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Penetrating Injury Abdomen, it's Incidence and Uses of Newer Diagnostic Modalities in Selective Conservatism-A Prospective Study

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ABSTRACT

INTRODUCTION-previously surgeons used to go for exploratory laparotomy for all penetrating abdominal trauma, recent trend has changed for "selective conservatism" in stable patients [(1,2)]. In this study we used modern diagnostic modalities like FAST (focused assisted abdominal sonography), Diagnostic lap, diagnostic peritoneal lavage, CT scan in early diagnosis & management.

MATERIALS AND METHOD- It was a prospective observational study in Surgery dept of VIMSAR Burla. from Nov 2016 to April 2018 including penetrating injury abdomen with fascial breech cases were subjected for selective conservatism with availing all newer diagnostic investigations like DPL FAST,CT, DL etc. Patients brought dead, LAMA and lost to follow up were excluded. Primary outcomes were studied on basis of intra-abdominal abscess, wound infection, wound dehiscence and mortality with a follow up period of 6 months.

RESULTS- out of total 267 abdominal trauma cases penetrating injury cases were 88, among them 31 cases had gone for selective conservatism & in rest 57 cases we did immediate laparotomy(<2hr) for 7 cases, early laparotomy(2-6) for 37 cases & in rest 13 cases delayed laparotomy(>6hr) is done. Outcome of the study is measured by post op morbidity like intra-abdominal abscess, wound infection/dehiscence, septicemia & death. Out of 88 cases, 11 cases died constituting a mortality rate 12.5%, 9 patients had intra-abdominal abscess (10.22%), followed by 4 cases of wound infection/dehiscence (4%).

CONCLUSION- selective conservatism can be tried in hemodynamically stable patient instead of doing a negative laparotomy and giving patient a burden of surgery.

Keywords: selective conservatism, FAST, DPL, DIAGNOSTIC LAPAROSCOPY

INTRODUCTION

Until late 19th century, when **sims** & others began recommending intervention in penetrating abdominal trauma, it used to be managed expectantly with rest, dressings, blood transfusion & opioids with high mortality rates [1]. **Shafton and Nance**'s landmark articles, which emphasized surgical judgment in the management of penetrating wounds of the abdomen, changed the approach to penetrating abdominal injuries from mandatory celiotomy to a more selective management. [(2,3)]

Previously surgeons used to go for exploration for all penetrating abdominal trauma, recent trend has changed to selective watch full conservative approach in stable patients without any signs of peritonitis or diffuse abdominal tenderness or evisceration, which helps in minimizing negative laparotomy. Incidence of unnecessary laparotomy range from 23%-53% in penetrating abdominal injuries & 5.3%-27% for gunshot injuries[{2,4,5-7)].Complication develops in 2.5-4.1% of all trauma undergoing unnecessary laparotomy.[(4-7)] Selective conservative approach is tried to get rid of unnecessary laparotomy which will reduce unnecessary burden of health. This approach mostly applied for low velocity stab injuries, can also be

applied for other type low impact injuries even in short gun injuries.

Abdomen is the third most commonly affected region of body in trauma. In penetrating injury anatomical site of injury & mode decides which organ to be involved & the severity of injury. Among solid organ injury liver is the most common organ to be involved followed by spleen, where as in hollow organs small intestine tops the list followed by colon & Stomach. Abdominal penetrating trauma includes sharp objects damage (stab wound) and gunshot damage (gunshot wound). It is more common in men than women due to more involvement tin act of violence, exposure to sharp objects due to their occupational exposure. Stab injury is the most common mode of penetrating injury mostly done by knife/gupti. In stab injury the size, sharpness of weapon, velocity, direction of impact decide the severity of injury. Brief history taking, followed by documentation for medico legal registration is must.

Diagnostic peritoneal lavage:

Developed by **David Root** in 1965, was a major advance in the care of the hemodynamically labile patient who sustained blunt trauma.[8,11,12]With the advent of FAST and rapid CT, DPL has very limited utility. Although some have advocated its use with **tangential wounds of the abdominal wall**, the technique has failed to receive widespread support, with sensitivity and specificity 59–96% and 78–98% respectively in penetrating injury.[14]DPL is a **poor** diagnostic modality with little risk for detecting **diaphragmatic and retroperitoneal injuries.**A gastric tube is placed to empty the stomach and a urinary catheter is inserted to drain the bladder. A cannula is inserted below the umbilicus, directed caudally and posteriorly.

Standard criteria for positive DPL:

1. At least 10 ml of gross blood, a bloody lavage effluent,
2. Red blood cell count >100,000/mm
3. White blood cell count >500/mm,
4. Amylase level greater than75 IU/dl,
5. Detection of bile, bacteria, or food particles.

Indications:1.Equivocal physical examination, **2** Unexplained shock or hypotension**, 3.**penetrating injury with altered sensorium ,other injuries like head injury ,Cord injury, **4.**If general anesthesia has to be given for other extra-abdominal procedures

Contraindications: Previously operated, Pregnancy, Obesity

DPL is highly sensitive to the presence of intra peritoneal blood (97–98%); however, its specificity is low, which leads to significant number of non-therapeutic laparotomy (10-15 %), has largely been replaced by FAST. So a negative DPL is often more useful than a positive one in avoiding an unnecessary laparotomy.

Focused abdominal sonography for trauma (FAST):

It a rapid, reproducible, portable and non-invasive, bed side ultrasound imaging is to detect presence of blood (at least >100ml**)** in abdomen or chest with **no attempt to determine the specific injury**. It is performed along with resuscitation by trained operator but very much **operator and experience dependent**, quite unreliable in patients who are obese or if the bowel is full of gas .So gastric decompression with Ryle' tube and catheter should be given before doing FAST. Hollow viscus injuries are very difficult to diagnose with FAST. Even in the most experienced hands, it has a low sensitivity (29-35%).

Diagnostic laparoscopy: It is an invasive method mostly performed in operation room under GA, can be done bed-side under LA for detection any violation of fascia or peritoneum, intra peritoneal bleed in laceration or mesenteric tear, spillage of GIT contents in hollow organ injuries. Procedures like primary repair of laceration, perforation with proper hemostasis maintained and finally through peritoneal toileting with drain can be done with placement of a drain[8-12,13].

Procedure it should be performed in EOT under GA to explore whole intra-abdominal with all preparation ready for exploration if required. In virgin abdomen without any previous abdominal surgery history, in a infra umbilical incision of 1-1.5cm CO_2 pneumo-peritoneum of 10-12 mmHg is achieved through Veress needle (closed technique)**, open technique of Hassan** is done to get rid of traumatic injury to bowel in previously operated persons. A 10 mm trocar followed by video scope is entered after insufflation, peritoneum is stretched to detect any laceration .The

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source & degreeof bleeding decide whether to go for exploration or managed laproscopically. Intra-abdominal bleed are mostly due to solid organs injuries like liver and splenic lacerations or due to mesenteric injury which can be repaired with proper hemostasis maintainance. Free fluid mixed with intestinal content due to intestinal injury, can be repaired. If presence of intra-abdominal urine is suspected, diluted **methylene blue** can be administered into the urinary bladder through a urinary catheter and intra-abdominal fluid can be observed per operatively. **Reverse-Trendelenberg** position is useful for better visualization of urinary bladder. If needed, second and/or third trocars can be placed. Areas like inferior of liver, splenic and para-splenic area, anterior & post of stomach (through rent in gastro-colic ligament) and duodenum area are also searched for any injury, blood and fluid collection. Right and left para-colic gutters are explored. Beginning from caecum, entire colon must be explored. Small intestine and pelvic organs should also be explored Localized irrigation of certain compartments can be done by with non-dextrose containing fluid like NS with a **Nelaton** catheter which can be used as drain in abdomen.

Role of team members: DL is of a team-work, needs help of anesthesiologist, experienced nurse on laparoscopy may require another assistant to put 2nd or 3rd port if requires.

Pre and post-operative management:-pre and intra-op IV fluid and post-op analgesic, antibiotics to be given. If a drain tube has been placed, drainage content can be watched. If surgeon desires, intra-abdominal cavity irrigation through drain tube with saline can be done and this irrigation fluid may be analyzed in laboratory.

Its disadvantage: 1. Two dimensional view, **2** limited view of all surfaces of the intra-abdominal organs.

Though it hasn't got a 100% of diagnostic value, it's minimal invasiveness, direct visualization of the organs, drain placement chance if needed are its advantages.

MATERIAL & METHODS: This is a descriptive cross-sectional study; all patients with penetrating abdominal trauma admitted to surgery dept of VIMSAR Burla Nov 2016 to Oct 2018 (2yrs) were involved in this study. Mode& site of injury,duration between injury to admission, admission to definitive surgery. Description of weapon, Age, sex, injured organs and associated injuries mechanism of trauma and the prognosis were documented in the checklist. Different investigations & intra op findings & post op events were recorded; later follow up was done for 6 months.

Inclusion criteria: All hospitalized penetrating abdominal injury patients with peritoneal/fascial breach & associated injuries like head, thoracic & perenial injuries are included in this study.

Exclusion criteria: brought dead, discharge against medical advice, penetrating abdominal injury not admitted, lost to follow up.

OBSERATION : In this study, 88 patients of penetrating injury abdomen & associated injury were enrolled out of total 267 abdominal cases with a incidence of 33%, among them 77 were male& 11 were female with a ratio of 7:1.

Table-1-demographic variables in penetrating abdominal injury-

Age group	Male	Percentage%	Female	Percentage%	Total	Percentage %
0-10	1	1	0	0	1	1%
11-20	11	14	1	9	12	14%
21-30	35	45	6	55	41	47%
31-40	19	24	2	18	21	24%
41-50	9	12	1	9	10	11%
51-60	2	3	1	9	3	3%
>60	0	0	0	0	0	0
Total	77	87	11	13	88	

In our study around 60% (41+21) of the patients belongs to the age group between 21-40 yr followed by 47% are between 21-30yrs,no cases are found above 60yrs

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Table-2 interval & no. of patients between injury-admission/admission-surgery-

Time interval	No of pts injury-admission	percentage	No of pts admission-surgery	percentage
<2hours	20	23	7	12
2-4 hours	33	37	14	25
4-6 hours	32	36	23	40
6-8 hours	3	3	13	23
total	88		57/88	65

Most of the penetrating injury cases reach to this tertiary care centres in 2-6hrs (33%).The average time duration between admission and surgery was 4 hour. In 2-4 hrs maximum % (37%) of injuries came, followed by in 4-6 hrs 36% cases came.

Table-3 -Mode & table 4-associated injury -

Mode of injury Table 3	No. of patients	Percentage %
Stab Injury	61	69
RTA	15	17
Bull gore	4	5
Bear mauling	4	5
Fall from height	2	2
Gun shot	2	2

Table-4-Assoc. injury	No. of patient	Percentage%
Thoracic injuries	20	45
Head injuries	10	22
Long Bone injuries	6	14
Pelvic injury	5	11
Bladder injury	3	7
Diaphragm injury	1	2
Total no assoc. injury	45/88	43%

Table- 5-Different organ involvement & Table-6-different mode of management-

Table 5-Organs involved	No of pts.	Percentage %

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Liver	28	32
Small bowel	22	25
mesentery	20	23
spleen	15	17
stomach	7	8
colon	5	5
bladder	3	3.4
Diaphragm	1	1.1

Management protocol of penetrating abdominal injury	No of pts.	Percentage %
Conservatively managed	31	35
Immediate laparotomy<2hr	7	6.1
Early laparotomy2< 6hrs	37	32.3
Delayed laparotomy6<12hr	13	49.2

Table-6- Out of total 88 penetrating injury in 31 cases (35%) selective conservatism tried. In 6% cases immediate laparotomy (<2hr) is planned in on-going bleeding patients with FAST/DPL done in causality during resuscitation. In 37 cases we did early laparotomy(2<6hrs) after investigations like USG ,CT, diagnostic lap, rest 13 cases delayed laparotomy(6<12) is planned after a failure of a trial of selective conservative management.

Small bowel injury: out of total 22 cases 10 were due to stab injury(45%), 5 due to RTA (23%), 2 due to gunshot (9%), 2 due to fall from height (9%), 3 cases bull gore injury(14%) Isolated small bowel injury tops list with 7 cases, 32% of total 22 small bowel injuries, followed by associated mesenteric tear of 5 cases, and rest 10 cases are associated with stomach, spleen & liver with or without mesenteric tear.Post operatively 3 patients had wound infection/dehiscence managed conservatively with secondary suturing later, other 3 patients had Intra-abdominal abscess, which was drained externally, later developed post of leak with high output enetro-cutaneous fistula. Four patients died of septicemia.

Liver injury: Out of 28 cases of liver injury 21 cases were due to stab injury (75%), 4 (14%) due to RTA and 2 due to bull gore, 1 due to fall from height. Liver is most common solid organ injured in penetrating injury abdomen (26%). Out of 28cases, 18 are isolated liver injuries and in remaining 10 cases,6 cases are associated with small intestine injury /mesenteric tear and rest 4 were associated with other organ injuries like spleen, stomach, large gut. Out of total 28 cases, 3 died with mortality rate of 11%, 5 developed sub phrenic/ peri hepatic abscess (18%).

Splenic injury: Out of total 15 cases of splenic injury, 12 were due to stab injury(80%), 3 due to RTA. There are 11 cases of isolated splenic injury followed by 4 cases of associated small intestine, 2 cases of stomach, lastly 1 case of associated liver injury Out of 15 patients 3 patients died, 3 had intra-abdominal abscess, other 9 had post op & follow up period uneventful

Stomach Injuries: Out of total 7 cases of stomach injuries, 6 were due to stab injuries, one due to RTA. Among them 1 case had isolated stomach injury, res

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were associated with other injuries like liver in 2 cases, spleen in 2 case and 1 case of diaphragm injury. 1 out of 7 patients had intra-abdominal abscess (17%) & 3 death were due to septicemia with high morality of 42%.

Colonic injury: There were totally 5 cases of colonic injury due to stab injury in 4 cases & 1 case of fall from height. Among them 3 are isolated colonic injury and rest 2 are associated with liver injury. Out of five colonic injuries 2 died due to septicemia,1 had intra-abdominal abscess.

Bladder injury: There 4 cases of bladder injury associated with other organ injury which are repaired primarily. Post op catheter and drain in abdomen & space of retzius is kept for 10 days to prevent leakage. In 3 cases SPC (supra pubic catheterization) is done along with repair of bladder.

Diaphragmatic injury: There were totally 1 case of diaphragmatic injury due to multiple stabbing which was also associated with stomach injury and liver injury. In this case laparotomy with primary repair of the stomach and diaphragmic rent done..

Negative laparotomy: there were 6 cases of negative laparotomy out of 88 cases (6.8%).

Overall Complications- Totally 11 deaths out of 88 cases occurred , mortality rate 12.5%, 9 patients had intra-abdominal abscess (10.22%), 4 cases of wound infection/dehiscence Outcome of the study came with early recovery of 63patients(71.5%),delayed recovery14pts(16%) & mortality of 12.5%.

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Figure 1 & 2- penetrating stab injury abdomen-multiple mesenteric tear with ileal perforation, resection of injured part with end to end ileo-ileal anastomosis & repair of the mesenteric tear done

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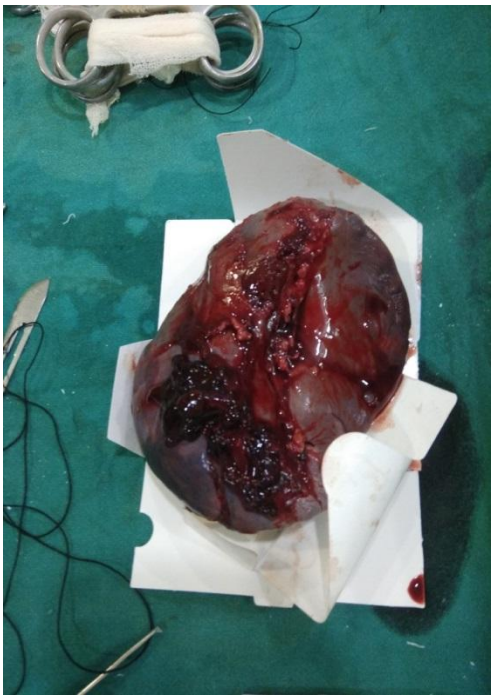

Figure 3 & 4-penetrating injury abdomen with splenic grade 4 laceration, splenectomy done

DISCUSSION- out of total 267 abdominal injuries 88 cases were penetrating injury (33%), among them male to female ratio is 7:1.Profession like manual labour, factory worker, coolie, drivers etc, are more prone to penetrating injury occupationally. As the study done in Imam Reza Hospital and From March 2012 to March 2014, out of 137 patients with abdominal penetrating trauma, 87% occurred in men and the ratio of men to women was 6.6 : 1

Most of the patients around 60% belongs to 21-40yr followed by 47% are between 21-30yrs, no cases were beyond 60yrs. Most of the cases reached to this tertiary centers in 2-6hrs(33%) without much delay in transport or referral from primary centers. Average time duration between admission and surgery was 4 hr. In 2-4 hrs maximum percentage (37%) of injuries came, followed by in 4-6 hrs 36% cases. Commonest mode of injury is by stabbing (69%) followed by RTA(17%),which were mostly de-gloving type injury. Gunshot injuries are very less in our set up (2%). Association of thoracic injury was highest (45%) followed by 10 head injuries, 6 patients of long bone injury(7.5%) and 5 patients had pelvic injury. Totally 38 patients had associated injuries (43%).pelvic injury patients are evaluated thoroughly for any genitourinary injuries. Many of them had multiple associated injuries.

As per **table-5** among intra-abdominal injuries, liver tops the list with 27 cases, followed by small bowel and mesentery, accounting for 22 and 20 cases each, and followed by spleen. There were 7 cases of stomach injury and 5 colonic injury cases. Liver is most commonly injured solid organ followed by spleen due to its large size & anatomical site .Among hollow organs small bowel injuries are quite common followed by colon & stomach.

Small bowel injury- commonest mode of small bowel injury was due to stab injury (45%) followed by RTA (23%). Isolated small bowel injuries (32%) with/without associated mesenteric tear are quite common .Small perforations can be repaired primarily with one or two layers after debridement of devitalized tissue. In case of gross contamination with ischemic long segments resection of the segment with proximal ileostomy & distal closure or exterisation of distal bowel as mucus fistula (double barrel ileostomy) was done. In 6 case with questionable viability of bowel, we have done resection and anastomosis in 2 layer transversely using inner continuous 2/0 vicryl and outer interrupted lembert sutures with 2/0 silk.

Out of total 22 patients, 3 devloped wound infection/dehiscence which was managed conservatively, other 3 had Intra-abdominal abscess,

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which was drained externally, later developed post of leak with high output entero-cutaneous fistula, 4 patients died of septicemia. Complications in small bowel injury are higher in this study (27%) mostly due increased anastomotic leak & wound infection.

Liver injury- Except a single case of isolated liver injuries, in remaining 10 cases, 6cases were associated with small intestine injury/mesenteric tear and rest 4 were associated with other injuries like spleen, stomach, large gut. Selective conservatism tried for stable cases (11 in no.) with serial hematocrit monitoring and repeat USG and CT. In unstable patients, laparotomy was planned with adequate blood in stock. Suture hepatorraphy (horizontal mattress) was done in 5 cases of isolated liver injury, one case among them was associated with splenic laceration grade IV for which splenectomy was done for that.

Mortality rate in liver injuries is 11%.5 patients developed sub phrenic/peri hepatic abscess in 18% cases, which was drained later by exploration and through toileting. The mortality rate at the Ben Taub General Hospital in Houston was 10 to 15%.The incidence of postoperative peri-hepatic abscess ranges from 3.5 to 22% (Feliciano D V et al).

Splenic injury- Out of total 15 splenic injuries, 12 were due to stab injury (80%), 3 due to RTA. Among them 11 cases were isolated splenic injuries & one case had splenic injuries with liver laceration.

One case died in the immediate post-operative period due to hypovolemic shock and 2 people died due to sepsis on post op day 4 due to sepsis leading to multiple organ failure, 3 patients had intra-abdominal abscess with fever ranging up to 102^{F}upto post- op day 2.

Stomach injury- Out of total 7 cases of stomach injuries, 6 were due to stab injuries, one due to RTA. Among them 1 case had isolated stomach injury, rest of which were associated with other injuries like liver in 2 cases, spleen in 2 case and 1 case of diaphragm injury. Pre operatively in one cases bright red blood came through the Ryle's tube aspiration. On DPL blood, bile, food particles aspirated in 4 pt. Gas under diaphragm noticed in all pts. On exploration frank blood with gross contamination noticed, peritoneal toileting done with control of bleeding, entrance and exit sites of the penetrating wound noticed, stomach was closed in two layers utilizing an inner running row of absorbable vicryl 2.0.

Colonic injury- out of 5 cases 4 cases were due to stabbing, 1 case due to fall from height. Among them 3 were isolated colonic injury and rest 2 were associated with liver injury. On exploration in 2 cases of mild hematoma of transverse colon wall & meso-colon seen, primarily repaired by lembert sutures transversely with 2/0 vicryl and in 3 case of gross fecal contamination with nonviable gangrenous bowel, Hartmann's procedure done with proximal colostomy and distal closure. Out of 5 colonic injuries 2 died due to septicemia, 1 had intra-abdominal abscess. Mortality rate in large bowel injury was approximately 40%which was quiet high due to gross fecal contamination and sepsis.

Bladder injury- There 3 cases of bladder injury associated with other organ injury which were repaired primarily with vicryl 2.0 in first layer followed by 2^{nd} layer of vicryl 2.0 including the peritoneal fold with SPC (supra pubic catheterization) done. Post op catheter and drain in abdomen & space of retzius is kept for 10 days to prevent leakage.

Diaphragmatic injury: In 1 cases of diaphragmatic injury associated stomach & liver injury was seen for which primary repair of the stomach and rent in diaphragm .The diaphragm rent was closed with no 1 prolene non absorbable suture material in figures of eight sutures and ICT was given for few days. Patient died on post op day 4 due to septicemia.

Negative laparotomy -In this study, there were 6 cases of negative laparotomy in 88 cases of penetrating injury (6.8%). Whereas in Feliciano et al 1984, Shor r et al1988 series, the negative laparotomy was from 5.8% to 7.4%.

Overall Complications- There were totally 11 deaths in the study of 88 cases, constituting a mortality rate of 12.5%, 9 patients had intra-abdominal abscess (10.22%), 4 cases of wound infection/dehiscence.

Conclusion: Out of total 88 cases selective conservatism tried for 31 hemodynamically stable patients, among remaining 57 cases laparotomy is planned after all investigations and accessing clinical condition of pt. outcome of the study came with early recovery of 63 patients (71.5%), delayed recovery 14 patients (16%) & mortality of 12.5% with a negative

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laparotomy of 6.8% which is comparable with previous study. Spjut-Patrinely V. Feliciano DV, Ben Taub General hospital Houston has reported in a series of 300 consecutive patients with penetrating abdominal injuries, a overall mortality rate of 15%. In our study the mortality rate was 12.5% which is comparable with literature and it included only those patients arriving to the hospital alive, lama & lost to follow up and without fascial breech patients are excluded. Hence the pre hospital mortality, LAMA, lost to follow up were excluded.

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