A RETROSPECTIVE STUDY ON PENETRATING INJURIES ABDOMEN

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ABSTRACT

BACKGROUND
Penetrating abdominal injuries forms an important component of surgical emergencies. It remains one of the commonest reasons for preventable deaths in any trauma systems. Abdominal injuries maybe parietal or visceral or perforating through and through injury. Unnecessary exploration leads to increased morbidity. The goal in managing penetrating abdominal injuries is to identify and treat all the damages caused by the weapon and to reduce negative laparotomy and avoid missed injuries.

MATERIALS AND METHODS
This is a retrospective study that was carried out in Government Kilpauk Medical College and Government Royapettah Hospital from May 2007 to July 2009. From the hospital database, 53 cases admitted with abdominal penetrating injury were included in this study. The patient charts were reviewed for demographic data, type of injury, symptoms and signs at presentation, methods of diagnostic investigations, treatment adopted and complications encountered.

RESULTS
Maximum number (42%) of cases in the age group of 30 to 40 yrs. among which 85% of cases commonly affected are males; assault injuries account for 87% of cases of penetrating abdominal injuries; peritoneal violation seen in 78% of cases as evidenced by CT scan. 64% of cases underwent laparotomy. Laparotomy was therapeutic in 94% of cases. Only 2 patients required delayed laparotomy. Serial abdominal examination and if necessary repeat CT is important in avoiding missed injuries. Small bowel was commonly injured organ in this study. 29% developed postoperative complications. Wound infection was the commonest complication. Dreaded complication like faecal fistula developed following delayed laparotomy and the mortality rate is 1.8%.

CONCLUSION
Following this, retrospective study of 53 cases of penetrating abdominal trauma, the following conclusions can be made. Young males were predominantly involved between the age group of 20 to 40 yrs. The commonest mode of penetrating injury is by stab wounds to abdomen. Careful and repeated clinical examination and appropriate diagnostic investigations leads to successful treatment in these patients. Those patients with haemodynamic instability, generalised peritonitis, evisceration of omentum and bowel and haemorrhage are the potential candidates for early mandatory laparotomy. Evidence of peritoneal penetration alone is a poor indicator for laparotomy, which may add on to the negative laparotomies and thereby increasing the morbidity and mortality. Computed tomography is highly sensitive in predicting both peritoneal penetration and intra-abdominal visceral injuries. Small bowel and stomach are common viscera injured in the present study. Postoperative wound infection is the common complication encountered. Intra-abdominal sepsis and faecal fistula is encountered in delayed laparotomies thereby indicating the importance of early identification of injuries and early institution of treatment.

KEYWORDS
Penetrating Injury, Laparotomy, Wound Injection, Sepsis.

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BACKGROUND
Penetrating abdominal injuries forms an important component of surgical emergencies. It remains one of the commonest reasons for preventable deaths in any trauma systems.1 Penetrating abdominal injuries were managed expectantly until late 19th century.2 Over the past century, great advances were made in the management of such injuries. Major improvements in the field of blood transfusion and liberal use of antibiotics lead to the increase in explorative laparotomy Abdomen occupies a vulnerable position in human anatomy and is the least protected and most susceptible part for accidental and homicidal injuries.3 Abdominal injuries maybe parietal or visceral or perforating through and through injury. Unnecessary exploration leads to increased morbidity. The goal in managing penetrating abdominal injuries is to
identify and treat all the damages caused by the weapon and to reduce negative laparotomy and avoid missed injuries.4

**Aim of the Study**- To evaluate the efficacy of computed tomography in identifying peritoneal breach and visceral injuries in penetrating abdominal injuries to identify the factors or issues that helps in reducing the morbidity in penetrating hallow viscous injuries. To evolve a better protocol in managing hallow viscous injury, following penetrating abdominal trauma with the experiences gained in the retrospective study.

**MATERIALS AND METHODS**

This is a retrospective study that was carried out in Government Kilpauk Medical College and Government Royapettah Hospital from May 2007 to July 2009. From the hospital database, 53 cases admitted with abdominal penetrating injury were included in this study. The patient charts were reviewed for demographic data, type of injury, symptoms and signs at presentation, methods of diagnostic investigations, treatment adopted and complications encountered. Those patients who were stable at the time of presentation were selected and subjected to CT scan. Intra-abdominal CT was performed within 2 hours after initial assessment and resuscitation. Axial scans with 1 cm cuts were taken from diaphragm to femoral heads after infusion of contrast after a delay of 70 seconds. Oral and rectal contrast was also given. The CT scans were reviewed by radiologists. Radiographic signs considered as positive were pneumoperitoneum, haemoperitoneum, wound track extending through the peritoneum and signs of bowel injury were- wound track extending to bowel wall, bowel wall defect, bowel wall thickening, extravasation of oral or rectal contrast and focal haematomas.

The following data were noted.

**Age Group Affected**- Incidence of penetrating abdominal trauma in various age groups-

| Age   | Number of Cases | Percentage |
|-------|-----------------|------------|
| 0-10  | 1               | 2          |
| 11-20 | 4               | 8          |
| 21-30 | 20              | 37         |
| 31-40 | 22              | 42         |
| 41-50 | 5               | 9          |
| >50   | 1               | 2          |
| Total | 53              | 100        |

**Table 1. Age Group Affected**

Nearly, 80% of cases were in the age group of 20 to 40 years.

| Sex    | Number of Cases | Percentage |
|--------|-----------------|------------|
| Male   | 45              | 85         |
| Female | 8               | 15         |
| Total  | 53              | 100        |

**Table 2. Sex Incidence**

Of the 53 cases, 45 were males and 8 were females.

| Weapons | Number of Cases | Percentage |
|---------|-----------------|------------|
| Knife   | 43              | 81         |
| Broken bottle | 7 | 13  |
| Iron rod | 2   | 4   |
| Gunshot | 0   | 0   |
| Bull gore | 1 | 2   |
| Total   | 53              | 100        |

**Table 3. Weapons Used in Penetrating Injury Abdomen**

| Cause          | Number of Patients | Percentage |
|----------------|--------------------|------------|
| Assault        | 46                 | 87         |
| Accident       | 4                  | 8          |
| Iatrogenic     | 1                  | 2          |
| Self-inflicted | 2                  | 4          |
| Total          | 53                 | 100        |

**Table 4. Cause of Injury**

Homicidal stab injury with knife was the commonest mode of penetrating abdominal injury encountered in this study. Out of 53 patients, 8 patients were immediately planned for early mandatory laparotomy. All these patients presented with either one of these findings- generalised peritonitis or evisceration or haemodynamic instability. They were not subjected to other forms of investigations like CT abdomen. Exploratory laparotomy was done.

| Indication                          | Number of Patients | Percentage |
|-------------------------------------|--------------------|------------|
| Generalised tenderness, guarding    | 4                  | 8          |
| and rigidity                        |                    |            |
| Evisceration                        | 1                  | 2          |
| Haemodynamic instability            | 3                  | 6          |
| Total                               | 8                  | 16         |

**Table 5. Indication for Early Laparotomy in Penetrating Abdominal Injury**

The remaining 45 patients were stable and were not showing any signs for immediate mandatory laparotomy. They were subjected for CT abdomen with contrast study to identify peritoneal breach and other internal organ injuries.

| Peritoneal Penetration | No. of Pts. | Percentage |
|------------------------|-------------|------------|
| Present                | 35          | 78         |
| Absent                 | 10          | 22         |
| Total                  | 45          | 100        |

**Table 6. Peritoneal Penetration Identification by CT Scan**

Out of 45 patients, 35 patients were showing evidence of peritoneal penetration in the form of free air in the peritoneum with or without positive CT findings of visceral injuries. 10 patients did not have peritoneal breach. These patients were discharged safely after an overnight observation.

**Identification of Injuries by CT Scan**- The initial CT demonstrated visceral injuries in 29 patients out of 35. In the remaining 6 patients, CT does not show any findings.
### Injuries Identified by CT Scan

| Injuries Identified by CT Scan | Number of Patients | Percentage |
|-------------------------------|--------------------|------------|
| Hollow viscous injury        | 18                 | 51         |
| Solid organ injury           | 6                  | 17         |
| Combined                      | 2                  | 6          |
| Minimal haemoperitoneum/mesenteric haematoma | 3           | 9          |
| Negative CT                   | 6                  | 17         |
| Total                         | 35                 | 100        |

**Table 7. Identification of Injuries by CT Scan**

Out of this, hollow viscous injury was present in 51% of cases.

### Treatment Offered

| Treatment Offered | Number of Patients | Percentage |
|-------------------|--------------------|------------|
| Operated          |                    |            |
| Early laparotomy  | 8                  | 64         |
| Laparotomy after CT scan | 34 | 24         |
| CT negative       | 2                  |            |
| Conservative      |                    |            |
| No peritoneal breach | 10     | 36         |
| No injuries detected | 19     | 4          |
| Minor injuries    | 5                  |            |
| Total             | 53                 | 100        |

**Table 8. Ratio of Operative to Conservative Treatment**

After detailed clinical evaluation and suitable investigation, 34 patients were offered exploratory laparotomy. These patients include those with peritoneal peritonitis, evisceration, haemodynamic instability and with CT scan of the abdomen showing significant solid organ injuries or hollow viscous injuries. Only one patient who was treated initially with conservative management later required laparotomy due to the development of peritonitis.

### Laparotomy Findings

- Immediate signs of laparotomy: 4
- Injury identified by CT: 6
- Isolated injury: 6
- Associated injuries: 4
- Colonic laceration: 2
- Omental tear: 1
- Multiple injuries - duodenum first part: 1
- Pancreatic and kidney laceration with retroperitoneal haematoma fundus of stomach: 1
- Body of stomach: 7
- Pylorus of stomach: 1
- Through and through injury of both: 1
- Anterior and posterior wall of stomach: 1
- Mortality (multiple injury): 1

**Table 11. Stomach**

In all the cases, injury to posterior wall is searched for and other organ injury was ruled out and stomach wall was sutured primarily in 2 layers. Associated injuries were treated by primary suturing. In all the cases, peritoneal lavage was given and drainage tube was kept. Other patient had multiple organ involvement. Laceration in the stomach extends to first part of duodenum along the greater curvature, pancreatic and kidney laceration and retroperitoneal haematoma was present. Patient presented with unstable haemodynamic status, resuscitated and prepared for laparotomy. Stomach and duodenal injury was primarily sutured. Diffuse bleeding from pancreas noted. Pancreas was sutured with non-absorbable suture material, retroperitoneal haematoma left undisturbed. Patient continuously monitored, but vitals were unstable and after 24 hrs. re-laparotomy done. There was no bleeding and abdomen closed. Patient died on second postoperative day due to shock.

### Conservative Management

| Conservative                  | No. of Patients | Percentage |
|-------------------------------|----------------|------------|
| No peritoneal penetration     | 10             | 19         |
| No visceral injury            | 4              | 8          |
| Visceral injury               | 5              | 9          |
| Total                         | 19             | 36         |

**Table 10. Conservative Management**

In the hollow viscous injuries, following findings were observed in the study.

**Stomach**: Totally, 10 cases of stomach injuries were encountered in our study.
All bowel injuries involved the antimesenteric border and were less than 1 cm in diameter. Associated injuries include colon, stomach, mesentery or omentum. All were sutured primarily except for the one where resection and anastomosis was done. Brantly et al. emphasised the importance of careful examination of whole of the abdomen during laparotomy, so as to avoid missing multiple injuries.

In 2 patients, injury was not identified by CT and was taken up for surgery in late stages as the patient developed peritonitis. Both of them had sigmoid laceration. One patient had faecal peritonitis due to faecal contamination, rent in sigmoid colon was primarily closed and transverse loop colostomy was done. After 6 weeks, colostomy closure was done. For all patients, thorough peritoneal lavage was given and drainage tube was kept.

Postoperative Complications Encountered in Hollow Viscous Injury - 28 patients underwent laparotomy for hollow viscous injuries. Out of which, 29% of patients developed complications.

Common postoperative complications following treatment of penetrating injury of abdomen is wound infection. One case of faecal fistula has been reported. It was reported in a case with missed findings in CT scan delayed identification of injury with the development of faecal peritonitis. The patient was managed conservatively and discharged without any complication. Colostomy was done in two patients who had faecal peritonitis because of delayed surgery as the injuries were not made out in CT scan. Colostomy closure was done after 2 months and both the patients improved normally.

**Mortality** - There was only one death reported in this study. The mortality rate is 1.8%.

**RESULTS**

Maximum number (42%) of cases in the age group of 30 to 40 yrs. among which 85% of cases commonly affected are males; assault injuries account for 87% of cases of penetrating abdominal injuries; peritoneal violation seen in 78% of cases as evidenced by CT scan. 64% of cases underwent laparotomy. Laparotomy was therapeutic in 94% of cases. Only 2 patients required delayed laparotomy. Serial abdominal examination, and if necessary repeat, CT is important in avoiding missed injuries. Small bowel was commonly injured organ in this study. 29% developed postoperative complications. Wound infection was the commonest complication. Dreaded complication like faecal fistula developed following delayed laparotomy and the mortality rate is 1.8%.

**DISCUSSION**

Identifying Peritoneal Violation by CT Scan - In this study of among the 45 patients who underwent CT, the peritoneal violation was defined with certainty in 35 patients (78%). This correlates with Demetriades et al study conducted during 2004-2006 as a prospective study. The CT was done in 67 patients, of which 47 patients had evidences of peritoneal violation (70%) of the 26 patients who underwent laparotomy.

| CT Findings | Laparotomy | Conservative | Total |
|-------------|------------|--------------|-------|
| Peritoneal breach | Confirms breach | Management |       |
| Present | 26 | 9 | 35 |
| Absent | 0 | 10 | 10 |
| Total | 26 | 19 | 45 |

**Table 15. Identifying Peritoneal Violation by CT Scan**

Of these 35 patients who showed positive peritoneal penetration in CT, only 26 patients underwent laparotomy and peritoneal violation was confirmed surgically in all of them. CT was negative for peritoneal violation in 10 patients. All of them were treated conservatively showing 100% sensitivity and 100% specificity confirming its accuracy in identifying peritoneal breach. Regarding 10 patients with no peritoneal violation were discharged uneventfully.

| CT Findings | Laparotomy | Conservative | Total |
|-------------|------------|--------------|-------|
| Intra-abdominal injuries | | Management |       |
| Present | 22 | 2 | 24 |
| Absent | 2 | 0 | 11 |
| Total | 24 | 11 |

**Table 16. Management of Intra-Abdominal Injuries**
Of the 35 patients with peritoneal violation, 29 patients were showing evidence of intraperitoneal visceral injuries and 6 patients with no visceral injuries. The sensitivity is 92%. The specificity is 82%. Positive predictive value of CT scan 92%. Negative predictive value is 82%. In Chiu W.C et al study, CT has a sensitivity of 97%, specificity of 98% and accuracy of 98%. In this study, 8 (29%) patients developed complications following hollow visceral injuries. This correlates well with Salim A et al study conducted on 57 patients with stab injuries. Postoperative complications occurred in 20% of cases. This study also shows that there is increase in complication rate when there is associated duodenal or colon injuries.

Table 17. Organ Injuries Encountered in Penetrating Abdominal Trauma

| Organ Injured     | No. of Pts. with Complication |
|-------------------|-------------------------------|
| Stomach           | 1                             |
| Jejunal injuries  | 3                             |
| Ileal injuries    | 1                             |
| Colonic injuries  | 2                             |
| Jejunum with colon| 1                             |

Though in this study, wound infection is more common in jejunal injuries. The most dreaded complications like intra-abdominal sepsis and faecal fistula is common with colon injuries. Primary repair of colon or resection and anastomosis without colostomy maybe considered only when all the following criteria are met- any patient who present without shock, no extensive faecal contamination, not having multiple injuries, no significant blood transfusion requiring blood transfusion of more than 6 units, no prolonged delay to operation and injury should not involve left side of colon. Early diagnosis and surgical treatment is important in reducing the peritoneal contamination and thereby reduces the morbidity and mortality. Most common complication encountered was wound infection, which was treated by appropriated antibiotics. Three cases of intra-abdominal sepsis were reported. Two of them had faecal contamination of peritoneum following sigmoid colon laceration. Another patient following jejunal tear. All of them were treated conservatively with appropriate antibiotics and blood transfusion. Majority of patients were presented to hospital immediately after stab injuries. Complications were relatively less. The ultimate goal in managing penetrating abdominal trauma is not only the early identification of injuries and appropriate treatment, but also to avoid unnecessary laparotomies. To accomplish this, patients are to be correctly selected and subjected to CT scan of the abdomen, which accurately identifies the need for further laparotomy. Considering the benefits of avoiding unnecessary hospital stay, man power loss and also the accuracy of CT scan in identifying peritoneal breach and visceral injuries. Such investigation is to be offered as a first line of investigation in stable patients.

CONCLUSION

Following this retrospective study of 53 cases of penetrating abdominal trauma, the following conclusions can be made- Young males were predominantly involved between the age group of 20 to 40 yrs. The commonest mode of penetrating injury is by stab wounds to abdomen. Careful and repeated clinical examination and appropriate diagnostic investigations leads to successful treatment in these patients. Those patients with haemodynamic instability, generalised peritonitis, evisceration of omentum and bowel, and haemorrhage are the potential candidates for early mandatory laparotomy. Evidence of peritoneal penetration alone is a poor indicator for laparotomy, which may add on to the negative laparotomies and thereby increasing the morbidity and mortality. Computed tomography is highly sensitive in predicting both peritoneal penetration and intra-abdominal visceral injuries. Small bowel and stomach are common viscera injured in the present study. Postoperative wound infection is the common complication encountered. Intra-abdominal sepsis and faecal fistula is encountered in delayed laparotomies, thereby indicating the importance of early identification of injuries and early institution of treatment.

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