emergency medicine department later shifted to department of general surgery in Kamineni hospitals, LB Nagar with blunt injury abdomen, over a period of 22 months from July 2016 to April 2018.

Inclusion criteria

Age \geq 18 years, patients with acute blunt injury abdomen were included in the study.

Exclusion criteria

Patients with penetrating injuries, polytrauma, bladder injury, pathology and urological problems, with intra-abdominal mass and pregnant females were excluded from the study.

Study protocol was submitted to the institutional research advisory board as well as institutional ethics committee of Kamineni hospital LB Nagar and clearance was obtained for conducting study. Written consent were obtained from patient/their legal attendants. All information collected was kept strictly confidential.

Sample size

$$N = \frac{z^2 \sigma^2}{L^2},$$

where,

N=sample size,

z=1.96 at 95% CI,

σ =(standard deviation)=22.8 (APACHE III score Tiwari et al),⁷

L=6% (precision),

$$N = \frac{3.94 \times 22.8 \times 22.8}{6 \times 6},$$

N=55.44,

making it to near value sample size considered is 60.

The study included patients admitted with blunt injury abdomen in our hospital.

Institutional ethics committee approval was obtained before starting the study.

Patients/patient attendants who were willing to give informed consent were included in study.

IAP was measured in emergency medicine department and ICU at presentation, that is, 0 hours, 3 hours, 6 hours, 12 hours, 24 hours, 48 hours, 72 hours and 96 hours.

Duration of ICU and hospital stay, occurrence of intraabdominal hypertension, new organ function damage, need for ventilatory support and mortality in patients of blunt trauma abdomen were noted as outcomes.

Parameters noted were blood pressure, pulse rate, respiratory rate, oxygen saturation (SpO₂), urine output, blood urea, serum creatinine, IAP, time of presentation to hospital after injury, duration of ICU and hospital stay, need for ventilatory support, morbidity (new organ-system dysfunction) and mortality.

IAP was measured indirectly by estimating intra vesical pressure through a Foley's catheter. The whole procedure was carried out under aseptic precautions. In already inserted per-urethral Foleys catheter (assuming and assuring empty urinary bladder, 25 ml of normal saline (NS) instilled into bladder, sterile transparent tubing attached to it and 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 urobag.

Blunt injury abdomen patients were managed as per advanced trauma life support (ATLS) guidelines in our study. Patients who were in need of assisted ventilation, were managed with mechanical ventilator. Post-operative clinical outcome was measured in terms of survival and mortality. 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.⁴

Patients who required surgical decompression (on basis of 2 consecutive findings of raised IAP in case of solid organ injury and all cases with hollow organ perforation, IAP >20 mm of Hg were considered for surgical intervention and inspite of IAP <20 mm of Hg if vital parameters were deranged were also considered for surgical decompression of abdomen.), underwent emergency exploratory laparotomy. In patients with ACS, the decision to proceed with decompressive laparotomy was decided by primary surgeon in-charge of the patient, who deteriorated upon a trial of non-operative

management, after taking in to above clinical and laboratory parameters.⁷

Statistical analysis

Descriptive statistical analysis is carried out in this study to explore the distributions of several characteristics of the cases studied. Results on categorical data are shown as N (% of cases) and the results on quantitative variables are shown as mean standard±deviation across two surgical groups. The statistical significance of difference of various qualitative responses between two surgical groups is tested using Chi square test for independence of attributes. For comparing quantitative variables across two surgical groups, independent sample t test and Pearson correlation is used after confirming the underlying normality assumption. P values less than 0.05 would be considered to be statistically significant. The entire statistical analysis is performed using statistical package for social sciences (SPSS ver 17, Inc. Chicago, USA) for MS windows.

The technical details on the sample size calculation and the statistical formulae used are given in 10.2 appendix-statistical analysis.

RESULTS

This study was carried out in department of general surgery, Kamineni hospitals, Hyderabad during the period July 2016 to April 2018. 77 patients who presented with blunt injury abdomen to emergency medicine department, who fulfilled the inclusion and exclusion criteria were studied.

Out of 77 patients, 66 were male (85.70%), 11 were female (14.30%). Mean time of presentation to the hospital was 7.40 hours, hospital stay 8.025 days. Most common age group involved is 20-30 years.

Out of 77 patients, 44 were treated conservatively, 32 required surgical intervention and 1 patient expired at 9 hours of study due to massive retroperitoneal hematoma.

12 patients required ventilator support in our study. 3 patients were expired. Out of 3 patients, 2 patients were expired in surgically intervened group of 32 and 1 patient succumbed to death at 9 hours of duration due to massive retroperitoneal hematoma.

Correlation between IAP and vital parameters, renal parameters at 0, 3, 6, 24 and 72 hours was found statistically significant.

Observation between IAP and vital parameters, renal parameters at 12 hours all parameters are significant except IAP has weak positive correlation with DBP and this was found statistically insignificant. SpO₂ has strong negative correlation with IAP and this was found statistically insignificant.

Observation between IAP and vital parameters, renal parameters at 96 hours all parameters are insignificant except PR has strong positive correlation with IAP and this was found statistically significant and RR has weak positive correlation with IAP and this was found statistically significant. High respiratory rate associates with low IAP.

Overall hospital stay (considering both conservatively managed and surgically intervened patients) increased significantly as IAP increases at 0, 3, 6, 24, 48, 72, 96 hours, except at 12 hours.

Hospital stay decreased as IAP increases in surgically intervened group because IAP returned to normal after surgical decompression, but this finding was statistically significant only at 72 hours (p value was 0.0001) in our study.

Correlation of hospital stay in conservatively treated patients (N=44).

In our present study of 77 patients with blunt injury abdomen Hospital Stay increased as IAP increases in conservatively managed patients, this finding is statistically significant at 0, 3, 6, 12, 24, 48, 72, 96 hours (p value was 0.0001).

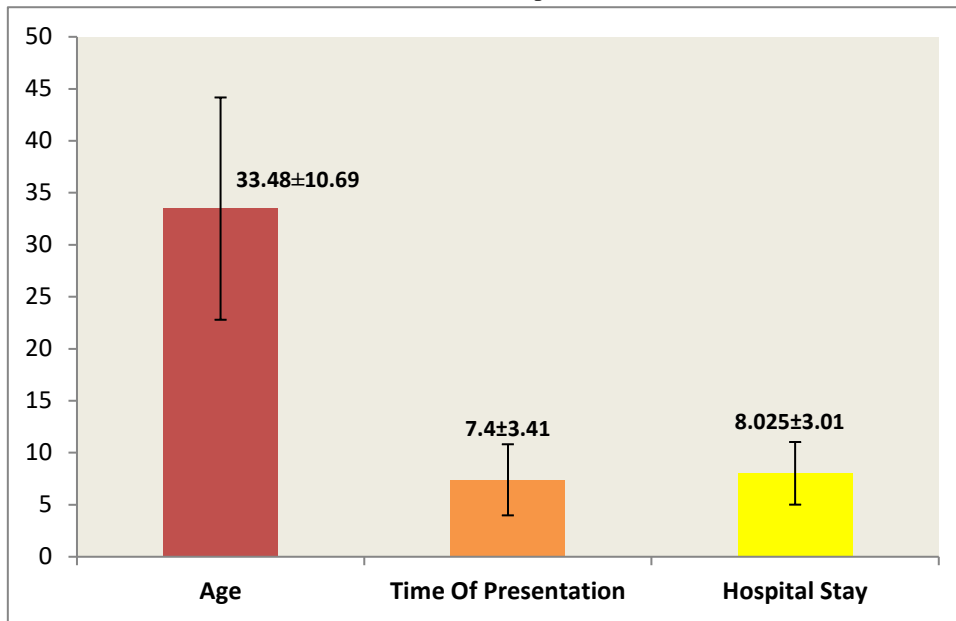


Figure 1: Age distribution, time of presentation, hospital stay of study population.

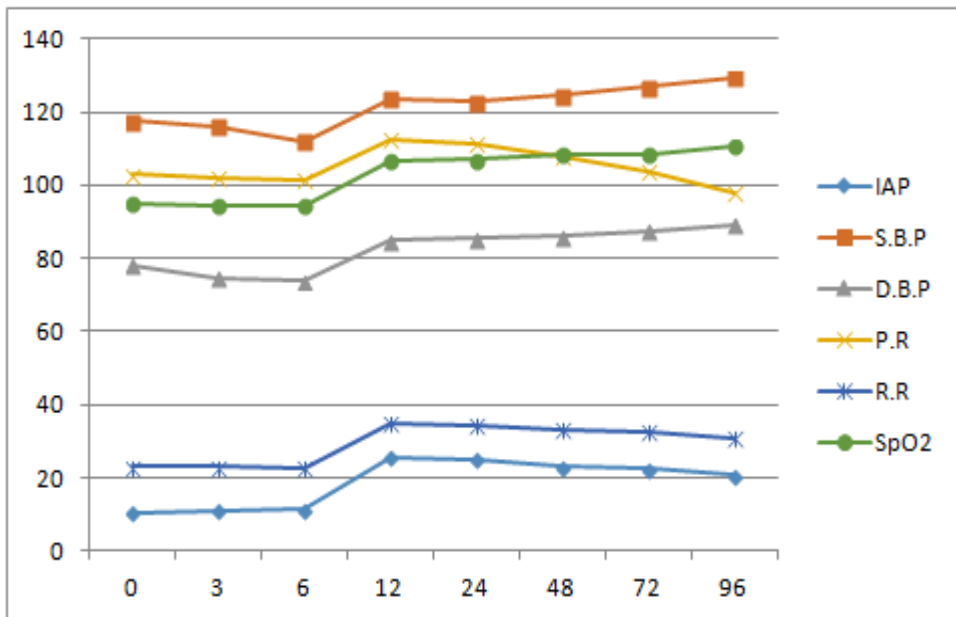


Figure 2: Observation between IAP and vital parameters in our study.

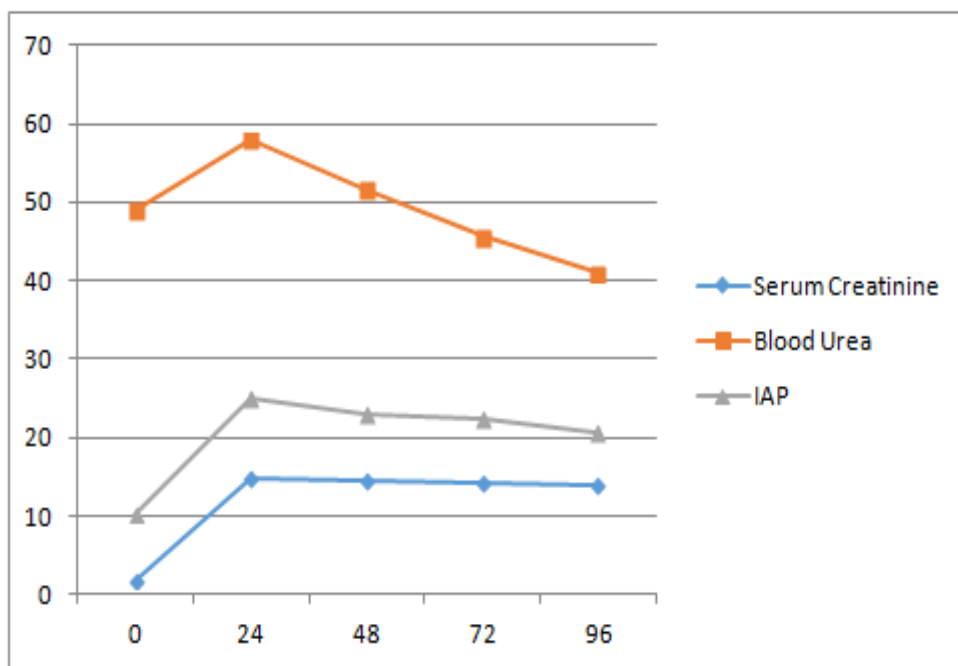


Figure 3: Observation between IAP and renal parameters in our study.

Table 1 : Conservative/surgical management.

Management	Frequency	Percent
Conservative	44	57.9
Surgery	32	42.1
Total	76	100.0
Ventilatory support		
Yes	12	15.6
No	65	84.4
Outcome of study population (survival/expired)		
Yes	74	96.1
No	3	3.9

Table 2: Observation between IAP and hospital stay in surgically intervened patients.

Time		Mean	Standard deviation	Correlation	P value
0	IAP	10.8	3.035	-0.313	0.081
	Hospital stay	10.781	1.67		
3	IAP	12.29	4.89	-0.267	0.139
	Hospital stay	10.781	1.6798		
6	IAP	13.07	4.99	-0.194	0.286
	Hospital stay	10.781	1.6798		
12	IAP	17.12	24.62	-0.118	0.520
	Hospital stay	10.781	1.67		
24	IAP	16.78	7.36	-0.280	0.121
	Hospital stay	10.781	1.67		
48	IAP	12.64	5.4	0.224	0.218
	Hospital stay	10.781	1.67		
72	IAP	11.7	6.2	0.607	0.0001
	Hospital stay	10.78	1.67		
96	IAP	8.075938	.8510936	0.473	0.006
	Hospital stay	10.781	1.6798		

Table 3: Observation between IAP and hospital stay in conservatively treated patients.

Time		Mean	Standard deviation	Correlation	P value
0	IAP	9.59	2.56	0.677	0.0001
	Hospital stay	6.182	1.9202		
3	IAP	9.63	2.25	0.740	0.0001
	Hospital stay	6.182	1.92		
6	IAP	9.32	2.37	0.787	0.0001
	Hospital stay	6.182	1.9202		
12	IAP	9.16	2.126	0.802	0.0001
	Hospital stay	6.182	1.9202		
24	IAP	8.66	1.837	0.776	0.0001
	Hospital stay	6.182	1.9202		
48	IAP	8.27	1.527	0.775	0.0001
	Hospital stay	6.182	1.92		
72	IAP	7.955	0.23	0.738	0.0001
	Hospital stay	6.182	1.9202		
96	IAP	7.41	1.1	0.653	0.0001
	Hospital stay	6.182	1.9202		

DISCUSSION

Our study population (77 patients) was a group of patients who presented with blunt injury to abdomen. To objectively define development of ACS in the patients of blunt injury abdomen managed with NOM (non-operative management) and surgically intervened, we serially measured their bladder pressures while they were being treated in their respective surgical units. At the end of the treatment we tried to correlate different clinical parameters and bladder pressures for early diagnosis and timely intervention in the event of development of ACS.

Most common age group involved in our study was 20-30 years, similar finding was observed in study conducted by Mehta et al (21-30 years), Amuthan et al (20-30 years).^{2,8}

In present study 66 were male (85.70%), 11 were female (14.30%). Similar finding was observed in study conducted by Mehta et al, Bhoir et al.^{2,4}

In present study, mean time of presentation of a blunt injury abdomen patient to the hospital was 7.40 hours.

SBP, DBP decreased significantly as IAP increases at 0, 3, 6, 24, 48 and 72 hours of hospital admission in our study. Similar finding was seen in study conducted by Bhoir et al in which they observed inverse relation between B.P and IAP.⁴ P. R. increased significantly as IAP increases at 0, 3, 6, 12, 24, 48, 72 and 96 hours of hospital admission in our data. Similar finding is seen in study conducted by Bhoir et al.⁴ R. R. increased significantly as IAP increases at 0, 3, 6, 12, 24, 48, 72 and 96 hours of hospital admission. Similar finding was seen in study conducted by Bhoir et al.⁴ In our data, SpO₂ decreased significantly as IAP increases at 0, 3, 6, 24, 48

and 72 hours of hospital admission. Similar finding was seen in study conducted by Bhoir et al.⁴

U/O decreased significantly as IAP increases at 3, 6, 12, 24, 48 and 72 hours of hospital admission. This finding was in concordance with study conducted by Bhoir et al.⁴ As IAP increases serum creatinine increased significantly at 0, 24, 48, 72 and 96 hours of hospital admission. This was in concordance with studies conducted by Khan et al, Bhoir et al.^{4,9} As IAP increases serum creatinine increased significantly at 0, 24, 48 and 72 hours of hospital admission. Similar observation noted in study conducted by Khan et al in which they noted statistically significant increase in B.U. in patients of IAH.⁹

Surgical abdominal decompression had helped in all operated patients to get statistically significant decrement of IAP during initial post-operative hours in our data. Bhoir also observed significant decrement of IAP during initial post-operative hours in their study.

12 patients required ventilator support in our study.

Mean duration of hospital stay was 8.025 days in our data, that observed in study by Tiwari et al was 11 days.⁷

In our present study considering both conservatively managed and surgically intervened patients overall hospital stay increased significantly as IAP increases at 0, 3, 6, 24, 48, 72, 96 hours except at 12 hours. This was in contrast to study conducted by Khan et al, in which there was no significant correlation between IAP and duration of hospital stay.⁹ Hospital stay decreased as IAP increases in surgically intervened patients because IAP returned to normal after surgical decompression, but this finding was statistically significant only at 72 hours (p value was 0.0001) in our study. As IAP increases hospital stay

increased in conservatively managed patients as IAP took longer time to become normal in contrast to surgically managed patients, this finding was statistically significant at 0, 3, 6, 12, 24, 48, 72, 96 hours (p value was 0.0001). One patient succumbed to death at 9 hours of presentation to hospital in emergency department due to massive retroperitoneal hematoma (detected on CECT abdomen IV contrast) in spite of prompt resuscitative measures.

Ventilator acquired pneumonia in one patient and sepsis with MODS in other patients of surgically intervened patients were the causes of death. Cheatham et al had found that elevated IAP alone not a useful predictor of mortality.¹⁰ Mortality rate in our study was 3.9% (3 patients out of 77), this was in accordance with study conducted by Mehta et al 4%, study conducted by Bhoir et al 3.84%.^{2,4} In conservatively treated patients there was no mortality observed because in patients who showed impending signs and sequels of raised IAP, early surgical decompression of abdomen was performed.

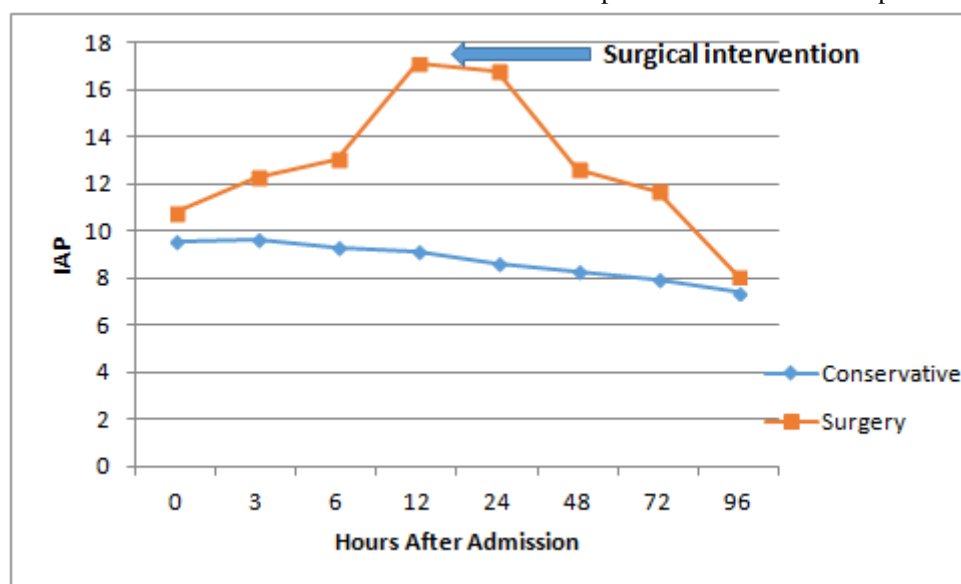


Figure 4: Decrement of IAP during initial post-operative hours.

CONCLUSION

From our study we concluded that road traffic accident forms the most common mode of blunt injury abdomen. Measures for early transport of the patients from the accident site to trauma centres should be undertaken. Recognizing patients at risk, monitoring the abdominal pressure frequently and initial resuscitative measures could reduce the mortality to a significant level. IAP should be measured and monitored by any standard available method, with all aseptic precautions, in all cases with traumatic acute abdomen.

Along with IAP, patients should be monitored meticulously for simple parameters like heart rate, blood pressure, respiratory rate, 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. Non-operative management for blunt abdominal trauma was found to be highly successful and safe in our analysis. Management by NOM depends on clinical and hemodynamic stability of the patient, after definitive indications for laparotomy are excluded.

There is no significant correlation regarding hospital stay and increased IAP in our study as hospital stay increased both in conservatively managed and surgically intervened patients except at 72 hours in surgically intervened group. Before development of IAH and ACS, the potential candidates should be offered surgical decompression at proper time.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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