

Unusually low mortality of penetrating wounds of the chest

Twelve years' experience

Within a 12-year period ending in March 1984, 1109 patients with penetrating thoracic injuries were treated at King-Drew Medical Center located in south central Los Angeles. The average age of the patients was 28.1 years. There were 607 stab wounds and 502 gunshot wounds. Antibiotic prophylaxis was prescribed only for the 428 patients who had laparotomy, thoracotomy, and pulmonary contusion with hemothysis. Of the 1109 patients, 105 had cardiac injuries. All patients with cardiac trauma underwent thoracotomy, and the mortality rate was 18.1%. Specifically, the mortality rate of gunshot wound of the heart 24.5% and that of stab wound of the heart, 11.5%. In contrast, of the 1004 patients without cardiac injuries, only 115 required thoracotomy and the mortality rate in this group was 0.8% (8/1004). The mortality rate was 69.6% in patients who had a thoracotomy in the emergency room but only 2.8% in patients who had a thoracotomy in the operating room within the first 24 hours after admission. In the 242 patients who had associated abdominal injuries, the mortality rate was 2.1% (5/242), as compared with 2.5% (22/867) for those who had isolated chest injuries. In the entire group, the incidence of complications was 5.1%, of which 1.8% were infectious complications. The presence of associated abdominal injuries did not influence the outcome. The mortality rate in noncardiac thoracic injuries is very low compared with that of cardiac injury. Because of the complexity of the injury, gunshot wound of the heart has the highest mortality rate.

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Intentional injury is the leading cause of death in young persons.¹ Penetrating chest wounds are reported to be a major cause of death among inner-city youths.² Ten percent to 20% of penetrating injuries to the chest necessitate surgical treatment.³⁻⁵ Victims of penetrating thoracic injuries in civilian life usually reach the hospital alive; however, as in wartime, lethal truncal injuries often result in death before a treatment unit is reached.⁶ In this article, we have reviewed our experience with penetrating chest injuries.

Patients and methods

Between April 1972 and March 1984, 1109 patients with penetrating injuries to the chest were hospitalized at Martin Luther King, Jr., Los Angeles County General Hospital.

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There were 973 male and 136 female patients whose ages ranged from 10 to 90 years, average 28.1 years (Fig. 1). The causes of injury were stab wounds in 607 patients and gunshot wounds in 502. One hundred five patients had cardiac injuries, 52 (45 male, 7 female) from stab wounds and 53 (50 male, 3 female) from gunshot wounds. The remaining 1004 patients had noncardiac chest injuries. Antibiotic prophylaxis was administered only to 428 patients who had laparotomy, thoracotomy, or pulmonary contusion with hemothysis.

Of the 1109 patients, 220 patients (all 105 with cardiac injuries and 115 with noncardiac injuries) required thoracotomy and 665 patients were managed by tube thoracostomy (Table I). Of the 220 patients having thoracotomy, 23 underwent the procedure in the emergency room, 177 in first 24 hours of hospitalization, and the rest more than 24 hours after admission. A total of 242 laparotomies were performed, all among the patients having noncardiac injury (Table I).

Results

Of 1109 patients, 27 died, for an overall mortality rate of 2.4% (Table II). Mortality rates among patients with cardiac and noncardiac penetrating chest injuries were 18.1% (19/105) and 0.8% (8/1004), respectively. The mortality rate was lower among the stab wound victims in both instances (Table III). The types of injuries among the 27 patients who died are detailed in Table IV. Nearly 70% of patients who required thora-

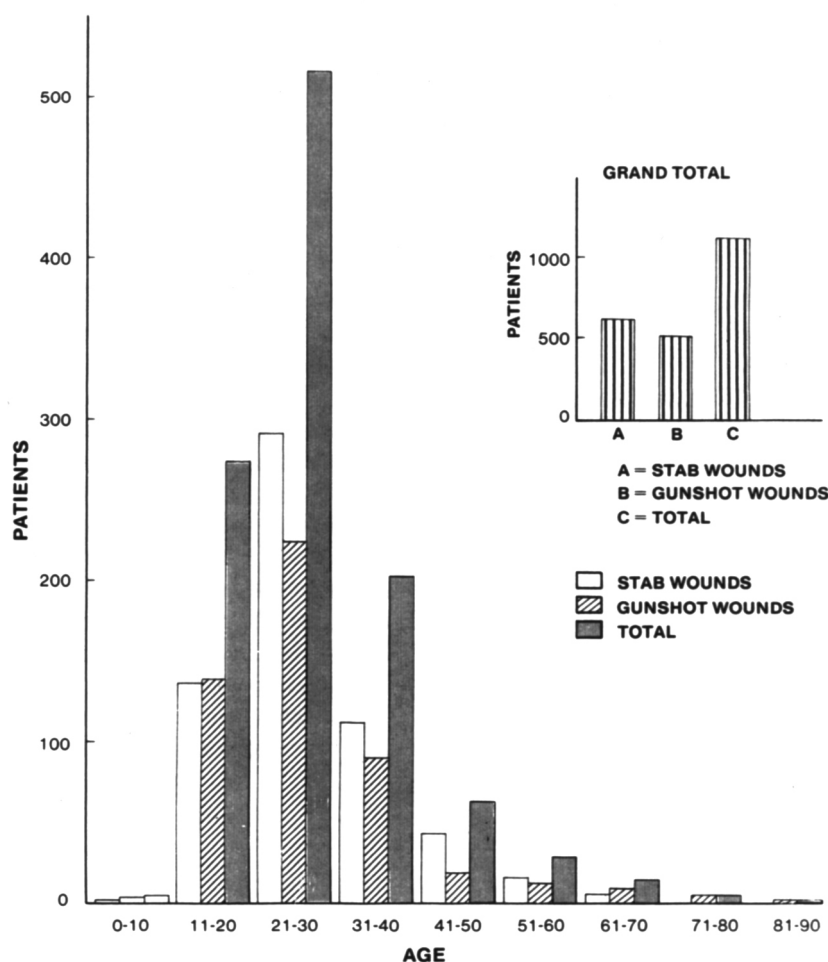


Fig. 1. Penetrating wounds of the chest. Age distribution in 1109 consecutive patients.

cotomy in the emergency room died (16/23), compared with only 2.8% (5/177) if thoracotomy was performed within the first 24 hours of admission to the hospital. On chest roentgenographic examinations, hemothorax was detected in 301 (59.9%) gunshot wound victims and pneumothorax in 230 (37.9%) stab wound patients (Table V). Among the 115 patients with noncardiac injury who had a thoracotomy, the three major sources of bleeding identified were laceration of the lung (79%), bleeding intercostal/internal mammary vessel (65%), and laceration of the subclavian artery (29%).

In the 242 patients with concomitant abdominal injuries, an average of 2.4 abdominal organs were wounded. The intraabdominal organ injuries are listed in order of frequency in Table VI. The diaphragm and liver were the organs most commonly injured. The mortality rate in this group of patients was 2.1% (5/242), as compared with 2.5% (22/867) of those who had isolated chest injuries. One patient with a penetrat-

ing chest injury who had an associated gunshot wound of head and quadriplegia was treated only by tube thoracostomy and died. Among 1082 survivors, the prevalence of complications was 5.1%, but the prevalence of infectious complications was only 1.8% (Table VII). The average hospital stay of the 1082 survivors was 7 days.

Discussion

Management in the emergency room requires an initial head-to-toe systemic examination. Early establishment of a patent airway, insertion of large-bore venous catheters, administration of resuscitative fluids with restoration of intravascular volume, maintenance of cardiac output, evaluation of hemothorax and pneumothorax with or without tension, and assessment of the open chest wound are the immediate objectives in the patient with penetrating thoracic injury. A chest radiographic examination with the patient upright is most

Table I. Type of treatment in 1109 patients with penetrating wounds of the chest

Treatment	Patients					
	Total		SW		GSW	
	No.	%	No.	%	No.	%
Tube thoracostomy	665	59.9	413	68.0	252	50.2
Thoracotomy	172	15.5	88	14.5	84	16.7
Thoracotomy and laparotomy	48	4.3	14	2.3	34	6.7
Tube thoracostomy and laparotomy	194	17.5	72	11.8	122	24.3
Thoracentesis	2		2		0	
Pericardiocentesis	3		3		0	
Observation	25	2.2	15	2.4	10	1.9
Total	1109		607		502	

SW, Stab wound; GSW, gunshot wound.

Table II. Mortality according to type of treatment

Treatment	Patients					
	Total		SW		GSW	
	Deaths/patients	%	Deaths/patients	%	Deaths/patients	%
Tube thoracostomy	1/665	0.15	0/413		1*/252	0.39
Thoracotomy	21/172	12.2	7/88	8.0	14/84	16.6
Thoracotomy and laparotomy	2/48	4.2	1/14	7.1	1/34	2.9
Tube thoracostomy and laparotomy	3/194	1.5	0/72		3/122	2.4
Thoracentesis	0/2		0/2		0	
Pericardiocentesis	0/3		0/3		0	
Observation	0/25		0/15		0/10	
Total	27/1109	2.4	8/607	1.3	19/502	3.8

*Quadriplegic patient.

valuable, although a supine chest radiographic examination also provides valuable diagnostic clues. The most important radiographic examination is a subsequent chest film after placement of an intercostal chest tube. Awareness of the path of penetrating objects is important for the physician to be able to suspect the injuries early. Arterial blood gases are helpful in assessing hypoxemia and acidosis in these patients. Other diagnostic studies such as bronchoscopic, esophagoscopic, esophagographic, and aortographic examinations need to be individualized according to the clinical and chest roentgenographic findings. At present, computed tomographic scanning of the chest has little value for penetrating injuries to the chest. In thoracoabdominal injuries, it is advisable not to perform a contrast roentgenogram examination of the stab wound site (i.e., stabogram) to diagnose penetration of the pleural cavity by the knife.

In large cities, black males have a 1:20 chance of being murdered before the age of 20 years.¹ In the

inner-city population, penetrating thoracic injuries have become one of the leading causes of death. Social altercations usually are resolved with guns, knives, and other "handy" weapons. In southeast Los Angeles, there has been a tremendous increase in the homicide rates among the black population, almost doubling from 35.7/100,000 in 1970 to 61.3/100,000 in 1979. Moreover, homicide rates have almost tripled among Hispanic men from 11.1/100,000 to 29.6/100,000 during the same period.⁷ For all unintentional injuries combined, the death rate in low income areas (areas with less than \$3000 per capita annual income) is twice the rate in areas where per capita income is \$6000 or more.⁸ Penetrating chest wounds are not common in children. We have few patients with penetrating wounds of the chest under the age of 10 years. The general principles of therapy in these patients are the same as those in the adult.⁹ In our series of 1109 patients, 45.2% had a gunshot wound and 54.7% had a stab wound of the chest. Since gunshot wounds are generally associated

Table III. Mortality rates

Type of wounds	No. of patients	No. of deaths	Percent
<i>Penetrating wounds of heart</i>			
Stab wounds	52	6	11.5
Gunshot wounds	53	13	24.5
Total	105	19	18.1
<i>Noncardiac penetrating chest wounds</i>			
Stab wounds	555	2	0.4
Gunshot wounds	449	6	1.3
Total	1004	8	0.8

Table IV. Associated injuries in 27 patients who died of penetrating wounds of the chest

Injuries	No. of deaths		
	SW	GSW	Total
RV + hilar vessels	1	0	1
LV + hilar vessels	1	3	4
LV + RV	2	2	4
LV	0	2	2
LV + RV + LAD + VSD	0	1	1
LV + RV + VSD	0	1	1
LV + LAD + Circ.	0	1	1
LV + LAD	1	0	1
RV + RA + lungs	1	1	2
RA + carotid + esophagus	0	1	1
RA	0	2	2
Brain + lungs	0	1	1
Aortoiliac + colon + hilar vessel	0	1	1
Subclavian artery	0	1	1
Lungs + major abdominal vessel	0	2	2
Lung + hilar vessel	2	0	1
Total	8	19	27

RV, right ventricle; LV, left ventricle; RA, right atrium; VSD, ventricular septal defect; LAD, left anterior descending coronary artery; Circ., circumflex.

with more tissue destruction,¹⁰ we expect to perform more thoracotomies for this type of chest injury. However, the lung with its higher air content and lower specific gravity sustains significantly less devitalization than solid organs, such as the liver, spleen, and kidney, since these organs offer greater resistance to the passage of a missile and thus absorb more kinetic energy.

For our series, the rate of thoracotomy was 19.8% (220/1109), and the percentage of patients treated without operation was 80.2%. In a group of 6452 patients with penetrating injuries, published data collected by Jones and associates¹¹ revealed that 85.4% do not need thoracotomy. On the other hand, recent reports on war injuries in Lebanon⁶ and Iraq¹² indicated that 71% necessitated thoracotomy and the remaining 29%

Table V. Chest roentgenographic findings in patients with penetrating wounds of the chest

Findings	Patients					
	Total		SW		GSW	
	No.	%	No.	%	No.	%
No. of patients	1109		607		502	
Hemothorax	461	41.5	160	26.3	301	59.9
Hemopneumothorax	376	33.9	202	33.3	174	34.6
Pneumothorax	247	22.2	230	37.9	17	3.4
Pneumomediastium	4	0.36	3	0.1	1	0.2
Pulmonary contusion	18	1.6	5	0.8	13	2.6
Normal	25	2.3	15	2.5	10	2.0

were managed by tube thoracostomy. Of course, the causative agent and magnitude of war injuries are different from civilian handgun injuries.

The mortality rate for gunshot wound of the chest varies from 14.3% to 36.8%.^{13,14} The mortality rate for our patients with gunshot wound of the heart was 24.5% and with stab wound, 11.5%. On the other hand, the mortality rate for noncardiac penetrating chest injury was 1.3% for gunshot wound and 0.4% for stab wound. The overall mortality rate in 1109 patients was 2.4%, with 1.3% for stab wounds and 3.8% for gunshot wounds. Although surprisingly low, the mortality rate in gunshot wound of the chest is nearly three times that of stab wound injuries.

We believe that thoracotomy always should be performed in the operating room if the patient's condition permits. The indications for emergency thoracotomy include the following: massive bleeding (1.0 to 1.5 L) with persistent blood loss (200 ml/hr for 3 hours); bronchial injury (massive air leak) in which the lung cannot be expanded with two well-placed, functioning, large-bore chest tubes; esophageal injury; pericardial tamponade; diaphragmatic injury; loss of part of the chest wall; large intrathoracic foreign bodies; great vessel injuries; and acute deterioration of the patient's condition. Urgent thoracotomy saves the life of the patient. From our experience, the mortality rate is related directly to the rapidity with which thoracotomy is needed. This belief has been supported by other investigators.¹⁵⁻¹⁸ In patients treated by emergency room thoracotomy, the mortality rate was 69.6%. This rate dropped to 2.8% when thoracotomy was performed within the first 24 hours. Of the total 27 deaths, most were the result of injuries to the heart and great vessels. Most of these cardiac injuries involved multiple chambers, a situation that remains problematic to treat successfully even with aggressive emergency room tho-

Table VI. Intraabdominal organ injuries in 242 of the 1109 patients with penetrating wounds of the chest

Organs involved	Incidence		
	SW	GSW	Total
Diaphragm	70	133	203
Liver	46	99	145
Spleen	28	39	67
Stomach	23	40	63
Colon	8	22	30
Small bowel	4	16	20
Kidney	3	11	14
Pancreas	2	11	13
Inferior vena cava	1	8	9
Gallbladder	0	6	6
Bladder	1	4	5
Iliac artery	1	2	3
Aorta	0	2	2
Hepatic artery	0	1	1
Portal vein	0	1	1
Uterus	0	1	1
Total	187	396	583

racotomy.^{19,21} We could not determine how many patients having thoracotomy in the emergency room died of air embolism after trauma, although we did notice air in the coronary artery system in six patients during emergency thoracotomy for gunshot wound of the heart. The clinical diagnosis can be overlooked because air embolism is insidious: The signs and symptoms are not specific and not different from hypovolemic shock or arrest, and detection of air in the vascular system is mostly accidental.²² The survival rate after emergency room thoracotomy ranged from 5% to 25%.¹⁵⁻¹⁸ Although that survival rate is not high, the results are particularly gratifying in patients with a single penetrating wound of the heart who has some signs of life on admission.^{19,23,24}

Many have reported that the prevalence of thoracoabdominal injuries is 10% to 30%.²⁵⁻²⁷ In this study, associated abdominal injuries were found in 242 (21.8%) patients with intrathoracic injuries. For patients who have wounds at the thoracoabdominal area, even without a pneumothorax, we recommend preoperative tube thoracostomy (prophylactic chest tube) plus laparotomy to prevent the development of a tension pneumothorax during general anesthesia and positive-pressure ventilation.^{3, 26} Thoracoabdominal injuries tend to be more lethal than isolated thoracic injuries.¹³ The mortality rates in patients (n = 48) who required both laparotomy and thoracotomy and in patients (n = 194) who underwent tube thoracostomy and laparotomy were

Table VII. Complications among 1082 survivors of penetrating wounds of the chest

Complications	Prevalence		
	SW	GSW	Total
Atelectasis	6	9	15
Pneumonia*	2	4	6
Empyema*	1	4	5
Septicemia*	2	3	5
Subphrenic abscess*	0	4	4
Pericardial effusion	0	4	4
Pleuro-biliary fistula	0	4	4
Delirium tremens	2	0	2
Dressler's syndrome	1	1	2
Pancreatitis	1	0	1
Acute renal failure	0	1	1
Small bowel obstruction	1	0	1
Reoperation for bleeding	1	1	2
Paraplegia	0	2	2
Quadriplegia	0	1	1
Total	17	38	55 (5.1%)

*Infectious complications.

4.2% and 1.5%, respectively. Only five patients of 242 patients with thoracoabdominal injuries died. Thus the overall mortality rate was only 2.1% as compared with 2.5% (22/867) for those who had isolated chest injuries. In our series, therefore, presence of associated abdominal injuries did not influence the outcome. In patients with thoracoabdominal injuries not necessitating thoracotomy, laparotomy should be performed after the injury to the thorax has been controlled by conservative therapy. On the other hand, when thoracotomy is needed for thoracoabdominal injuries, thoracotomy should be performed before the laparotomy. Sometimes laparotomy and thoracotomy are required simultaneously, and if needed a separate incision should be used to prevent cross-contamination of the pleural cavity. We advise that a contrast roentgenogram examination of the stab wound not be performed because of the risk of further contaminating the pleural cavity. Also, such studies have a high incidence of false negative results.

In abdominal trauma, antibiotic usage is therapeutic, not prophylactic, because the peritoneum has already been contaminated by spillage of intestinal bacteria. The value of antimicrobial prophylaxis in chest trauma is still controversial unless the esophagus is injured. Normally, the tracheobronchial tree is sterile, and the esophagus contains the mouth flora.

Handguns are considered to be low-velocity weapons, whereas all rifles (except the 0.22 long rifles) should be considered high-velocity weapons. (Any missile traveling faster than 1800 feet/sec, regardless of its size, is

considered to be a high-velocity missile.) Wounds from low-velocity missiles are considered clean. A high-velocity missile wound must be considered contaminated because it brings a large amount of foreign material into both the entrance and exit wound sites. Those wounds must be debrided extensively besides being treated with appropriate antibiotic therapy. Antibiotics are not prescribed routinely unless there are specific indications such as thoracotomy, laparotomy, pulmonary contusion with hemoptysis, and extensive destruction of the lung substance and/or soft tissue by a shotgun blast.^{28, 29} Although we did not use prophylactic antibiotics in general, the prevalence of infectious complications among the survivors surprisingly was only 1.8%. However, other reports support the routine use of antibiotic prophylaxis.^{30, 31} The most effective way to prevent infection is placement of a properly functioning chest tube, discontinuation of mechanical ventilation in a timely manner, and thoracotomy as soon as indicated. Because in many instances clotted hemothorax and pleural effusion with or without pneumothorax will become infected from the outside, from lung or from abdominal trauma, an empty pleural space must be maintained with the apposition of the lung to the chest wall. The source of organisms leading to colonization and infection in critically ill patients with thoracic injuries who need mechanical ventilation for 5 days or more is usually endogenous, coming from bacteria that colonize the patient's oropharynx and alimentary tract. All parenterally prescribed antibacterial agents are secreted into the oropharynx via saliva and in lower concentrations into the intestines via bile and mucosa. The combination of high concentrations of hospital bacteria and low antibiotic concentration leads to the emergence of resistant organisms.^{31, 32}

Twenty-five patients (2.2%) required only simple observation for minor injuries of the pleural cavity as a result of penetrating injuries of the chest. None of these patients required delayed chest tube drainage. The prevalence of delayed, expanding pneumothorax and hemothorax has been reported in the literature to be 8% to 9%.^{33, 34} In most of these patients delayed hemothorax or pneumothorax developed within 6 hours, but in some, within 12 hours to 3 days.³⁵ Ordog, Balasubramaniam, and Wasserberger³⁶ concluded that patients with gunshot wounds to the chest with normal vital signs and normal findings on x-ray films can be treated reasonably as outpatients after 4 hours of observation.

Although injury severity scores were not calculated for the injuries in our 1109 patients, scores were reported in 875 with gunshot wounds.³⁷ They revealed

increased mortality rates with increasing scores, but the relationship was not linear.³⁷

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REFERENCES

1. Trunkey DD. Trauma. *Sci Am* 1983;249:28-36.
2. Miller DW, Hutchinson JE, Malm JR. Chest trauma: its nature in an urban ghetto, *NY State J Med* 1976;7: 1103-5.
3. Oparah SS, Mandal AK. Operative management of penetrating wounds of the chest in civilian practice. *J THORAC CARDIOVASC SURG* 1979;77:162-8.
4. Beall AC, Crawford HW, DeBailey ME. Considerations in the management of acute traumatic hemothorax. *J THORAC CARDIOVASC SURG* 1966;52:351-60.
5. Reul GJ, Mattox KL, Beall AC, Jordan GL. Recent advances in the operative management of massive chest trauma. *Ann Thorac Surg* 1973;16:32-66.
6. Zakharia AT. Thoracic battle injuries in the Lebanon War: Review of the early operative approach in 1,992 patients. *Ann Thorac Surg* 1985;40:209-12.
7. Homicide—Los Angeles, 1970-1979: morbidity and mortality weekly report. Atlanta, Georgia: Centers for Disease Control, 1986;35:61-5.
8. Baker SP, O'Neill B, Karpf RS. The injury fact book. Lexington, Massachusetts: DC Health and Company, 1984.
9. Burrington JD. Chest injuries in children. *Can J Surg* 1984;27:466-9.
10. Demuth WE. Bullet velocity and design as determinants of wounding capability: an experimental study. *J Trauma* 1966;6:222-32.
11. Jones JW, Kitchema A, Webb WR, McSwain N. Emergency thoracotomy: a logical approach to chest trauma management. *J Trauma* 1981;21:280-4.
12. Suleman ND, Rasoul HA. War injuries of the chest. *Injury* 1985;16:382-4.
13. Kish G, Kozloff L, Joseph WL, Adkins PC. Indications of early thoracotomy in the management of chest trauma. *Ann Thorac Surg* 1976;22:23-8.
14. Beall AC, Crosthwait RW, Crawford ES, DeBailey ME. Gunshot wounds of the chest: a plea for individualization. *J Trauma* 1964;4:382-8.
15. Baker CC, Thomas AN, Trunkey DD. The role of emergency room thoracotomy in trauma. *J Trauma* 1980; 20:848-55.
16. Washington B, Wilson R, Steiger Z, Bassett JS. Emergency thoracotomy: a four-year review. *Ann Thorac Surg* 1985;40:188-91.
17. Demetriades D, Rabinowitz B, Sofianos C. Emergency room thoracotomy for stab wounds to the chest and neck. *J Trauma* 1987;27:483-5.
18. Flynn TC, Ward RE, Miller PW. Emergency room thoracotomy. *Ann Emerg Med* 1982;11:413-6.

19. Rohman M, Ivatury RR, Steichen FM, et al. Emergency room thoracotomy for penetrating cardiac injuries. *J Trauma* 1983;23:570-6.
20. Carrasquilla C, Wilson RF, Walt AJ, Arbulu A. Gunshot wounds of the heart. *Ann Thorac Surg* 1972;13:208-13.
21. Marshall WG Jr, Bell JL, Kouchoukos NT. Penetrating cardiac trauma. *J Trauma* 1984;24:147-9.
22. Yee SE, Verrier ED, Thomas AN. Management of air embolism in blunt and penetrating thoracic trauma. *J THORAC CARDIOVASC SURG* 1983;85:661-8.
23. Mandal AK, Awariefe SO, Oparah SS. Experience in the management of 50 consecutive penetrating wounds of the heart. *Br J Surg* 1979;66:565-8.
24. Kaushik VD, Mandal AK, Awariefe AO, Oparah SS, Ekong EA, Francis CK. Early thoracotomy for stab wounds of the heart. *J Cardiovasc Surg* 1979;20:423-6.
25. Boraj AR, Ransdell HH. Treatment of thoracoabdominal gunshot wounds in civilian practice. *Am J Surg* 1971;121:580-2.
26. Oparah SS, Mandal AK. Penetrating gunshot wounds of the chest in civilian practice: experience with 250 consecutive cases. *Br J Surg* 1978;65:45-8.
27. Adkins RB Jr, Whiteneck JM, Woltering EA. Penetrating chest wall and thoracic injuries. *Am Surg* 1985;51:140-8.
28. Mandal AK, Montano J, Thadepalli H. Prophylactic antibiotics and no antibiotics compared in penetrating chest trauma. *J Trauma* 1985;25:639-43.
29. Oparah SS, Mandal AK. Penetrating stab wounds of the chest: experience with 200 consecutive cases. *J Trauma* 1976;16:868-72.
30. Grover FL, Richardson JD, Fewer JG, Arom KV, Webb GE, Trinkle JK. Prophylactic antibiotics in the treatment of penetrating chest wounds. *J THORAC CARDIOVASC SURG* 1977;74:528-36.
31. Walker WE, Kapelanski DP, Weiland AP, Stewart JD, Duke JH Jr. Patterns of infection and mortality in thoracic trauma. *Ann Surg* 1985;201:752-7.
32. Vansaene HKF, Stoutenbeek P, Miranda DR, Zandstra DF, Langrehr D. Recent advances in the control of infection in patients with thoracic injury. *Injury* 1986;17:332-5.
33. Weigelt JA, Aurbakken CM, Meier DE, Thal ER. Management of asymptomatic patients following stab wounds to the chest. *J Trauma* 1982;22:291-4.
34. Muckart DJJ. Delayed pneumothorax and hemothorax following observation for stab wounds of the chest. *Injury* 1985;16:247-8.
35. McLatchie GR, Cambell C, Hutchison JSF. Pneumothorax of late onset after chest stabbings. *Injury* 1980;11:331-5.
36. Ordog JG, Balasubramaniam S, Wasserberger J. Outpatient management of 357 gunshot wounds to the chest. *J Trauma* 1983;23:832-5.
37. Beverland DE, Rutherford WH. An assessment of validity of the injury severity score when applied to gunshot wounds. *Injury* 1983;15:19-22.