PENETRATING WOUNDS OF THE ABDOMEN AND CHEST AN ANALYSIS OF 107 CONSECUTIVE CASES

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SYNOPSIS

A total of 107 consecutive cases of penetrating injuries of the abdomen and chest admitted to the Department of Surgery, Alexandra Hospital during a five year period between January 1978 and September 1982 were retrospectively studied. The injuries were caused by knives (33.6%); an unknown stabbing instrument (18.7%); and gunshot (a rare 2.8%). Most cases were young adult males. There were 45 abdominal and 57 chest injuries. Another 5 were combined thoracoabdominal injuries. 62% of the abdominal injuries required general anaesthesia for surgical intervention while only 15% of chest injuries did so. The organs most frequently injured were located in the upper abdomen. Exploratory laparotomy was done on 61.7% of the abdominal cases (29/47 cases). Our negative laparotomy rate was 28.6% (8/28 cases). Most of the negative laparotomy cases recovered without complications. The mortality for abdominal cases was zero. Most chest injuries were adequately treated by insertion of chest tubes. Chest injuries were noted to have a lower morbidity than abdominal ones.

INTRODUCTION

There is a great paucity of literature relating to penetrating injuries of the chest and abdomen in Singapore. Nambiar et al (1, 2) have discussed abdominal trauma generally and the value of needle paracentesis for the detection of viscera injuries. A total of 107 consecutive cases of penetrating injuries of the abdomen and chest admitted during a five year period at the Department of Surgery, Alexandra Hospital were retrospectively studied. In particular the epidemiology of these injuries, site, extent and nature of organs injured, modes of management and complications were analysed.

The aim of this paper is directed ultimately to consolidate information and rationalise treatment for this eminently treatable injury.

MATERIAL AND METHOD

The case records of 107 consecutive patients with penetrating wounds of the chest and abdomen admitted to Alexandra Hospital, Department of Surgery, Singapore, between January 1978 to September 1982 were reviewed.

Alexandra Hospital is one of the four general hospitals in Singapore. These four hospitals cater for a multiracial, urban port city of two million. The main races are Chinese, Malays and Indians. The Surgical Department of our hospital handles a fairly representative portion of trauma cases in Singapore.

The city provides a speedy and comprehensive ambulance service. When brought to hospital, the cases are first screened by the casualty medical officer who initiates emergency treatment.

The case is then referred to the hospital surgical team for further management. Cases in shock were resuscitated, haemorrhage arrested where possible and a course of management decided by the registrar-on-call.

The wounds of those with lesser injuries were carefully examined and exploration and suture out in theatre.

All abdominal cases were explored in theatre within twelve hours; most within six hours. This initial exploration is carried out with proper preparation for immediate laparotomy. If exploration revealed that the peritoneum has been entered, a full laparotomy under general anaesthesia is performed.

Injuries that have not penetrated the peritoneum are treated by simple toilet and suture.

If there is any suspicion of chest injury, a chest x-ray is routinely done.

If there is pneumothorax, a chest tube is inserted under local infiltration anaesthesia. The chest wound is explored and sutured in theatre. A careful watch is kept on the patient's condition. If there is appreciable haemothorax ie. greater than 1000 mls of blood over twenty-four hours (as shown by blood from chest tube) a thoracotomy is done.

RESULTS

The sex, race and age distributions of the cases are shown on Tables 1, 2 and 3. Over 90% of the cases were male. The racial distribution roughly approximates the population distribution. A small but significant fraction of these cases originated from ships in the Singapore Port. These were of various races and tend to have more serious injuries. In one case, an Indonesian sustained a penetrating peritoneal injury at sea and sought treatment only after two days. About 80% of the cases were between 10 and 30 years of age. No cases were seen below 10 years and only 2 cases were encountered after 60 years.

Table 1: Sex distribution of cases

	No. of cases	Percentage of total
Male	103	96.7%
Female	4	3.7%
Total	**107**	

Table 2: Racial distribution of cases

	No. of cases	Percentage of cases
Chinese	74	69.2%
Indian	10	13.1%
Malay	14	9.3%

Others: 2 each of Bengalis and Indonesian.
1 each of Taiwanese, Filipinos, Thai, Eurasian, Indian.

Total: 107 cases

(Singapore population statistics 1978:
Chinese 76%, Malays 15%, Indians 7%, Others 2%)

Table 3: Age distribution of cases

Age range (yrs)	No. of cases	Percentage
1 — 10	0	0
11 — 20	37	34.6
21 — 30	41	38.3
31 — 40	12	11.2
41 — 50	8	7.4
51 — 60	4	3.7
61 — 70	1	1.0
71 — 80	1	1.0
Age not known	3	2.8
Total	**107**	**100**

Table 4: Mode of anaesthesia used for Abdominal and Chest operations

Region	Abdomen		Chest	
Anaesthesia	General	Local	General	Local
No. of cases	28.	17	8	49.
Percentage	62.2%	37.8	14.0%	86.0%
Total	**45**		**57**	

Thoraco-abdominal Injuries

Anaesthesia	General	Local
No. of cases	4	1
Total	**5**	

Note: All cases were surgically explored on an emergency basis

The Mode of Injury/Weapon used (Table 5); the Portion of Injuries that have penetrated pleura or peritoneum (Table 6) and Internal organs injured (Table 7) are as tabulated. The method of management is as shown on Table 8. Of the 5 cases requiring thoracotomies, 4 were done because of uncontrolled haemorrhage from chest tubes. In one case, the lung and pericardium were found to be lacerated. The fifth case was thoracotomised because of a swinging fever and an empyema thoracis was drained.

Laporatomy was performed on 29 out of 47 patients. The indications for laporatomy were clinical and as a result of wound exploration. They were those with:

Class I — *Definite signs* of intraperitoneal soiling/haemorrhage. E.g. those admitted with haemorrhage shock, with board-like abdominal rigidity, protrusion of the gut or omentum through the wound.
Class II — Signs of *peritoneal irritation* eg with guarded abdomen; slight rebound tenderness and sluggish bowel sounds.
Class III — No evidence of peritoneal soiling or haemorrhage eg. abdomen soft and non tender, but where local wound exploration revealed intraperitoneal penetration.

Table 5: Mode of injury/Weapon used

Mode of injury/ Weapon used	No. of cases	Percentage
Road traffic accident	2	1.9
Glass	8	7.5
Knife	36	33.6
Unknown	20	18.7
Stabbed (weapon unknown)	26	24 3
Barbed wire	1	1.0
Bearing scraper*	4	3.7
Plank	1	1.0
Forklift	1	1.0
Gunshot	3	2.8
Broom stick	2	1.9
Metal hook	1	1.0
Total	**107**	**100**

* The bearing scraper is an instrument used in numerous motor workshops in Singapore.

Table 6: Portion of injuries that have penetrated pleural/peritoneum

Abdomen		Chest		Chest and abdomen	
penetrated peritoneum	did not penetrate peritoneum	penetrate pleura	did not penetrate pleura	penetrating pleura/ peritoneum	did not penetrate pleura/ peritoneum
28	21	27	32	4	1

Table 7: Internal organs injured

		No. of cases
Abdomen:	Diaphragm	5
	Solid viscera	
	pancreas	1
	liver	7
	spleen	2
	Hollow organ	
	duodenum	4
	jejunum	2
	stomach	4
	omentum*	3
	caecum	1
	inferior venae cavae	1
	Total	**31**

Chest:	Nature of injury	No. of cases
	Pneumothorax	21
	Haemothorax	14
	Lung laceration	4
	Pericardial laceration	1
	Foreign body in chest	1
	Total	**41**

* omental injuries are classified here for simplicity

Table 8: Treatment Modes

Abdomen	No. of cases	Percentage
Simple toilet and suture	18	38.3
Exploratory laparotomy	29	61.7
Total	**47**	**100**

Chest	No. of cases	Percentage
Simple toilet and suture	40	64.5
Chest tube	17	27.4
Thoracotomy	5	8.1
Total	**62**	**100**

Laporatomy was negative for all cases in Class II and III. In contradistinction, all cases under Class I had definite visceral injury. The cases under Class I, II and III are shown on Table 8a.

Complications of surgery and length of hospital stay are shown on Tables 9 and 10.

Table 8(a): Indication for laparotomy

	No.
I Definite intraperitoneal injury	
Shock	4
Peritonitis	9
Gut or omental protusion	4
Total	**17**
II Peritoneal Irritation (guarded and tender bowel sounds sluggish)	4
III No intraperitoneal injury, Initial exploration leading to full laparotomy	4

Negative laparotomy: 8. Negative laparotomy rate 28.6%
Complication from negative laparotomy: Nil.
Average hospital stay in 7 days.

Table 9: Complications of surgery

Abdomen:	
paralytic ileus	1
wound infection	2
intestinal obstruction	1
renal failure	1
Total	**5**
Morbidity rate: 5/28 : 17.9%	
Chest:	
recurrent pneumothorax	1
empyema thoracis	2
secondary haemorrhage	1
wound infection	1
Total	**5**
Morbidity rate: 5/62 : 8.1%	

Table 10: Length of hospital stay

Chest		Abdomen	
No. of days	No. of cases	No. of days	No. of cases
1	10	1	7
2	17	1	7
3	9	3	2
4-10	12	4	3
11-20	6	5-6	6
20	1	7-8	7
not known	2	9-10	4
		10-15	3
		15	4
		not known	2
Total	**57**	**Total**	**45**

Mean Hospital Stay	No. of days (mean)
Chest Injuries	4.8
Abdominal injuries	5.7
Thoracotomies done	11.0
Chest tubes inserted	4.0

DISCUSSION

It is difficult to make comparisons between two studies as population and study criteria vary. However, some general comparisons may be instructive always, of course, keeping in mind the limitations.

The pattern of sex distribution seen is similar to that reported from Glasgow (3) (7 males: 1 female); New York (4) (5 males: 1 female) and Colombo (5) (9 males: 1 female). There is a greater male predominance in Singapore (9.6 males: 1 female) and Colombo (5) as contrasted to western countries. This may be due to the more domesticated nature of Asian women.

These injuries affected mainly the economically active age group.

It is noted that many of the more severe injuries involved sailors from ships in port.

Most injuries were definitely (1/3) or circumstantially (1/4) caused by knives. This is not surprising since the knife is the most commonly available instrument.

In sharp contrast only 3 gunshot injuries were encountered. This is about 3% of the total number of weapons used. This is in contrast with figures from

Colombo (12%) (5) and the United States (6) where such injuries are commonplace. The only roughly comparable figures come from Sir Lanka only (5). In the United States the figures are not comparable as gunshot injuries are usually separately considered. Singapore has strict gun control laws as opposed to the United States and elsewhere. The scarcity of such injuries must in large measure have contributed to our zero mortality figures.

A recurring feature is the greater severity and morbidity of abdominal compared to chest injuries. The mean hospital stay; portion of cases requiring surgery under general anaesthesia and the number of organs injured is higher in abdominal than chest injuries.

In chest injuries, pneumothorax or haemothorax are the most frequent features and these are adequately treated by insertion of chest tubes under local anaesthesia. This procedure can be competently done by medical officers.

In contrast, 62% of abdominal injuries required general anaesthesia. Additionally, expert surgical skills at registrar level are needed.

This is even more so in combined thoraco-abdominal injuries.

The most common organs injured in abdominal injuries are the liver, diaphragm, stomach and duodenum. This accords with figures by Donaldson (3), Kazarian (7) and Sandrasagra (5). It would appear then that the upper abdomen is the most common site of injury.

A major issue in penetrating abdominal injuries are the indications for laparotomy. In deciding the need for surgical intervention we must balance the risks associated with a missed viscera injury to the dangers and complications of a negative laparotomy. Maynard (8), whose exploration rate is 100% for such injuries, feels surgical intervention is mandatory. Other authors (3,4,6,7,8,9) have devoted their energies to lowering the number of negative laparotomies. Donaldson (3) in Cardiff attempted to gauge the relationships between the presenting signs and subsequent injuries found at laparotomy. He found that one-quarter of patients with haemorrhage and one-half of those with bowel injuries were stable on admission. Therefore to depend on clinical signs alone may be misleading. Notwithstanding this, Kazarian (7) reduced his exploration rate from 56% to 28% through close clinical observation without any increase in mortality. Our own exploration rate is about 60%. It is difficult to have hard and fast rules about laparotomies and there are as many protocols as there are authors.

During the period of study, our policy has been to laparotomise those patients with signs of peritoneal irritation (eg. tenderness with rebound, sluggish bowel sounds). In those without peritoneal irritation, a laparotomy was done when a simple toilet and suture revealed torn peritoneum. Over the past 5 years, these two groups of injuries resulted in 8 negative laparotomies, a negative laparotomy rate of 28%.

This is rather high compared to Nance's 11% (4) negative laparotomy rate. This may be attributed to his use of peritoneal lavage, IVP, cystogram and arteriogram studies where appropriate, to identify those genuinely requiring open surgical intervention. In our institution, we have difficulty of access to these investigations on an emergency basis (except for peritoneal lavage). Our patients are healthy young adults and they can tolerate al laparotomy better than most. The advantage of a laparotomy is that it enables definite exclusion of visceral injury and thorough peritoneal toilet if peritoneum is entered. We must therefore ensure that a lower negative laparotomy rate does not result in increasing the number of missed injuries.

Notwithstanding the laparotomy and the negative findings, all the cases recovered without complication and the average period of hospital stay was 7 days. This compares favourably with the negative laparotomy complication rate of 20% morbidity in a study by Lowe (10).

In older patients, where a more complicated post-operative period in anticipated, there is room for a more conservative approach. In such poor risk patients, an abdominal paracentesis or peritoneal lavage might be useful as a pointer to laparotomy as advocated by Nambiar (1).

Although 62.2% of all the abdominal injuries underwent laparotomy we had a low overall complication rate of 17.9% (5/28). Uncommon complications included wound infection, paralytic ileus, intestinal obstruction and renal failure. There was not a single mortality. It would thus appear that our approach to penetrating wounds of the abdomen is safe and effective, albeit giving rise to a slightly higher negative laparotomy rate.

We consider this a small price to pay in order to prevent a missed injury causing possible fatality.

All cases of chest injuries involving pleura were treated by insertion of chest tubes. This is to prevent sucking chest wounds from developing. Only if haemorrhage continues (ie. greater than 1000 mls over 24 hours), is a thoracotomy done. After a thoracotomy the average hospital stay is 11 days compared to 2 days for those inserted with chest tubes.

The complication rate for chest injuries is 6.5% (4 cases out of 62). This is much lower than our abdominal complication rate of 17.9%. It would appear that penetrating injuries of the chest is easier to treat in that treatment can be done under local anaesthesia for the majority; it has a lower complication rate and hospital stay is shorter.

REFERENCES

1. Nambiar R: Abdominal Trauma. South-east Asian J Surg 1978; 1: 78-81.
2. Nambiar R, Ho YM: The diagnosis of abdominal trauma. Ann Academy Med Singapore 1978; 7: 351-53.
3. Donaldson LA, Findlay IG, Smith A: A retrospective review of 89 stab wounds to the chest and abdomen. Br J Surg 1981; 68: 793-7.
4. Nance FC, Wennar MH, Johnson LW et al: Surgical judgement in the management of penetrating wounds of the abdomen. Experience with 2212 patients. Ann Surg 1974; 179: 639-46.
5. Sandrasagra FA: Penetrating thoracoabdominal injuries. Br J Surg 1977; 64: 638-40.
6. Taylor FW: Gunshot wounds of the abdomen. Am Surg 1973; 177: 2: 174-7.
7. Kazarian K, Dispaltro FL, Mckinnon WMP: Stab wounds of the abdomen: an analysis of 500 patients. Arch Surg 1971; 102: 465-8.
8. Maynard AL, Oropeza G: Mandatory operation for penetrating wounds of the abdomen. Am J Surg 1968; 115: 307-12.

9. Moss KL, Schmidt FE, Creech O: Analysis of 550 stab wounds of the abdomen. Am Surg 1962; 28: 483-9.

10. Lowe RJ, Boyd DR, Folk FA et al: The negative laparotomy for abdominal trauma. J Trauma 1972; 12: 853-61.