ORIGINAL RESEARCH PAPER

Volume-7 | Issue-4 | April-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

AN OBSERVATIONAL STUDY ON THE INCIDENCE MECHANISM, DIAGNOSIS AND MANAGEMENT OF SMALL BOWEL AND MESENTERIC INJURIES IN BLUNT ABDOMINAL TRAUMA.

General Surgery

Sreerag S.R Senior Resident, Department Of General Surgery, Government Medical College, Trivandrum, Kerala, India. 695011.

Santhosh Kumar S* Associate Professor, Department Of General Surgery, Government Medical College, Trivandrum, Kerala, India. *Corresponding Author

Unnikrishnan G Associate Professor, Department Of General Surgery, Government Medical College, Trivandrum, Kerala, India.

ABSTRACT

BACKGROUND Blunt abdominal trauma is a leading cause of morbidity and mortality among all age groups. Identification of serious intra-abdominal pathology is often challenging. Whatever the mechanism, early recognition of these lesions can be difficult. Intestinal disruption can be due to a variety of types of blunt trauma, with automobile being the most common. Diagnostic tools include ultrasonography (US), diagnostic peritoneal lavage (DPL), computed tomography (CT) and diagnostic laparoscopy (DL). Exploratory laparotomy, drainage of septic peritoneal fluid and wound saline lavage are the treatment of choice.

OBJECTIVES

1. The incidence of small bowel and mesenteric injuries in relation to blunt trauma abdomen
2. To evaluate the various diagnostic methods used in diagnosis of small bowel injuries.
3. To undertake a study of the operative procedures and their morbidity in the treatment of small bowel injuries

RESULTS AND CONCLUSION The majority of cases of blunt abdominal trauma occur in the economically productive age group of 31-40(37.3%).The etiological factor in 68.5% of cases of blunt abdominal trauma was automobile accidents.There was an overwhelming male preponderance of 80% in the victims of blunt abdominal trauma. The time interval between occurrence of the injury and admission to hospital was within 24 hours(over 90%). Incidence of small bowel and mesenteric injuries in blunt abdominal trauma was found to be 41% of cases undergoing laparotomy. Plain x-ray abdomen combined with repeated clinical examination could diagnose the small bowel injury in 80% of cases.
Primary closure of small bowel injury was done in 53.3% of cases whereas resection and end to end anastomosis was done in 26.7% cases.Wound infection occurred in 53.3 % of cases whereas anastomotic leak occurred in 13.3% cases.

KEYWORDS

Blunt abdominal trauma, small bowel, and mesentery

INTRODUCTION

Injury has been man's constant companion since the earliest times. The first recorded medical text, the Smith Papyrus (written over 5000 years ago) has an account of 48 different injuries described from head downwards.

Modem trauma care has increased in sophistication all the time, but despite its huge importance trauma has been called 'the neglected disease of modem society'.

Injury is the commonest cause of death among people aged 1-34 years, a leading cause of disability and a major contributor to health costs. WHO data suggest that 1 in 10 deaths worldwide is the result of injury.

The majority of deaths from injury occur in economically productive persons aged 14-44 years and the male to female ratio of deaths from injury is 2:1.Deaths from injury are predicted to rise by 65% by the year 2020 ,by which time road traffic accidents will be the third most important cause of death world wide and the second most important cause in developing nations.[1]

The economic burden of road traffic accidents is very high. The American National Highway traffic safety administrations has calculated that for each person killed in a Motor Vehicle accident(MVA) 45 require emergency department treatment and nine require hospital admission.

Blunt abdominal trauma (BAT) most often results from a motor vehicle crash (MVC), and such incidents, combined with pedestrian versus automobile collisions, account for over 75 percent of cases. Blows to the abdomen and falls are responsible for 15 and 6 to 9 percent, respectively *. Occult BAT may occur with child abuse and domestic violence.

Globally injury accounts for 10% of all deaths. Estimates indicate that by 2020 ,8.4 million people will die yearly from injury and injuries from traffic collisions will be the third most common cause of disability world wide and 2nd most common cause in the developing world.

Blunt abdominal trauma most often results in injury to the spleen, which in over 60 percent of cases is the only damaged intraperitoneal structure [1,2]. The liver and kidney can also be injured. Less commonly, hollow viscus injury may occur.[2]

Annan in 1837 reported the first case of intestinal rupture secondary to blunt trauma in America.[3]It has been observed in earlier studies that these injuries are seen in the younger age groups and usually occur due to road traffic accidents.[2]

Small bowel and mesenteric injuries are relatively uncommon being found in approximately 3-5% of patients undergoing laparotomy for blunt abdominal trauma. Small bowel perforation after blunt abdominal trauma is a rare condition (0.3% of blunt trauma admissions), the vast majority is caused by motor vehicle accidents, handle bar injury and falls.[4]

Small bowel and mesenteric injuries are difficult to diagnose both clinically and by imaging studies. Clinical signs of bowel injury such as abdominal tenderness, rigidity and diminished bowel sounds are present in < 50 % of patients.[4]

MATERIALS AND METHODS

STUDY DESIGN- Descriptive study

STUDY SETTING:
Department of General Surgery, Govt. Medical College Thiruvanan thapuram.

STUDY POPULATION:
Patients admitted in surgical wards of Govt. Medical College Thiruvananthapuram with a history of blunt abdominal trauma who are undergoing laparotomy

INCLUSION CRITERIA
All patients admitted with history of blunt trauma abdomen who

underwent laparotomy who gave consent for participating in the study.

EXCLUSION CRITERIA
Those who did not give consent for the study.

SAMPLE SIZE
Every consecutive patient eligible for study is included.

SAMPLING TECHNIQUE
No random samples axe taken. Every consecutive patient eligible for study is included

DATA COLLECTION
Data will be collected using a semi structured questionnaire based interview, clinical examination, lab investigations and intraoperative findings

ETHICAL CONSIDERATIONS
Institutional ethical committee clearance will be obtained before starting the study.

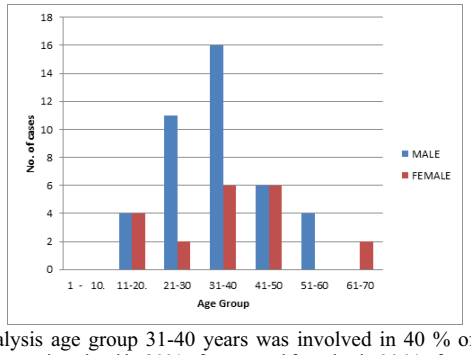
Written informed consent will be obtained from all patients participating in the study.

OBSERVATION AND RESULTS

Table 1 Age And Sex Incidence In Blunt Abdominal Trauma (Total Cases-51)

AGE GROUP RANGE	MALE No.	MALE %	FEMALE No	FEMALE %	TOTAL
1-10	0	O	O	*O*	O
11-20	4	7.8	2	*4*	6
21-30	11	21.5	1	*2*	12
31-40	16	31.3	3	*6*	19
41-50	6	11.7	3	*6*	9
51-60	*4*	7.8	0	0	4
61-70	0	0	1	2	1
	41	80%	10	20%	51

(Diagram I) Age And Sex Incidence In Blunt Abdominal Trauma



On analysis age group 31-40 years was involved in 40 % of cases .Males were involved in 80% of cases and females in 20 % of cases.

Diagram 2
Sex Distribution

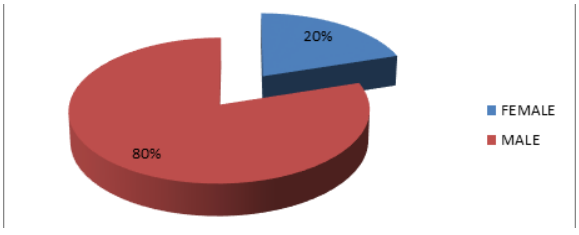
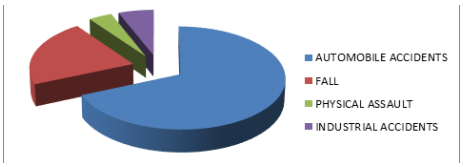


Table 2 Causative Factors Of Blunt Abdominal Trauma

CAUSATIVE FACTORS	NO OF CASES	PERCENTAGE
Automobile accidents	**35**	**68.5**
Fall	**11**	**21.5**
Physical assault	**2**	**4.0**
Industrial accidents	**3**	**6**
Total	**51**	**100**

Diagram 3 Causative Factors Of Blunt Abnorminal Trauma

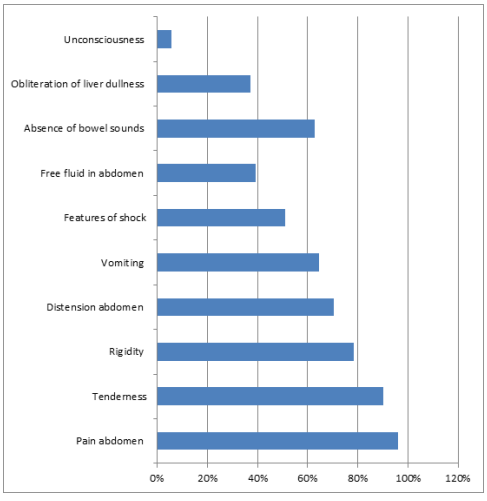


In the present series 68.5% of injuries were caused by automobile accidents, 21.5% of cases had abdominal trauma due to fall. Industrial accidents accounted for 6% of cases only 4% had physical assault as offending agent.

Table 3 Relative Incidence Of Clinical Features (Total Cases – 51)

CLINICAL FEATURES	NO OF CASES	PERCENTAGE
Pain abdomen	**49**	**96**
Tenderness	**46**	**90**
Rigidity	**40**	**78.4**
Distension abdomen	**36**	**70.5**
Vomiting	**33**	**64.7**
Features of shock	**26**	**51**
Free fluid in abdomen	**20**	**39.2**
Absence of bowel sounds	**32**	**62.7**
Obliteration of liver dullness	**19**	**37.2**
Unconsciousness	**3**	**5.8**

Diagram 4 Relative Incidence Of Clinical Features

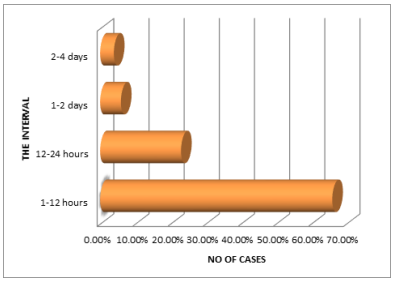


Pain and tenderness were the features in more than 90% of cases. Rigidity was found in 78.4% of cases whereas distension of abdomen was found in 70.5% of cases.

Table 4 Interval Between Occurrence Of Injury And Admission To The Hospital

TIME INTERVAL	NO OF CASES	PERCENTAGE
1-12 HOURS	**34**	**66.7**
12-24 HOURS	**12**	**23.5**
1-2 DAYS	**3**	**5.9**
2-4 DAYS	**2**	**3.9**
TOTAL	**51**	**100**

Diagram 5 Interval Between Occurrence Of Injury And Admission To The Hospital

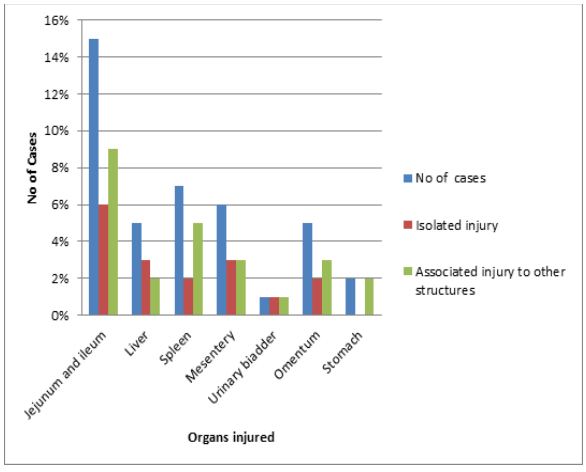


In present study it was found that most patients (more than 90%) presented themselves with the symptoms within 24 hours of injury. Immediate admission (within 12 hours) was 66.7%.

Table 5 Analusis Of Intraabdominal Organs Injuries

ORGAN INJURED	NO OF CASES	ISOLATED INJURY	ASSOCIATED INJURY TO OTHER STRUCTURES
JEJUNUM AND ILEUM	15	6	9
LIVER	5	3	2
SPLEEN	7	2	5
MESENTERY	6	3	3
URINARY BIADDER	1	1	1
OMENTUM	5	2	3
STOMACH	2	0	2

Diagram 6 Analusis Of Intraabdominal Organs Injuries



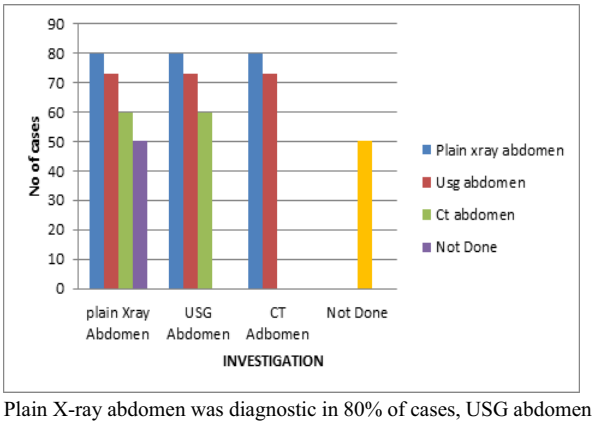
Analysis of different intraabdominal organs injured revealed small bowel (jejumunm and likeum) to be the most common organ injured. The injury was associated with other organ injuries in 9 cases out of a total 15 cases.

Injuries to the mesentery was observed in 6 cases. 3 of them were associated with other injuries.

Table 6 Investigations Done As Aids To Diagnosis

INVESTIGATION	POSITIVE RESULT	TOTAL NO OF CASES	PERCENTAGE
PLAIN XRAY ABDOMEN	12	15	80
USG ABDOMEN	11	15	73.3
CT ABDOMEN	12	15	80

Diagrom 12
Investigations Done As Aids To Diagnosis

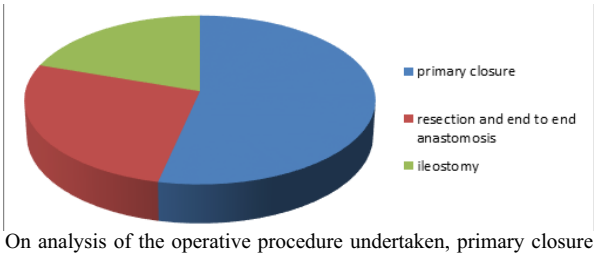


Plain X-ray abdomen was diagnostic in 80% of cases, USG abdomen was diagnostic in 73.3% of cases, CT scan could not be done in 3 cases.

Table 7 Analysis Of Operative Procedure Undertaken

NAME OF PROCEDURE	NO OF CASES	PERCENTAGE
PRIMARY CLOSURE	8	53.3
RESECTION AND END TO END ANASTOMOSIS	4	26.7
ILEOSTOMY	3	20
TOTAL	15	100

Diagram 13
Analysis Of Operative Procedure Undertaken

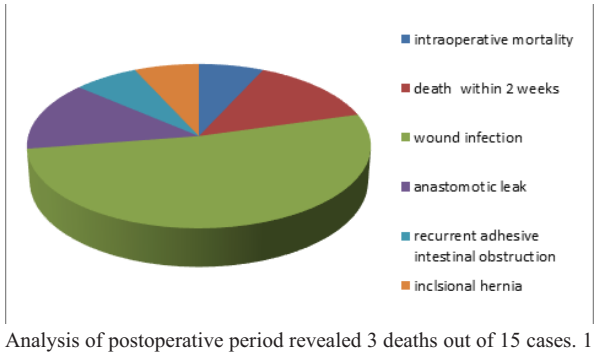


On analysis of the operative procedure undertaken, primary closure was done in 53.3% of cases whereas 26.7% of cases required resection and end to end anastomosis. Only 3 cases out of 15 (20%) required ileostomy as a temporary diversion procedure.

Table 8
Post Operative Complication

POST OPERATIVE COMPLICATIONS	NO OF CASES	PERCENTAGE
INTRAOPERATIVE MORTALITY	1	6.7
DEATH WITHIN 2 WEEKS	2	13.3
WOUND INFECTION	8	53.3
ANASTOMOTIC LEAK	2	13.3
RECURRENT ADHESIVE INTESTINAL OBSTRUCTION	1	6.7
INCLSIONAL HERNIA	1	6.7

Diagram 17
Post Operative Complication



Analysis of postoperative period revealed 3 deaths out of 15 cases. 1 death occurred intraoperatively whereas the rest was in 2 week follow up period following laparotomy. Wound infection occur5ed in 53.3% of patients. Anastomotic leak occurred in 13.3% of cases, Recurrent adhesive intestinal obstruction occur5ed in 6.7% of cases.

DISCUSSION

An evaluation of the incidence,age distribution, causative factors of blunt abdominal trauma and time from injury to presentation was done in this present study with special reference to small bowel and mesenteric injuries.In this study On analysis age group 31-40 years was involved in 37% of cases (19 out of 51 cases).This is similar to the finding of mean age group of 34 years as seen by Celeen N.W, Hesse.U et al(Acta Chirugica Belgica 95(4 suppl.),1995).

The results also compared favorably with the mean age 39+/- 15 years as reported by Kinin. N, Letoquart JP,et al (Journal de chirugie,1994 march).

The age group 31-40 seems to be the most affected in blunt abdominal trauma. This may be due to the extensive travel undertaken by this economically productive age group.

There was an unmistakable male preponderance in most of the cases of blunt abdominal trauma. Out of a total of 51 cases 80 % were males. This observation is in accordance with observation made by Ceelen W.et al (Acta Chirugica Belgica 1995).The high incidence of blunt abdominal injuries in males may be due to their higher outdoor activities.

In the analysis of causative factors of blunt abdominal trauma automobile accidents predominated with an incidence of 35 cases out Of 51(68.5%), ,21.5 % of cases had blunt abdominal trauma due to fall .industrial accidents accounted for 6 % of cases only 4 % had physical assault as offending agent. This observation was in agreement with the observation made by CELEEN. W, Hesse.U et al(Acta Chirugica Belgica 95(4 suppl.),1995). Where in they reported 81 % of cases to be due to road traffic accidents. Automobile accidents are increasing in incidence as causative factors in blunt abdominal trauma.

While analyzing the time interval between occurrence of the injury and admission to the hospital,it was found that found that most patients (more than 90%)presented themselves with the symptoms within 24 hours of injury.Immediate admission (within 12 hours) was 66.7%.This is in accordance with report of Xeropotamos N S,Nousias,Irannou HV,Kappas H.M in the European journal of surgery,2001 ,Feb.

In a study conducted by Bloom A C,Rivkind A,Zamir G,Gross E,Kluger .Y . early diagnosis (within 6 hours)was done in 56 % of patients suspected of having small bowel and mesenteric injury after blunt abdominal trauma.They advise the necessity of diagnosing bowel and mesenteric injuries as early as possible since delayed diagnosis results in increased morbidity and hospital stay.

The small bowel (jejunum and ileum)was found to be injured in 15 out of total 51 cases studied. small bowel injury was associated with other injuries mostly mesenteric injuries. Mesenteric injuries was found in 6 out of 51 cases (11%) which is in accordance with study done by Stuart E. Mirivis, Gens D.R, Shnagumuganathan-rupture of the bowel with blunt abdominal trauma where they reported 8 % incidence.

Discussing the investigation used in blunt abdominal trauma plain X-RAY abdomen in erect posture could clinch the diagnosis in 80 % cases.USG abdomen was diagnostic in 73.3% of cases. CT scan was diagnostic in 80 % of cases ,CT scan could not be done in 3 cases.Plain X-ray abdomen is invaluable in the diagnostic workup of blunt abdominal trauma patients.lt can demonstrate ruptured hemidiaphragm, pneumoperitoneum,fractures of thoracolumbar spine, transverse fractures of the vertebral bodies i.e chance fractures (suggesting a higher likelihood of blunt injuries to the bowel.)[46]

Similarly abdominal ultrasonography is also an invaluable tool for the diagnosis of blunt abdominal trauma. CT scan has emerged as a promising new modality. A survey conducted among trauma surgeons of the American association for the surgery of trauma(AAST) revealed that 75 % of surgeons used CT scan most or all of the time in patients with a possible diagnosis of small bowel injury. Intraperitoneal free fluid, pneumoperitoneum, direct tear in the bowel wall, bowel wall thickening bowel wall enhancement were all CT signs of bowel and mesenteric **injury (45.,46)**

The surgical treatment modality adopted undertaken, primary closure was done in53.3 % of cases whereas 26.7 % of cases required resection and end to end anastomosis.

Only 3 cases out of 15 (20%)required ileostomy as a temporary diversion procedure.

On analysis of intraoperatve and post operative complications there were 3 deaths out of 15 cases. 1 Death occured intraoperatively whereas the rest was in 2 week follow up period following laparotomy. Wound infection occured in 53.3% of patients. Anastomotic leak occured in 13.3 % of cases, Recurrent adhesive intestinal obstruction occured in 6.7 % of cases. In the study by Ceelen W,Hesse li, De Hemptinne B,(Acta Chirugica Belgica, 1995) there was only one death which was due to ARDS and sepsis syndrome.In another study by Xeropotamos, Nousias VE, Ioannoou HV,Kappas AM,(European journal of surgery,2001 Feb)no deaths were reported out of a total of 31 patients.

Wound infection occured in 53.3% of patients.. Xeropotamos, Nousias VE Ioannoou HV, Kappas AM (European journal OF surgery2001)reported 19 % incidence of wound infection Anastomotic leak occured in 13.3 % of cases,Recurrent adhesive intestinal obstruction occured in 6.7 % of cases.De Backer ,De Schapper AM,Vanudeberg W,Palckmans P(European Radiology, 1999)also report a case of blunt abdominal trauma with mesenteric injury presenting late with ischaemic stricture of small bowel.Incisional hernia occured at a rate of 6.7%,in this present study.

Limitations of study

The patients were followed up only for a limited period of time and hence the rates of complications mentioned may be an underestimation.

SUMMARY AND CONCLUSION

This study was undertaken in the department of surgery, Medica College, Thiruvananthapuram and evaluated the cases of blunt abdominal trauma with special reference to small bowel and mesenteric injuries.

The majority of cases of blunt abdominal trauma occur in the economically productive age group of 31 -40(37.3%)

The etiological factor in 68.5% of cases of blunt abdominal trauma was automobile accidents. There was an overwhelming male preponderance of 80% in the victims of blunt abdominal trauma The time interval between occurrence of the injury and admission to hospital was within 24 hours(over 90%) Incidence of small bowel and mesenteric injuries in blunt abdominal trauma was found to be 41% of cases undergoing laparotomy.

Wound infection occurred in 53.3 % of cases whereas anastomotic leak occurred in 13.3% cases. Recurrent adhesive intestinal obstruction and incision hernia occurred in 6.7% cases.

REFERENCES

1. Davis, JJ, Cohn, I Jr, Nance, FC. Diagnosis and management of blunt abdominal trauma. Ann Surg 1976; 183:672. Marx, JA, Isenhour, JL. Abdominal Trauma. In: Emergency Medicine Concepts and Clinical Practice, 6th ed, Marx, JA (Ed), Elsevier 2006.
2. Newgard, CD, Lewis, RJ, Kraus, JF. Steering wheel deformity and serious thoracic or abdominal injury among drivers and passengers involved in motor vehicle crashes. Ann Emerg Med 2005; 45:43.
3. Dauterive AH, Flancbaum L, Cox EF. Blunt intestinal trauma. A modem day review. Ann Surg 1985; 201:198-203.
4. S.M. Fakhry, M. Brownstein, D.D. Watts, C.C. Baker, D. Oiler, Relatively shortdiagnostic delays (<8hours) produce morbidity and mortality in blunt small bowel injury: an analysis of time to operative intervention in 198 patients from a multicenter experience, J. Trauma 48 (3) (2000) 408-414, Discussion 14—5.
5. .RJ Last-The Abdomen Anatomy regional and applied 6th edition.pg.268,1978.
6. Watts DD, Fakhry SM. Incidence of hollow viscus injury in blunt trauma: an analysis from 275, 557 trauma admissions from the East multi-institutional trial. J Trauma 2003;54(2):289-94. [CrossRefl [Pubmed],
7. Imtiaz Wani, Rayees A Bhat, Shayiq Wani, Nawab Khan, Rauf A Wani, Fazal Q Parray. Isolated Small Bowel Mesentery Injury After Steering Wheel Trauma. Trauma Mon 2012;17(2):279-81.
8. Killeen KL, Shanmuganathan K, Poletti PA, Cooper C, Mirvis SE. Helical computed tomography of bowel and mesenteric injuries. J Trauma 2001 Jul;51(l):26-36.
9. A.L.J. Jahromi, M.Y. Asser, Delayed small bowel perforation following blunt abdominal trauma: a case report and review of the literature, Asian J. Surg. (2013) 1-4
10. Rodriguez A, DuPriest RW Jr., Shatney CH: Recognition of intra-abdominal injury in blunt trauma victims. A prospective study comparing physical examination with peritoneal lavage. Am Surg 48: 457-459,1982.
11. Schurink GW, Bode PJ, van Luijt PA, et al: The value of physical examination in the diagnosis of patients with blunt abdominal trauma: a retrospective study. Injury 28: 261— 265,1997.
12. Branney SW, Moore EE, Cantrill SV, et al: Ultrasound based key clinical pathway reduces the use of hospital resources for the evaluation of blunt abdominal trauma. J Trauma 42: 1086-1090, 1997.
13. Healey MA, Simons RK, Winchell RJ, et al: A prospective evaluation of abdominal ultrasound in blunt trauma: Is it useful? J Trauma 40: 875-883, 1996.
14. Glaser K, Tschmelitsch J, Klingler P, et al: Ultrasonography in the management of blunt abdominal and thoracic trauma. Arch Surg 129: 743-747, 1994.
15. Liu M, Lee CH, P'eng FK: Prospective comparison of diagnostic peritoneal lavage, computed tomographic scanning, and ultrasonography for the diagnosis of blunt abdominal trauma. J Trauma 35: 267-270, 1993.
16. Boulanger BR, McLellan BA, Brenneman FD, et al: Emergent abdominal sonography as a screening test in a new diagnostic algorithm for blunt trauma. J Trauma 40: 867-874, 1996.
17. Boulanger BR, Brenneman FD, McLellan BA, et al: A prospective study of emergent abdominal sonography after blunt trauma. J Trauma 39: 325-330, 1995.
18. Ma OJ, Kefer MP, Mateer JR, et al: Evaluation of hemoperitoneum using a singlevs. multiple-view ultrasonographic examination. Acad EmergMed 2: 581-586, 1995.
19. Branney SW, Wolfe RE, Moore EE, et al: Quantitative sensitivity of ultrasound in detecting free intraperitoneal fluid. J Trauma 39: 375-380, 1995.
20. Sherboume CD, Shanmuganathan K, Mirvis SE, et al: Visceral injury without hemoperitoneum: a limitation of screening abdominal songography for trauma. Emerg Radiol 4: 349-354, 1997.
21. Tso P, Rodriguez A, Cooper C: Sonography in blunt abdominal trauma: a preliminary progress report .J Trauma 33: 39-44, 1992.
22. Buzzas GR, Kern SJ, Smith RS, et al: A comparison of sonographic examinations for trauma performed by surgeons and radiologists. J Trauma 44: 604—608, 1998.

23. Smith SR, Kern SJ, Fry WR, et al: Institutional learning curve of surgeon-performed trauma ultrasound. Arch Surg 133: 530-536, 1998.
24. McKenney MG, Martin L, Lentz K, et al: 1000 consecutive ultrasounds for blunt abdominal trauma. J Trauma 40: 607-612, 1996.
25. McKenney KL, McKenney MG, Nunez DB, et al: Cost reduction using ultrasound in blunt abdominal trauma. Emerg Radiol 4: 3-6, 1997.
26. Kimura A, Otsuka T: Emergency center ultrasonography in the evaluation of hemoperitoneum: A prospective study. J Trauma 31: 20-23, 1991.
27. Gruessner R, Mentges B, Duber C, et al: Sonography versus peritoneal lavage in blunt abdominal trauma. J Trauma 29: 242-244, 1989.
28. Rothlin MA, Naf R, Amgwerd M, et al: Ultrasound in blunt abdominal and thoracic trauma. J Trauma 34: 488-495, 1993.
29. Kern SJ, Smith RS, Fry WR, et al: Sonographic examination of abdominal trauma by senior surgical residents. Am Surg 63: 669-674, 1997.
30. Rozycki GS, Ochsner MG, Schmidt JA, et al: A prospective study of surgeon-performed ultrasound as the primary adjuvant modality for injured patient assessment. J Trauma 39: 492-500, 1995.
31. PeitzmanAB, Makaroun MS, Slasky BS, et al: Prospective study of computed tomography in initial management of blunt abdominal trauma. J Trauma 26: 585-592, 1986.
32. Webster VJ: Abdominal trauma: Pre-operative assessment and postoperative problems in intensive care. Anaest Int Care 13: 258-262, 1985.
33. Lang EK: Intra-abdominal and retroperitoneal organ injuries diagnosed on dynamic computed tomograms obtained for assessment of renal trauma. J Trauma 30: 1161-1168, 1990.
34. Matsubara TK, Fong HM, Bums CM: Computed tomography of abdomen (CTA) in management of blunt abdominal trauma. J Trauma 30: 410-414, 1990
35. Livingston DH, Lavery RF, Passannante MR, et al: Admission or observation is not necessary after a negative abdominal computed tomographic scan in patients with suspected blunt abdominal trauma: Results of a prospective, multi-institutional trial. J Trauma 44: 272-282, 1998.
36. Nolan BW, Gabram SG, Schwartz RJ, et al: Mesenteric injury from blunt abdominal trauma. Am Surg 61: 501-506, 1995.
37. Kane NM, Dorftnan GS, Cronan JJ: Efficacy of CT following peritoneal lavage in abdominal trauma. J Comp Asst Tomo 11: 998-1002, 1987.
38. Ceraldi CM, Waxman K: Computerized tomography as an indicator of isolated mesenteric injury. A comparison with peritoneal lavage. Am Surg 56: 806-810, 1990.
39. Nolan BW, Gabram SG, Schwartz RJ, et al: Mesenteric injury from blunt abdominal trauma. Am Surg 61: 501-506, 1995.
40. Lang EK: Intra-abdominal and retroperitoneal organ injuries diagnosed on dynamic computed tomograms obtained for assessment of renal trauma. J Trauma 30: 1161-1168, 1990.
41. Kane NM, Dorftnan GS, Cronan JJ: Efficacy of CT following peritoneal lavage in abdominal trauma. J Comp Asst Tomo 11: 998-1002, 1987.
42. Berci G, Sackier JM, Paz-Partlow M: Emergency laparoscopy. Am J Surg 161: 332335, 1991.
43. Ward RE: Study and management of blunt trauma in the immediate post-impact period. Rad Clin NA 19: 3-7, 1981.
44. Liu M, Lee CH, P'eng FK: Prospective comparison of diagnostic peritoneal lavage, computed tomographic scanning, and ultrasonography for the diagnosis of blunt abdominal trauma. J Trauma 35: 267-270, 1993.
45. Boulanger BR, Brenneman FD, McLellan BA, et al: A prospective study of emergent abdominal sonography after blunt trauma. J Trauma 39: 325-330, 1995.
46. johnudeani ,MD,Hermenegildo P Ocampo Jr ,Sidney R Steinberg MD,Journal of emergency medicine 2004.
47. Sabiston's text book of surgery 19th edition page no 455,456,457,462,464,465.
48. Schwartz's principles of surgery 10 th edition page no 207,208,209