Section: Radio Diagnosis

Original Research Article

VENOUS PHASE DIAMETER OF INFERIOR VENACAVA ON COMPUTED TOMOGRAPHY- A PREDICTOR OF HYPOTENSION IN BLUNT ABDOMINAL TRAUMA

Nagashri Swamy[1], Veeresh S Aland[2], Santosh D Patil[3], Pradeep Goudar[4]

[1]Resident, Department of Radio Diagnosis, JNMC, KAHER University, Belagavi, Karnataka, India
[2]Associate Professor, Department of Radio Diagnosis, KBN University, Kalaburgi, Karnataka, India
[3]Professor, Department of Radio Diagnosis, JNMC, KAHER University, Belagavi, Karnataka, India
[4]Assistant Professor, Department of Radio Diagnosis, JNMC, KAHER University, Belagavi, Karnataka, India

Received : *26/11/2023*
Received in revised form : *19/01/2024*
Accepted : *05/02/2024*

Keywords:
Blunt abdominal trauma, Flat IVC, Hypotension.

Corresponding Author:
Dr. Pradeep Goudar,
Email: pradeepsgoudar6543@icloud.com

DOI: 10.47009/jamp.2024.6.1.345

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 1744-1751

Abstract

Background: According to the World Health Organization (WHO), injuries result in the death of about 5 million individuals annually across the globe. Injuries to the abdominal viscera, which are a major source of haemorrhage, present to hospital with few or no symptoms making their assessment and management very difficult. The objectives are to obtain contrast enhanced CT scan of the abdomen in patients who presented with history of blunt abdominal trauma and to assess the diameter of IVC in venous phase as a predictor of hypotension. **Materials and Methods:** A cross sectional study from January 2018 to December 2018 with sample size of 30 in Department of Radio diagnosis at KLE'S Dr. Prabhakar Kore Hospital, teaching Medical College, Belagavi. The data collected was by a validated semi-structured questionnaire. The data sheet included socio demographic profile of the study subjects, clinical presentation and axial sections of CE-CT abdomen USING 120 Kvp and 400mAS with 1.5mm cuts and retro collimation of 1mm were studied from the lung base to the symphysis pubis. Imaging performed in arterial phase and venous phases. Delayed excretory phase performed in cases of renal injury. **Result:** Among the study population majority were aged between 21 to 40 years, males, met with road traffic accidents, all had evidence of solid organ injury, majority had splenic injury, mild hemoperitoneum, flat IVC and hypotension. Flat IVC had sensitivity of 82.14% specificity of 100% in detecting hypotension. Positive predictive value was 100% Negative predictive value was 28.57% and the total diagnostic accuracy was 83.33%. **Conclusion:** Flat IVC on CT could be of value in predicting hypotension among blunt abdominal trauma patients.

INTRODUCTION

Trauma and the resultant injuries can be considered as a major global mortality cause. According to the World Health Organization (WHO), injuries result in the death of about 5 million individuals annually across the globe. Almost 9% of the worldwide mortality is due to trauma. According to the reports released by the Centre for Disease Control and Prevention, each year around 214,000 individuals lose their lives because of injury related mortality. This translates to 1 person per 3 minutes.[1]

However, the morbidities due to injuries vastly outnumber the mortality rates. For every person who dies due to trauma, many more are hospitalized due to injuries. For each person who died, 129 individuals were reported to be admitted to the emergency room and 13 were reported to be hospitalized.[2] Major proportion of people, who survive following a major injury may suffer from various degrees of temporary or permanent disability. Apart from the adverse physical consequences, these people often face severe economic and psychosocial consequences. Considering the fact that injuries predominantly affect the economically productive population, this injury results in enormous burden on health care system and on the society.[3]

According to the World Health Organization statistics released in 2018, injuries result in multiple losses such as losses to the economy at the individual, family and the country level. Apart from the direct cost incurred during treatment and hospitalization, the indirect cost due to loss of productivity is enormous. Accidents are reported to result in up to 3% loss of the country's Gross Domestic Product.[1]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Injuries are more common in young age group and hence it can be considered as a major cause for loss of potential years of life of an individual. Haemorrhage is one of the trauma related preventable causes of mortality. Injuries to the abdominal viscera, which are a major source of haemorrhage, present to hospital with few or no symptoms making their assessment and management very difficult.[4,5]

Even in cases of mortality in blunt abdominal trauma, there might be no external signs.[6] Furthermore, the diagnostic accuracy of physical examination in abdominal visceral injury is low. The associated injuries to central nervous system pose additional difficulties in the diagnosis of abdominal trauma due to altered level of consciousness.[7] Even the cases without physical signs of abdominal pain, there might be harbouring occult injuries. This often leads to missed diagnosis, especially in a resource limited setting where there is a poor availability of necessary investigations and huge reliance on clinical examination. This has been reported as a major contributing factor to preventable mortality among people affected by trauma.[8]

There are two types of abdominal trauma, namely blunt and penetrating trauma. Penetrating trauma mostly affects liver, small intestine and colon. In blunt abdominal trauma, the traumatic effects are transferred through the abdominal wall to the internal organs and hence the organs mostly affected are the spleen and the liver. Other organs which are affected include the bladder, rectum, along with structures like mesentery, diaphragm and major blood vessels. External compression, deceleration and crushing injuries are the major causative forces in blunt abdominal trauma. In cases of blunt trauma, abdominal visceral injury contributes to as much as 13% of the cases.[9]

Road accidents are a cause for 75% of blunt trauma cases, assaults & fall contribute to 15% and 10% respectively. Studies have indicated that the incidence of blunt abdominal trauma has been increasing in the past decade. However, the mortality has remained steady or in other situations has declined. Patients with multiple injuries must be evaluated thoroughly for abdominal injuries by imaging because most of the injuries affecting abdominal viscera are treatable and a great proportion of the patients can recover completely.[8]

Computed tomography has significantly enhanced the current knowledge regarding abdominal trauma.[10] Accurate diagnosis of blunt abdominal trauma has now been made possible with advances in CT imaging techniques. [4,11] CT has also been useful in the evaluation of multiple injuries and to base the clinical decisions depending on the severity of injuries.

Inferior Vena Cava (IVC) is an important diagnostic tool for evaluation of patients with blunt abdominal trauma. The diameter of IVC changes in response to intravascular volume in the patients. Hence, the IVC diameter can be used as a predictor of blood loss and hypovolemia in patients with blunt abdominal trauma. Assessment of Inferior Vena Cava can be done using either ultrasonography or CT imaging. Ultrasound imaging is difficult since the presence of bowel gas, inter-observer variability and the presence of subcutaneous emphysema might complicate the visualization of IVC to assess the presence of hypovolemia. Hence, CT imaging has been found to be superior to USG in assessing the IVC diameter in patients with blunt trauma.

Objectives

1. To obtain contrast enhanced CT scan of the abdomen in patients who presented with history of blunt abdominal trauma.
2. To assess the diameter of IVC in venous phase as a predictor of hypotension.

MATERIALS AND METHODS

Study Site: The study was conducted in the department of Radio diagnosis at KLE'S DR. PRABHAKAR KORE HOSPITAL & MRC, BELAGAVI

Study Population: All the eligible patients with blunt abdominal trauma in the study setting were considered as study population.

Study Design: The observational study.

Sample Size: 30 patients with blunt abdominal trauma were studied during a period of one year (2018-19) at our hospital.

Sampling Method: All the eligible subjects were recruited into the study consecutively by convenient sampling till the sample size is reached.

Study Duration: The data collection for the study was done between 1 January 2018 to 30 December 2018 for a period of 1 year.

Inclusion Criteria

Patients with blunt abdominal trauma who underwent CT scan of abdomen with contrast administration,

Intra-abdominal free fluid on abdominal sonography

Exclusion Criteria

Non-Consenting Patients

Abdominal trauma patients who underwent only non-contrast CT

Hemodynamically unstable patients who directly proceed to the operating room for surgery.

Data Collection Tools: All the relevant parameters were documented in a structured study proforma.

CT Equipment: Using a 64-slice CT Siemens somatom scanner system and using Iopromide injection for IV contrast, scan of the abdomen and pelvis were performed on the patients who presented with a history of blunt abdominal trauma with patient in supine position.

CT Technique: Axial sections of CE-CT abdomen USING 120 Kvp AND 400mAS with 1.5mm cuts AND RETROCOLLIMATION OF 1MM were studied from the lung base to the symphysis pubis.

Imaging was performed in arterial phase and venous phases. Delayed excretory phase was performed in cases of renal injury.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Evaluation Criteria: In our study the TRANSVERSE: AP RATIO OF IVC was measured 2 cm above the bifurcation of the renal veins. The normal value of ratio was considered as 1.9. We considered >or = 1.9 as flat IVC and <1.9 -as non-flat IVC, as proposed by Jhonson JJ et al. [12]

Presence of following were evaluated,

Hemoperitoneum

Solid organ injuries according to their AAST GRADING: The abdominal injuries were classified as per AAST grading.

Skeletal injuries of ribs, pelvic bone, vertebrae were noted.

Ethical considerations: Study was approved by institutional human ethics committee. It was mandatory for participants of the study to sign an informed written consent. The risks and benefits involved in the study and voluntary nature of participation were explained to the participants before obtaining consent. The study maintains Confidentiality of all the participants.

Statistical Methods: Hypotension was the primary outcome variable and flat IVC was the primary explanatory variable. Solid organ injury, presence of hemoperitoneum were considered as other variables of interest. Descriptive analysis: Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram and box plots. Categorical outcomes were compared between study groups using Chi square test /Fisher's Exact test (If the overall sample size was < 20 or if the expected number in any one of the cells is < 5, Fisher's exact test was used.) Hypotension was considered as the outcome. Flat IVC was considered as screening test. The sensitivity, specificity, predictive values and diagnostic accuracy of the flat IVC were calculated along with their 95% CI were presented. P value < 0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.[13]

RESULTS

Among the study population 7(23.3%) were aged <20 years, 21(70%) aged between 21 to 40 years, 1(3.3%) was aged between 41 to 60 years and 1 (3.3%) was aged more than 61 years. The mean age was 26.93 ± 11.51 years. Minimum age was 5 years and maximum age was 65 years in the study population. (95% CI 22.64 to 31.23). Among the study population 25(83.3%) participants were males and remaining 5 (16.7%) participants were females. [Table 1]

Among the study population, 29(96.7%) participants met with road traffic accidents and remaining 1 (3.3%) participant met with fall. Among the study population, all 30(100%) had evidence of solid organ injury. Among the study population, 16(53.3%) had splenic injury, 15(50%) had liver injury, 4(13.3%) had pancreatic injury and 5 (16.7%) had kidney injury. Among the study population, 7(23.3%) had minimal hemoperitoneum, 12(40%) had mild hemoperitoneum, 8(26.7%), had moderate hemoperitoneum, and 3 (10%) had no hemoperitoneum. Among the study population 23(76.7%) had flat IVC, 7 had no flat IVC. Among the study population 28(93.3%) had hypotension. Among the study population 23(76.7%) had both hypotension and flat IVC. [Table 2]

Among the people with splenic injury, 13 (81.25%), among the patients with liver injury 12(80.0%), among the patients with kidney injury 3 (60%), among the patients with pancreatic injury 3 (75%) had flat IVC. The difference in the proportion of splenic, liver, pancreatic, kidney injuries between flat IVC was statistically not significant. [Table 3]

Among the patients with splenic injury 15(93.8%) had hypotension. Among the patients with liver injury 14(93.8%) had hypotension. Among the patients with kidney injury 5(100%) had hypotension. Among the patients with pancreatic injury 4(100%) had hypotension. The difference in the proportion of splenic, liver injury between hypotension was statistically not significant. (P value >0.05). [Table 4]

Among the people with splenic injury 13 (81.25%) had flat IVC + hypotension. Among the patients with liver injury 12(80.0%) had flat IVC + hypotension. Among the patients with kidney injury 3(60%) had flat IVC + hypotension. Among the patients with pancreatic injury 3(75%) had flat IVC + hypotension. The difference in the proportion of splenic, liver, kidney, pancreatic injuries between flat IVC + hypotension was statistically not significant. [Table 5]

Among 28 people with hypotension 23 (82.14%) had flat IVC. [Table 6]

Flat IVC had sensitivity of 82.14% (95% CI 63.11% to 93.94%), specificity of 100.00% (95 CI 15.81% to 100%) in detecting hypotension. Positive predictive value was 100.00% (95 CI 85.18% to 100%), Negative predictive value was 28.57% (95 CI 3.67%to 70.96%), and the total diagnostic accuracy was 83.33% (95 CI 65.28%to 94.36%). [Table 7]

Majority of the study population 10(33.3%) had splenic injury alone, 8 (26.7%) had liver injury alone, 4(13.3%) had splenic +liver injury and 3 (10%) had pancreatic injury alone. [Table 8]

All the people with only splenic injury alone (100%) had hypotension. Among the people with liver injury 7 (87.5%) had hypotension and among people with splenic and liver injury 4 (100%) had hypotension. [Table 9]

Majority people with only splenic injury 8 (80%) had flat IVC. Among people with only liver injury 6 (75%) had flat IVC and among people with splenic + liver injury 4 (100%) had flat IVC. [Table 10]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 1: Socio-demographic Profile of the study subjects

Age Group (Years)	Frequency	Percentages
<20	7	23.3%
21 to 40	21	70.0%
41 to 60	1	3.3%
61 and above	1	3.3%
Gender		
Male	25	83.3%
Female	5	16.7%

Table 2: Clinical presentation of the study subjects

Mechanism of Injury	Frequency	Percentages
RTA	29	96.7%
FALL	1	3.3%
Evidence of Solid Organ Injury		
Yes	30	100.00%
No	0	0.00%
Organ injury	Yes (%)	No (%)
Splenic	16(53.3%)	14(46.7%)
Liver	15(50.0%)	15(50.0%)
Pancreatic	4(13.3%)	26(86.6%)
kidney	5(16.7%)	25(83.3%)
Presence of hemoperitoneum	Frequency	Percentages
Minimal	7	23.3%
Mild	12	40.0%
Moderate	8	26.7%
Nil	3	10.0%
Flat IVC (FIVC)		
Flat IVC	23	76.7%
Non flat IVC	7	23.3%
Presence of Hypotension		
Hypotension (BP<90/60 mm/ Hg)	28	93.3%
No hypotension(BP >=90/60 mm/Hg)	2	6.7%
Hypotension+ Flat IVC		
Hypotension+ Flat IVC	23	76.7%
No hypotension+ Flat IVC	7	23.3%

Table 3: Proportion of Flat IVC among people with different solid organ injuries

Associated solid organ injury	Flat IVC (FIVC)		Fisher exact P value
	Present	Absent	
Splenic (N=16)	13 (81.25%)	3 (18.75%)	0.675
Liver (N=15)	12 (80%)	3 (20%)	1.00
Kidney (N=5)	3 (60%)	2 (40%)	0.565
Pancreatic(N=4)	3 (75%)	1 (25%)	1.00

Table 4: Proportion of hypotension among people with different solid organ injuries

Associated solid organ injury	Hypotension		Fisher exact P value
	Hypotension	No hypotension	
Splenic (N=16)	15 (93.75%)	1 (6.25%)	1.00
Liver (N=15)	14 (93.33%)	1 (6.67%)	1.00
Kidney (N=5)	5 (100%)	0 (0%)	**
Pancreatic(N=4)	4 (100%)	0 (0%)	**

Table 5: Comparison of associated organ injuries between flat IVC (FIVC) + hypotension

Associated solid organ injury	Flat IVC (FIVC) +Hypotension		Fisher exact P value
	Flat IVC (FIVC) +Hypotension	No Flat IVC (FIVC) +Hypotension	
Splenic (N=16)	13 (81.25%)	3 (18.75%)	0.675
Liver (N=15)	12 (80%)	3 (20%)	1.00
Kidney (N=5)	3 (60%)	2 (40%)	0.565
Pancreatic(N=4)	3 (75%)	1 (25%)	1.00

Table 6: Association between Flat IVC (FIVC) and hypotension

Flat IVC (FIVC)	Presence of Hypotension	
	Hypotension	No hypotension
Flat IVC	23 (82.14%)	0 (0%)
No flat IVC	5 (17.86%)	2 (100%)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 7: Predictive validity of Flat IVC (FIVC) in predicting hypotension

Parameter	Value	95% CI	
		Lower	Upper
Sensitivity	82.14%	63.11%	93.94%
Specificity	100.00%	15.81%	100.00%
False positive rate	0.00%	0.00%	84.19%
False negative rate	17.86%	6.06%	36.89%
Positive predictive value	100.00%	85.18%	100.00%
Negative predictive value	28.57%	3.67%	70.96%
Diagnostic accuracy	83.33%	65.28%	94.36%

Table 8: Descriptive analysis of combination of solid organ injuries in the study population

Combination Of Associated Organ Injuries (n=30	Frequency	Percentages
Splenic alone	10	33.3%
Liver alone	8	26.7%
Splenic +Liver	4	13.3%
Pancreatic alone	3	10.0%
Kidney alone	1	3.3%
Liver + Kidney	1	3.3%
Pancreatic +Kidney +Liver	1	3.3%
Splenic + Kidney	1	3.3%
Kidney + Splenic +Liver	1	3.3%

Table 9: Comparison of combination of associated organ injuries vs presences of hypotension

Combination of associated organ injuries (n=30)	Presence Of Hypotension	
	Hypotension	No hypotension
Splenic alone (N=10)	10 (100%)	0 (0%)
Liver alone(N=8)	7 (87.5%)	1 (12.5%)
Splenic +Liver(N=4)	4 (100%)	0 (0%)
Pancreatic alone(N=3)	3 (100%)	0 (0%)
Kidney alone (N=1)	1 (100%)	0 (0%)
Liver + Kidney (N=1)	1 (100%)	0 (0%)
Pancreatic +Kidney +Liver(N=1)	1 (100%)	0 (0%)
Splenic + Kidney(N=1)	0 (0%)	1 (100%)
Kidney + Splenic +Liver(N=1)	1 (100%)	0 (0%)

Table10: Comparison of combination of associated organ injuries between flat IVC (FIVC)

Combination of associated organ injuries(n=30)	Flat IVC (FIVC)	
	Flat IVC	No flat IVC
Splenic alone (N=10)	8 (80%)	2 (20%)
Liver alone(N=8)	6 (75%)	2 (25%)
Splenic +Liver(N=4)	4 (100%)	0 (0%)
Pancreatic alone(N=3)	2 (66.67%)	1 (33.33%)
Kidney alone (N=1)	1 (100%)	0 (0%)
Liver + Kidney (N=1)	0 (0%)	1 (100%)
Pancreatic +Kidney +Liver(N=1)	1 (100%)	0 (0%)
Splenic + Kidney(N=1)	0 (0%)	1 (100%)
Kidney + Splenic +Liver(N=1)	1 (100%)	0 (0%)

Table 11: Comparison of age and gender composition of RTA patients presenting with blunt abdominal trauma across different studies.

Studies	Age (in years)	Male
Bansod et al,[17]	21-40	87.4%
Srivastav et al,[16]	11-40	94%
Hemmati H et al,[19]	34.1 ± 1.68	88.2%
Costa G et al,[18]	38.7 ± 16.2	83.6%
Present study	21-40	70 %

DISCUSSION

Mortality and morbidity due to road accidents has been on the rise globally and also in India. Blunt abdominal trauma is one of the commonly encountered injuries among the victims of road traffic accidents.[14] These victims often may present with an apparently stable clinical picture, but tend to present with compromised hemodynamic status due to associated internal organ injuries. Although the vital signs such as blood pressure, pulse are routinely used to assess the hemodynamic stability inpatients, their ability to predict the severity of hemodynamic status is limited.[15] In these situations, the computer tomography scan of the abdomen with analysis of venous phase diameter of IVC has shown to guide the physician to predict the hemodynamic status more accurately.[12] Hence, in the present study we attempted to evaluate the independent predictive value of IVC diameter in the assessment of

ISSN (O): 2687-5365; ISSN (P): 2753-6556

hypotension among those with blunt abdominal trauma.

This study included 30 subjects with history of blunt abdominal injury with mean age of 26.93± 11.51 years for analysis. There was a strong male preponderance, as 83.3% of the study population were males. Higher male preponderance to road traffic injuries had been reported by multiple previous studies published on the subject. [16,17] Even the global studies have reported the predominant involvement of men in their second and third decades of life in road traffic accidents. [18,19]

Present study showed more percentage of male victims with blunt abdominal injury which is in comparison to other studies. Also, in comparison to other studies, present study had witnessed that mostly people of productive age group had encountered blunt abdominal injury which can have an impact on the individual and the national economic growth.

In the current study, major portion of the blunt abdominal injuries (96.7%) were due to road accidents and 3.3% were due to a fall. The relative contribution of road traffic accidents to the blunt abdominal trauma reported from many other hospital-based studies is similar to current study. Among the road traffic accident patients, blunt abdominal injury is more commonly reported compared to penetrating type. [18,20]

All the subjects included in the current study had involvement of at least one of the four solid organs i.e. liver, spleen, pancreas and kidney. Splenic injury was the most common solid organ involvement found in 53.3% of the subjects. Liver injury was found in 50%, 16.7% had kidney injury. Least commonly injured solid organ was pancreas in 13.3% of the subjects. Similar findings were observed by many previous studies published on the subject. [16,21,22] This illustrates that the blunt injury to the abdomen have greater chance of splenic organ injury compared to injury to the pancreas, liver and kidney. In contrast to this, a study by Solanki et al23 and Smith et al,[24] have recorded greater percentage of liver injury among the cases with blunt abdominal injury.

Among the splenic injury patients, 1(6.25%) had AAST grade I injury, 3(18.75%) had grade II, 6(37.5%) had grade III and 6(37.5%) had grade IV. The percentage of Grade II and Grade III (n=5, 33.33% each) injuries were higher among the liver injury patients. The percentage of grade III (n=2, 50%) injury was greater among patients with pancreatic injury compared to Grade II and IV (n=1, 25% each). Whereas, the percentage of grade I and II (n=2, 40% each) each injury was equal among patients with kidney involvement. In a study in Qatar in which many number of cases of blunt injury due to road accidents were registered, there was a greater percentage of grade I and III splenic injuries than grade IV.[25] Along with splenic injury, 67 (35.1%) patients also had involvement of other solid organs, such as the liver (19.9%), kidneys (17.8%), and pancreas (4.2%). Another study by Al-Qahtani et al,[26] reported greater proportion of grade IV/V blunt splenic injury (62%), followed by lower grades (I–III). Lower grades of blunt splenic injuries are ideally managed by non -operative methods of stabilising the patient's hemodynamic status , thereby improving the immune function and decreasing the post-operative complications. In cases with grade IV splenic injury, operative method of treatment was recorded to be successful. [27-29]

In the present study 90% of the blunt abdominal trauma patients (BAT patients had hemoperitoneum. Out of this 23.3% had minimal, 40% had mild and 26.7% had moderate hemoperitoneum. In a similar study by Srivastava SK et al,[16] who had studied blunt injury on 48 patients, only 8 patients had hemoperitoneum. In another study by Gupta S et al,[30] out of 63 patients studied, 40 (63%) had hemoperitoneum. Differences in the severity of injury and proportion of involvement of different solid organs etc. may be responsible for these differences in the proportion of hemoperitoneum across the studies.

In the present study, we aimed to find the predictive validity of IVC diameter along with grades of solid organ injury through CT scan so that the treating physicians could decide between non- surgical or surgical treatment of patients with blunt abdominal injury.

The ability of the IVC diameter in predicting hypovolemia, hemodynamic decline and the presence of blood loss were well recognized by earlier studies. [31-33] The flat inferior venacava (FIVC) defined by these studies were very subjective and the measurements of IVC diameter was from different anatomical positions. Few studies have proposed flat IVC as an indicator or predictor of mortality, but its independent association had not been established. [32,34] A retrospective study by Johnson et al,[12] attempted to establish an independent association of IVC diameter by adjusting the known confounders. The authors determined a cut off IVC ratio by using ROC analysis and area under the curve (AUC) analysis. This cut off values were used for diagnostic and prognostic purposes. Based on the analysis, FIVC was defined as an infra renal transverse to AP IVC ratio of >1.9 and that <1.9 were labelled to be non FIVC.

In our study we used the ratio of IVC proposed by Johnson et al,[12] to define flat IVC. This was because this study analysed amongst the other anatomic location of IVC (intra hepatic IVC or IVC near renal vein) with hypo perfusion markers. (Haemoglobin, bicarbonates, creatinine, base excess). With AUC analysis both sensitivity and specificity of IVC diameter in predicting death was highest at the ratio of 1.9.

In the current study, the mean Antero posterior (AP) IVC diameter in cms was 1.25 ± 0.34 ranging from 0.76 to 1.89. The mean IVC Diameter- Transverse (T) in cms was 2.69 ± 0.5 ranging from 1.62 to 3.50. The mean IVC Diameter Ratio T: AP was 2.22 ± 0.34 cms, ranging from 1.46 to 2.90 cms in the study population.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

The mean systolic blood pressure was 91.4 ± 11.57 mm of Hg. Minimum level of systolic BP was 80 mm of Hg and maximum was 120 mm of Hg. The mean diastolic blood pressure was 63.13 ± 9.24 mm of Hg. Minimum level of diastolic BP was 50 mm of Hg and maximum was 90 mm of Hg. Hypotension was seen in 23(76.7%) patients and flat IVC was present in 23 (82.14%) patients. All patients who had hypotension had FIVC.

In our study majority of patients who had (n=16, 53.3%) splenic injury, had flat IVC (n=12, 80%), whereas hypotension was recorded in 14 (93.8%). Among patients (n=15, 50%) with liver injury, 12(80 %) of them had flat IVC and 14 (93.8%) of them had reported hypotension. Among patients (n=4, 16.7%) with pancreatic injury, all of them had presented with flat IVC and hypotension. Among patients (n=5, 16.7%) with kidney injury, 4(80%) had flat IVC and 5 (100%) of them had reported to have hypotension. A similar study by Bhagavat et al,[22] evaluated 25 cases of blunt abdominal trauma, where 40 % of patients had hemoperitoneum. Majority of the patients (56%) had splenic injury, of which 10 % of them had FIVC. Among the liver injury (25 %) patients 20 % had FIVC and among of renal injury (20%) patients, 5% of them had FIVC. Our study findings in were in comparison to Bhagavat et al22 study.

Flat IVC had sensitivity of 82.14% (95% CI 63.11% to 93.94%), specificity of 100.00% (95 CI 15.81% to 100%), positive predictive value of 100.00% (95 CI 85.18% to 100%), negative predictive value of 28.57% (95 CI 3.67%to 70.96%), and the total diagnostic accuracy of 83.33%. The utility of flat IVC in predicting the hypotension has been studied by very few studies in the past. In a study, the predictive value of IVC diameter was studied during blood donation. The diameter of IVC reduced after blood donation and inference was made by this study that measurement of IVC diameter would be helpful in an acute blood loss situation.[35] Similarly, in another study, the trauma patients who presented with a flat IVC were at 2.87 times greater risk of developing occult shock and at 2.26 times higher risk of developing complications compared to those who had a normal IVC diameter.36 The sensitivity and specificity of Flat IVC in the present study recommends the use of IVC diameter measurements among the trauma and acute blood loss victims. Hence, the diameter of IVC on computer tomography could predict hypotension among majority of patients with blunt abdominal trauma.

CONCLUSION

This cross-sectional study of 30 subjects with blunt abdominal injury had greater predisposition among males. Blunt type of injury was mostly encountered in road accidents. Increased incidence of blunt injury was noted among 11-40 years of age group. Among all the patients, who had organ injury majority had splenic injury followed by liver, pancreas and kidney. Minimal hemoperitoneum was recorded among the study population. Patients who had splenic injury had flat IVC in 93.98% and hypotension in 75% of them. Patients with liver injury had flat IVC in 73.3% and all of them had hypotension. All the Patients who had pancreatic injury, had both flat IVC and hypotension. Patients with kidney injury had flat IVC in 80 % and all of them had recorded hypotension. Flat IVC had a sensitivity of 82.14% (95% CI 63.11% to 93.94%), specificity of 100.00% (95 CI 15.81% to 100%); Hence, flat IVC on CT could be of value in predicting hypotension among blunt abdominal trauma patients. Perhaps, this finding could serve the treating physician as an aid in early diagnosis and management to prevent mortality in such patients.

Limitations And Recommendation

As the study was a cross-sectional study, the follow up of the patients was limited due to the study design. Due to a small sample size, the external validity of the present study limits generalisation of the study findings and hence, further large longitudinal cohort studies are required to validate our findings.

The primary health care centres in India are deficient in sophisticated diagnostic aids, especially CT scan equipment etc. and hence the value of flat IVC cannot be assessed in such situations.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556