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A Study on Fluid Resuscitation in Blunt Abdominal Trauma Patients In Relation To Intra-Abdominal Hypertension

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Abstract:
BACKGROUND:
Excessive fluid administration for saving patients from hypovolemic shock is one of the main causes of intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS). The world society of abdominal compartment syndrome (WSACS) defines Intra-abdominal pressure (IAP) as the pressure within the abdominal cavity measured at end expiration in a relaxed, supine patient. It defines IAH as a sustained elevation of IAP >12 mmHg and ACS as a sustained elevation of IAP >20mmHg that is associated with the onset of organ dysfunction. IAH/ACS not only affects the function of intra-abdominal organs but can also cause cardiovascular, respiratory and renal dysfunction and ultimately cause multiple organ failure. The purpose of this study is to survey the relationship between fluid resuscitation and development of IAH/ACS.
AIMS AND OBJECTIVES:
To determine the relationship between intra-abdominal hypertension and volume of fluid resuscitation in patients with blunt abdominal trauma with hypovolemic shock.
MATERIALS AND METHODS:
The observational study was conducted in the Tamil Nadu Accident and Emergency care Initiative (TAEI) ward of Coimbatore medical college hospital. 30 patients who presented with blunt abdomen trauma (considering the inclusion and exclusion criteria) were included in the study. The volume of intravenous fluids and blood and blood products used in the resuscitation of the patients were recorded along with the intra-abominal pressure (measured by indirect method), urine output, systolic blood pressure and oxygen saturation measured every 4^{th} hourly for the first 24 hours and the data was analysed.
RESULTS :
Of the 30 patients whose IAP was measured, 5 patients developed IAH and none developed ACS. It was observed that the total volume of fluids given in patients who developed IAH (mean volume = 7880ml) was higher than the total volume of fluids given in patients who did not develop IAH (mean volume = 3888ml).
***Key Words**: Abdominal compartment syndrome, fluid resuscitation, intra-abdominal hypertension, blunt abdominal trauma*

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I. Introduction

Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) are increasingly recognized clinical entities in the critically ill patient. IAH is likely more common than previously established and it is unknown whether IAH is a sign of illness severity or rather a disease that, when treated, will improve patient outcomes. The predisposing conditions associated with IAH induced organ dysfunction can be classified into three categories:

1. Increased intra-abdominal volume (such as bleeding, ascites, intraperitoneal collections)
2. Decreased abdominal wall compliance (such as muscular guarding andburn eschars)
3. Combination of both (example - Secondary ACS after fluid resuscitation).

Primary IAH/ACS is a condition associated with injury or disease in theabdomino-pelvic cavity and mostly observed in patients with severe abdomino- pelvic trauma, severe pelvic fractures with hemorrhage and retroperitonealhematoma.Whereas IAH/ACS occurs as a result of a condition that originates outside the abdomen in a scenario lacking primary intraperitoneal injury or intervention. This state appears to be related to visceral, abdominal wall, and retroperitoneal edema such as severe hypovolemic shocks, in which massive volumes of different fluids are required to be administered to resuscitate and restore patient's hemodynamic status.

Massive volume resuscitation after "first hit" for any reason (like burn, pancreatitis, hemorrhagic shock) can lead to increase in Intra-abdominal pressure (IAP) particularly post-operatively. The "second hit" results from the effects of capillary leak, shock with ischaemia-reperfusion injury and the release of cytokines combined with massive increase in total extracellular volume. Hence the measurement of IAP is of prime importance in fluid resuscitation of critically ill blunt abdominal trauma patients.

II. Aim and Objectives:

- To determine the relationship between intra-abdominal hypertension and volume of fluid resuscitation in patients with blunt abdominal trauma with hypovolemic shock.
- To determine the relationship between type of fluid used for resuscitation and development of IAH in patients with blunt abdominal traum

III. Materials And Methods:

TYPE OF STUDY : Retrospective – observational

PERIOD OF STUDY: September 2019 To September 2020

PERIOD REQUIRED FOR DATA COLLECTION : 1 year

PLACE OF STUDY : Department of General Surgery, Coimbatore medical college and hospital, Coimbatore.

SAMPLE SIZE -30 cases.

INCLUSION CRITERIA
1. Patients with non – penetrating blunt abdominal trauma whose abdominal trauma was confirmed by an emergency physician or USG abdomen or CT scan.
2. Patients managed by non-operative management

EXCLUSION CRITERIA:
1. Patient refusal
2. Patients managed by operative management
3. Age <18 years
4. Patient without foley's catheter due to perineal injury
5. Patient with ascites

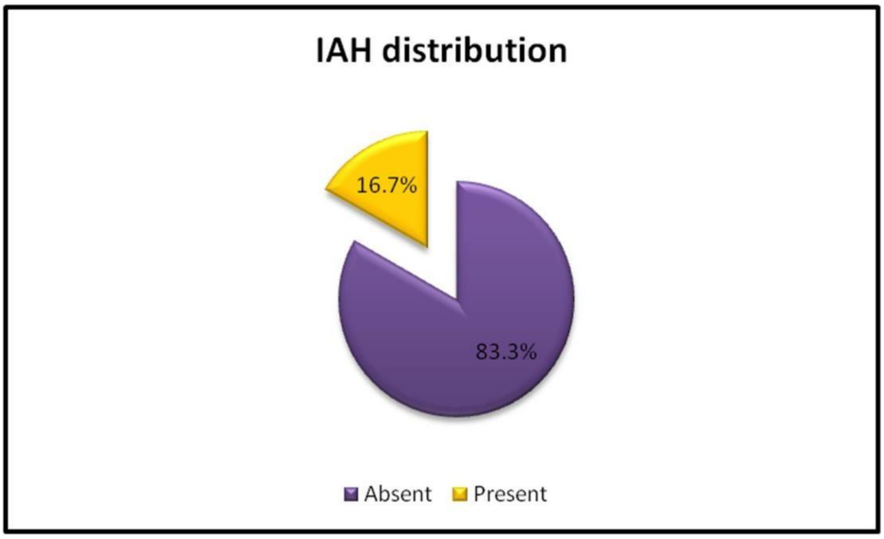
After obtaining informed consent from the patient with blunt abdominal trauma (considering the inclusion and exclusion criterias), fluid resuscitation chart is maintained with details about the volume and type of fluid infused. Intra abdominal pressure chart is maintained (measured by indirect method using foley's catheter at 4 hours interval for first24 hours. IAP is measured in Cm of H2O and converted to mmhg. 1Cm of H2O = 0.7 mmhg). Urine output, blood pressure and saturation chart for first 24 hours are maintained.Significant difference in the multivariate analysis was measuredwith ANOVA test

The collected data were analysed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference in the multivariate analysis for repeated measures the Repeated measures of ANOVA was used with Bonferroni correction to control the type I error on multiple comparison. In the above statistical tools the probability value .05 is consideredas significant level

IV. Results

- In our study of 30 patients, 8 were female and 22 were males with a female to male ratio of 1:2.7.
- In our study the commonest age group was found to be between 21- 30 years
- In our stud y the most common mode of injury is road traffic accident contributing 90% whereas self fall accounts for 10% of the total patients.
- In our study the most common CT finding distribution were 60.0% is AAST grade 2
- In our study 5 patients were found to have IAH(16.7%) and none developed ACS

TABLE 6: IAH DISTRIBUTION



IAH distribution		
	Frequency	Percent
Absent	25	83.3
Present	5	16.7
Total	30	100.0

The above table shows IAH distribution were 83.3% is Absent, 16.7% is Present.

DESCRIPTIVE STATISTICS

	N	Minimum	Maximum	Mean	S.D
Age	30	18	82	42	18
0.9% NS	30	1500.0	4000.0	2233.3	612.1
RL	30	1000.0	3000.0	1900.0	699.8
Total volume of crystalloides	30	2500.0	6500.0	4133.3	973.2
Plasma expanders	30	0.0	500.0	100.0	203.4
Total volume of fluids given	30	2500.0	7000.0	4233.3	1104.3
Whole blood	30	0.0	300.0	20.0	76.1
Packed cell	30	0.0	600.0	120.0	202.4
FFP	30	0.0	1000.0	166.7	355.6
Platelet	30	0.0	200.0	13.3	50.7
Total volume	30	0.0	1800.0	320.0	597.4
Total volume of transfusion (in first 24 hours)	30	2800.0	8300.0	4553.3	1596.7
Mean IAP in first 24 hours	30	6.0	13.0	8.3	2.0

The above table shows descriptive statistics of Age, 0.9% NS, RL, Totalvolume of crystalloides, Plasma expanders, Total volume of intravenous fluids given, volume of Whole blood, Packed cell, FFP and Platelet given, Total volume of transfusion (in first 24 hours), Mean IAP in first 24 hours.

Table 8: Comparison of Intra abdominal pressure (mmHg) within Group by Repeated Measures of ANOVA

IAP	N	Mean	S.D	F-value	p-value
0 hr	30	7.0	1.5	21.237	0.0005 **
4th hr	30	8.0	1.8		
8th hr	30	7.9	1.8		
12th hr	30	8.4	2.1		
16th hr	30	8.7	2.2		
20th hr	30	9.1	2.7		
24th hr	30	9.3	2.6		
** Highly Statistical Significance at p < 0.01 level					

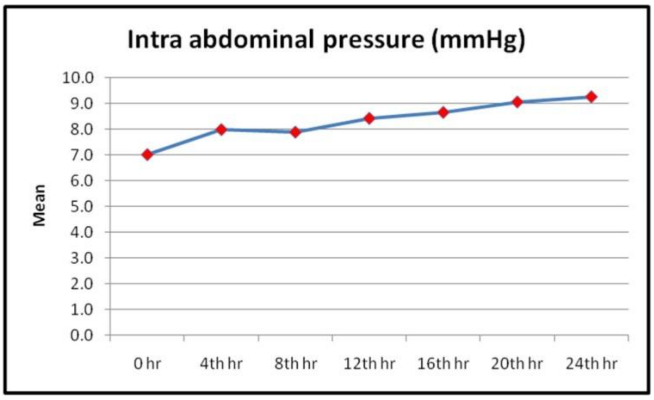


Chart 7 Comparison of Intra abdominal pressure (mmHg) within Groupby Repeated Measures of ANOVA

The above table shows comparison of Intra abdominal pressure (mmHg) withinGroup by Repeated Measures of ANOVA were F-value=21.237 , p=0.0005<0.01 which shows highly statistical significant difference between Intra abdominal pressure (mmHg) within Group.

Table 9: Comparison of Urine output (ml/Kg/hr) within Group byRepeated Measures of ANOVA

UO	N	Mean	S.D	F-value	p-value
0 hr	30	.48	.11	1.662	0.166 #
4th hr	30	.44	.09		
8th hr	30	.47	.06		
12th hr	30	.48	.09		
16th hr	30	.48	.11		
20th hr	30	.47	.09		
24th hr	30	.48	.11		
# No Statistical Significance at p > 0.05 level					

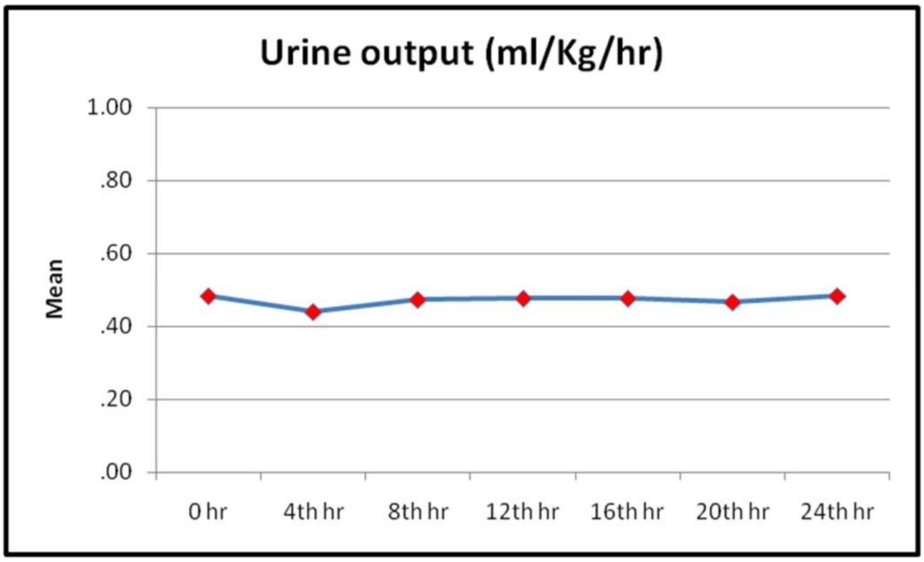


Chart 8 Comparison of Urine output (ml/Kg/hr) within Group byRepeated Measures of ANOVA

The above table shows comparison of Urine output (ml/Kg/hr) within Group byRepeated Measures of ANOVA were F-value=1.662 , p=0.166>0.05 which shows no statistical significant difference between Urine output (ml/Kg/hr) within Group.

Table 10: Comparison of Systolic Blood Pressure within Group byRepeated Measures of ANOVA

SBP	N	Mean	S.D	F-value	p-value
0 hr	30	92.8	7.8	56.198	0.0005 **
4th hr	30	99.7	8.5		
8th hr	30	106.7	6.1		
12th hr	30	111.0	9.2		
16th hr	30	112.3	9.0		
20th hr	30	110.3	8.5		
24th hr	30	111.7	9.1		
** Highly Statistical Significance at p < 0.01 level					

The above table shows comparison of Systolic Blood Pressure within Group by Repeated Measures of ANOVA were F-value=56.198 , p=0.0005<0.01 which shows highly statistical significant difference between Systolic Blood Pressure within Group.

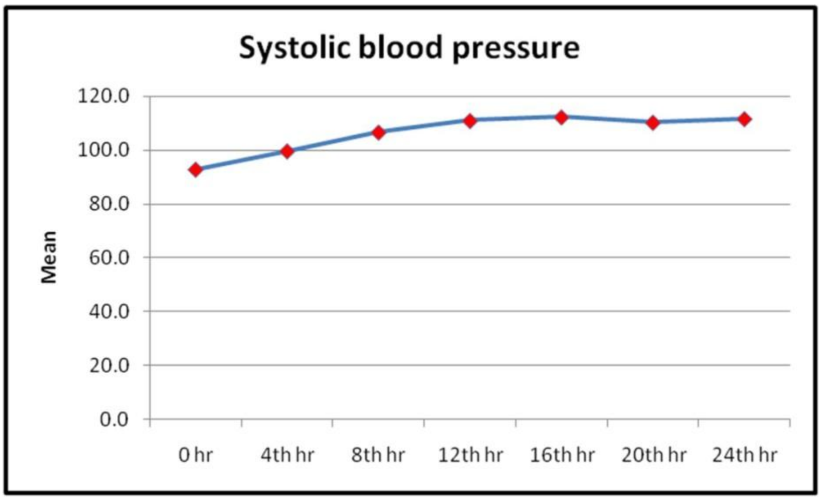


Chart 9 Comparison of Systolic Blood Pressure within Group by RepeatedMeasures of ANOVA

Table 11: Comparison of SPo2% within Group by Repeated Measures of ANOVA

SPo2	N	Mean	S.D	F-value	p-value
0 hr	30	97.7	0.8	0.195	0.737 #
4th hr	30	97.8	0.7		
8th hr	30	97.8	0.7		
12th hr	30	97.7	0.8		
16th hr	30	97.8	0.7		
20th hr	30	97.8	0.7		
24th hr	30	97.7	0.8		
# No Statistical Significance at p > 0.05 level					

The above table shows comparison of SPo2% within Group by Repeated Measures of ANOVA were F-value=0.195 , p=0.737>0.05 which shows no statistical significant difference between SPo2% within Group.

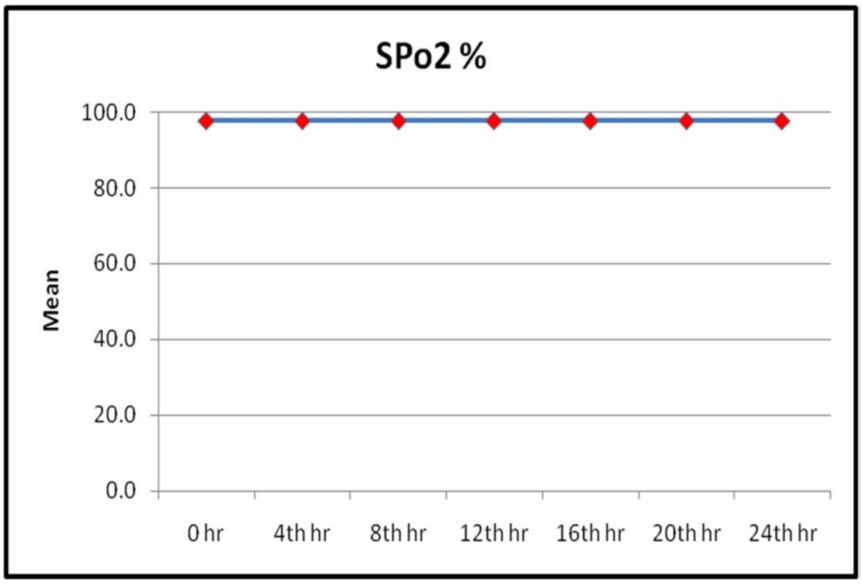


Chart 10 Comparison of SPo2% within Group by Repeated Measures of ANOVA

Table 12: Correlation between Total volume of transfusion (in first 24 hours) and Mean IAP in first 24 hours by Pearson's Correlation Coefficient

Correlations		
		Mean IAP in first24 hours
Total volume of transfusion (infirst 24 hours)	r-value	.948**
	p-value	.0005
	N	30
**. Significant at p < 0.01		

The above table shows Correlation between Total volume of transfusion (infirst 24 hours) and Mean IAP in first 24 hours by Pearson's Correlation Coefficient were r-value=0.948 shows positive linear relationship and p- value=0.0005<0.01 which shows highly statistical significant linear relationship between Total volume of transfusion (in first 24 hours) and Mean IAP in first 24 hours respectively.

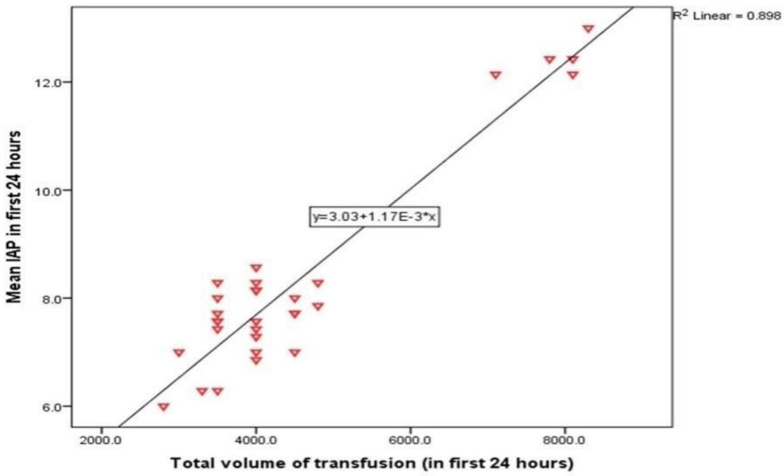


Chart 11 Correlation between Total volume of transfusion (in first 24 hours) and Mean IAP in first 24 hours by Pearson's Correlation Coefficient

Table 13: Correlation between Total volume of fluids given and Mean IAPin first 24 hours by Pearson's Correlation Coefficient

Correlations		
		Mean IAP in first 24 hours
Total volume of fluids given	r-value	.909**
	p-value	.0005
	N	30
**. Significant at p < 0.01		

The above table shows Correlation between Total volume of fluids given and Mean IAP in first 24 hours by Pearson's Correlation Coefficient were r- value=0.909 shows positive linear relationship and p-value=0.0005<0.01 which shows highly statistical significant linear relationship between Total volume of fluids given and Mean IAP in first 24 hours respectively.

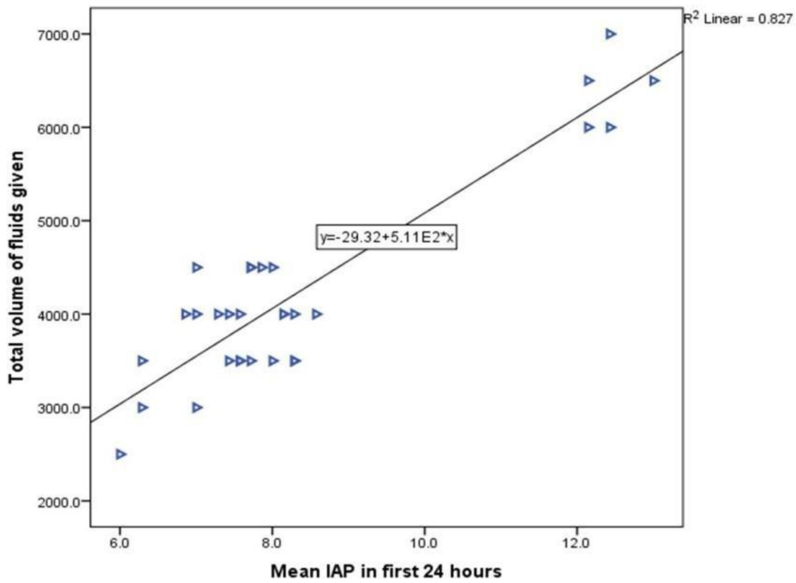


Chart 12 Correlation between Total volume of fluids given and Mean IAPin first 24 hours by Pearson's Correlation Coefficient

V. Discussion

Intra abdominal hypertension (IAH) and abdominal compartment syndrome(ACS) have detrimental effects on all organ systems. It is a well- recognized disease entity related to acutely increased abdominal pressure. The morbidity and mortality rate of ACS is very high; recognizing patients at risk, monitoring the abdominal pressure frequently and early initiation of treatment could reduce the mortality to a significant level. This study is an attempt to explore the relationship between volume of fluid resuscitation and developmentof IAH and ACS in patients with blunt abdominal trauma.

While analyzing the data, 5 out of 30 patients were found to have developed IAH and none of the patients developed ACS. The correlation between Total volume of intravenous fluids given and Mean IAP in first 24 hours was studied by Pearson's Correlation Coefficient. The r-value=0.909, shows positive linearrelationship and p-value=0.0005<0.01 shows highly statistical significant linear relationship between Total volume of fluids given and Mean IAP in first 24 hours. This is in accordance with other study conducted on 1976 patients in 2016 by Hwabejire *et al*. titled, "ACS in trauma patients with hemorrhagic shocks" which found 122 (6.2%) patients with ACS who had received significantly higher volumes of fluids compared to those without ACS. The analysis also showed that the that the duration of sustained IAH is moreimportant than the actual pressure.

There was significant correlation between the urine output and the intraabdominal pressure. This indicates that urine output is an ideal indicator of renal dysfunction in cases of intra abdominal hypertension or abdominal compartment syndrome. However there was no significant correlation between systolic blood pressure and saturation with intra abdominal hypertension. This may indicate that systolic blood pressure and saturation may not be idealparameters to measure to diagnose intra abdominal hypertension.

A review of the studies conducted on ACS and its relationships with thevolume of administered fluids, suggests that prompting administration of large fluids volume is one of the main factors contributing to IAH and ACS. Therefore, patients who for any reason are required to prompting administration of large fluid volumes, such as patients with extensive burns, severe abdominal trauma, retroperitoneal hematoma, unstable pelvic fractures with bleeding, hemorrhagic shock, extensive abdominal surgery, must have close monitoring of the exact amount of administrated fluids to prevent IAH and ACS.

VI. Conclusion

Patients with blunt abdominal trauma and severe injury such as pelvic fracture, internal bleeding, and damage to vital organs in the abdomen require resuscitation with a large volume of liquids because of hemodynamic shock. This is associated with IAH/ACS and high mortality and morbidity rate. Thus, ACS is a clinically important problem in critically ill patients in which massive volumes of different fluids are required to be administered to resuscitate and restore their hemodynamic status. This can be ameliorated by early recognition of IAH, optimal fluid resuscitation, and appropriate medical or surgical intervention for IAH and impending ACS. Bedside critical care and appropriateclinical setting, nurses are responsible for accurately measuring IAP and alerting physicians about important observed changes. Surgeon's knowledge of IAH and ACS, awareness of the patients at risk for IAH, and recognition of IAH and progression to ACS are important. Especially control the amount of administered crystalloid fluids prevents the progression of IAP to ACS as a seriously fatal condition. A high index of suspicion, judicious measurement of IAP, active IAP surveillance for at-risk patients, and early evaluation for organ dysfunction are essential in early detection and management of ACS.

Bibliography

[1]. Kirkpatrick AW, Roberts DJ, De Waele J, Jaeschke R, Malbrain ML,DeKeulenaer B, et al. Intra-abdominal hypertension and the abdominal compartment syndrome: updated consensus definitions and clinical practice guidelines from the World Society of the Abdominal Compartment Syndrome. Intensive Care Med. 2013 Jul;39(7):1190–206.) Marey E-J. Paris: A Delahaye; 1863. Medical physiology on the blood circulation; pp. 284–93.

[2]. Fietsam R, Jr, Villalba M, Glover JL, Clark K. Intra-abdominalcompartment syndrome as a complication of ruptured abdominal aortic aneurysm repair. Am Surg. 1989;55:396–402.

[3]. Smith JI-1, Merrell RC, Raffin TA. Reversal of postoperative anuria by decompressive celiotomy. Arch Intern Med. 1985;145:553-4

[4]. Kron IL, Harman PK, Nolan SP. The measurement of intra- abdominal pressure as a criterion for abdominal re-exploration. Ann Surg. 1984;199:28–3.

[5]. Emerson H. Intra-abdominal pressures. Arch Intern Med.1911;7:754–84. parameter in critically ill patients - a consensus review of 16. Part 2: measurement techniques and management recommendations. Anaesthesiol Intensive Ther. 2014;46(5):406–32.

[6]. Song C, Alijani A, Frank T, Hanna GB, Cuschieri A. Mechanical properties of the human abdominal wall measured in vivo during insufflation for laparoscopic surgery. Surg Endosc. 2006;20(6):987– 90.)

[7]. De Keulenaer BL, De Waele JJ, Powell B, Malbrain ML. What is normal intra- abdominal pressure and how is it affected by positioning, body mass and positive end- expiratory pressure? Intensive Care Med. 2009 Jun;35(6):969–76.

[8]. Barnes GE, Laine GA, Giam PY et al. Cardiovascular responses to elevation of intra- abdominal hydrostatic pressure. Am J Physiol.1985;248:R208-13

[9]. Malbrain MLNG, De laet I, De Waele J, Sugrue M, Schachtrupp A, Duchesne J, et al.

[10]. The role of abdominal compliance, the neglected
[11]. van Ramshorst GH, Salih M, Hop WCJ, van Waes OJF, Kleinrensink G-J,Goossens RHM, et al. Noninvasive assessment of intra-abdominal pressure by measurement of abdominal wall tension.J Surg Res. 2011 Nov;171(1):240–4.
[12]. J Emerg Trauma Shock.2011 Apr-Jun;4(2): 279-291 doi: 10.4103/0974- 2700.82224
[13]. Journal of Emergencies, Trauma and Shock Medknow Publications
[14]. Blaser AR, Sarapuu S, Tamme K, Starkopf J. Expanded measurements of intra- abdominal pressure do not increase the detection rate of intraabdominal hypertension: a single-centerobservational study. Crit Care Med. 2014 Feb;42(2):378–86.
[15]. De Laet I, Hoste E, Verholen E, De Waele JJ. The effect of neuromuscularblockers in patients with intra-abdominal hypertension. Intensive Care Med.2007 Oct;33(10):1811–4.
[16]. O'Malley C, Cunningham AJ. Physiologic changes during laparoscopy. Anesthesiol Clin North America. 2001 Mar;19(1):1–19.
[17]. Gutt CN, Oniu T, Mehrabi A, Schemmer P, Kashfi A, Kraus T, et al.
[18]. Circulatory and respiratory complications of carbon dioxide insufflation. Dig Surg. 2004 Jan;21(2):95–105.

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