

Prevention of Infection in War Chest Injuries

H. ROMANOFF, M.D., F.A.C.S.*

Infection is a major complication of military chest injuries. In a series of 142 wounded, infectious complications occurred in 7 (4.9%). Factors influencing the incidence of infection are evaluated. In this group of injuries, 81 patients were admitted soon after wounding. The intrathoracic damage was severe, due to penetration of metallic fragments. The hemothorax was treated by immediate intercostal drainage. Immediate thoracotomy was performed in 10 patients and late thoracotomy in 15. One patient developed a lung abscess and 5 patients had infection following thoracotomy (7.4%). Another 61 wounded patients had been first managed in a forward hospital, including three with thoracotomy for massive bleeding. Two, not in a forward hospital, had a bullet removed from the lung. Upon admission to this hospital, intercostal drains were inserted when needed and four patients underwent thoracotomy. Larger wounds were debrided in 24 patients. Late thoracotomy was performed in seven. Chronic empyema developed in one patient after pneumonectomy performed at the field hospital, resulting in a resuscitation or infection rate of less than 2%. Factors contributing to a low infection rate were: early drainage of hemothoraces and wide debridement of larger wounds with delayed closure and avoidance of thoracotomy as primary treatment. Resection of lung tissue was avoided. Thoraco-abdominal injuries were treated separately. The clotted hemothorax was immediately evacuated. Prolonged antibiotic therapy was usually indicated.

CONSIDERABLE PROGRESS has been made in the last decades in the management of war wounds of the chest. As stated by DeBakey, reductions in morbidity and mortality of chest wounds have been noted in each war.⁹ The early treatment of the wounded, begun close to the geographical site of injury, rapid evacuation to a large base hospital where specialists of all surgical disciplines and necessary facilities are available have all been important factors in the improvements of the results.^{12,18}

Infection of the contaminated chest remains a severe complication of the penetrating injury and prevention of

*From the Unit of Thoracic and Vascular Surgery
Hadassah University Hospital, Jerusalem, Israel*

infection is the surgeon's main concern. It was frequent in the past, and chronic, prolonged thoracic infections and fistulae plagued many wounded.⁴ In a series including 69 wounds of the chest from the year 1945, infectious complications occurred in 56.5% of the cases.⁴ In another series from the war of Indochina, a 46% rate of septic complications was noted.⁴ Better results were later obtained in the Algerian, Korean and Vietnam war theaters.^{4,5,21,22}

In the present study, two groups of patients with war wounds of the chest are analyzed, the emphasis being on the factors in management which had an influence on the rate of infection. Early and previous experience with the management of war chest injuries has been reported elsewhere.^{17,18}

Materials

The Six-Day War (June 1967) and later.

The first group of patients includes 81 with wounds of the chest incurred during the Six-Day War in June 1967 and during regional military activities in the subsequent five years. These wounded were evacuated as soon as feasible after wounding and transported rapidly to this hospital. The great majority of these were admitted shortly after wounding. Resuscitative measures were undertaken on admission, if not already started during transport.

The injury had been caused in a few cases by bullets but more frequently by splinters and shrapnel. There were 6 patients with stab wounds. Fifty-one patients had suffered two or more injuries, including abdominal penetration in 16 patients. The chest injury was naturally given priority and the patient was later transferred to the care of the particular surgeon involved, general, orthopedic, plastic, etc.

Submitted for publication April 3, 1975.

*Associate Professor, Hadassah Hebrew University Medical School. Head of Unit. Presently Head of Department of Vascular Surgery, Hadassah University Hospital, Jerusalem.

Reprint requests: Prof. H. Romanoff, P.O. Box 499, Jerusalem, Israel.

TABLE 1. *Surgical Management of the Chest Injury in 81 Wounded*

Procedure	Nos Patients
Wound Debridement	10
Aspiration of the Hemothorax	4
Intercostal Drainage Only	52
Drainage and Thoracotomy	15
Immediate Thoracotomy	10
Tracheostomy	6
Delayed Primary Suture	10

The entrance wounds into the chest were often of small diameter but the intrathoracic damage was generally severe and extensive with massive hemothoraces and widely spread lung hematomata. In only four patients the hemothorax was small and was managed by a pleural tap. Sixty-seven patients were treated by immediate insertion of an intercostal drain connected to a water-seal system using mild negative suction. This effected prompt re-expansion of the lung and contributed to the restoration of the well-being of the patient.

Three to 5 millions Units of crystalline Penicillin were added to each 500 ml bottle of I.V. administered fluids. Streptomycin 1g/day was also administered.

Wounds larger than 2 to 3 cm were debrided soon after admission and left open as a rule. Delayed suture of the wounds was done 4 to 5 days later. In one instance, the wound had to be reopened because of infection. It was closed a few days later.

Progress was checked by frequent chest roentgenograms. Breathing exercises were started early. Antibiotics, Penbritin and Orbenin, 3 to 4 g/day each, were

given by mouth following the Penicillin and Streptomycin injections administered in the first days. The chest tubes were usually removed 2 to 5 days after insertion.

Fifty-Six patients thus treated recovered quickly from their chest injury and were soon discharged to convalescence if no other injury was present and their condition allowed (Table 1). Additional measures taken were tracheostomy (6 patients) and formal thoracotomy (15 patients) (Table 1). Immediate thoracotomy was also performed in 10 additional patients. It was performed soon after wounding in a patient dying from exsanguination. Thoracotomy was also performed upon admission because of profuse bleeding from wide extensive chest wall defects, combined thoracoabdominal injury with rupture of the diaphragm, removal of a large shrapnel from the chest and cardiac tamponade after chest drainage (Table 2).

Thoracotomy became necessary because of continuous bleeding through the chest tubes in four patients. It was also performed at a later stage, during hospitalization for removal of a foreign body in the lung, cardiac tamponade or mainly, for evacuation of a clotted hemothorax. Surgical intervention was decided upon without further delay in these patients when fever appeared.

At operation, hemostasis, removal of clots, suture of a lung laceration, closure of a wide chest wall defect or lung decortication, were done as indicated. The lung hematoma which was present in all patients was left undisturbed. In one patient the apical segment of the left lower lobe, which was totally destroyed by the penetration of a large shrapnel lodged in the diaphragm, was removed. This was the only resection of lung tissue performed in a patient in this group. Recovery was complicated by a localized empyema and wound infection, which subsided slowly after several months of treatment (Table 3).

TABLE 2. *Indications for Thoracotomy in 25 Wounded of the Chest and Outcome.*

	Nos Patients	Recovered	Died
Immediate			
Exsanguination Resuscitation	1		1
Extensive Chest Wall Defect	4	3	1
Thoracoabdominal Injury	4	3	1
Removal of Foreign Body	1	1	
Cardiac Tamponade	1	1	
Early			
Continuous Bleeding	4	4	
Delayed			
Foreign Body Removal	1	1	
Cardiac Tamponade	2	1	1
Clotted Hemothorax	7	6	1
Total	25	20	5

Results

Fever was present in all patients for several days after wounding. It subsided slowly and gradually under antibiotic therapy. Fever reappeared a few days after discharge in one patient who had left the hospital one week after wounding. He had been treated for a left massive hemothorax and lung hematoma. The hemothorax had been managed by intercostal drainage and antibiotics were administered until his discharge. When seen again, a lung abscess had developed in the left lower lobe which was the site of the hematoma. The abscess responded well to prolonged antibiotic therapy.

There were no other infectious complications among those patients managed "conservatively" by intercostal drainage and prolonged antibiotic therapy.

Infectious complications occurred in 5 patients follow-

TABLE 3. *Infectious Complications in the First Group of 81 Wounded, Surgical Procedure Employed, and Outcome.*

Procedure	Infected Lung Hematoma	Infected Wound Only	Infected Wound and Empyema	Total	Recovered	Died
Aspiration Only (4 patients)	0	0	0	0		0
Intercostal Drainage Only (59 patients)	1	0	0	1	1	0
Thoracotomy (25 patients)	0	2	3	5	4	1
Total	1	2	3	6	5	1

ing thoracotomy (20%). All had infection of the thoracotomy incision and empyema occurred in three of them (Table 3). Four patients recovered and one died from a severe brain injury without regaining consciousness. Thus, a total of 6 cases were recorded as having infection in the whole group (7.40%). Another patient had a subdiaphragmatic abscess which developed following resection of a lacerated colonic flexure after a thoraco-abdominal injury. There was no chest infection. The subdiaphragmatic infection subsided following drainage.

Tracheostomy was performed much less liberally than in previous years. This no doubt reduced to a minimum the infection of the upper airways.

Ten patients died from either bleeding, pulmonary embolism, brain injury or respiratory failure (Table 4).

The October 1973 War

The second group of patients includes 61 with chest wounds incurred during the Yom Kippour War in October 1973. These were evacuated to this Institution from a forward hospital installation in which the necessary resuscitative measures had already been done. Many patients already had a drainage tube inserted into their chest and their condition was in general good on admission. Diagnostic procedures such as chest x-rays examinations were immediately started and intravenous fluid administration continued. Crystalline Penicillin and streptomycin were also given.

All injuries, except for one case of blunt trauma, had resulted from the penetration of bullets into the chest in a

few cases or shell fragments in most of them. Scattered soft tissue wounds were common.

Eighteen patients had a chest injury only while 45 patients had multiple injuries, such as abdominal penetration in 25 cases. In two cases, the splinter had not penetrated the chest cavity. In many patients, the entrance wound was very small but the intrathoracic damage was severe. All patients had at least one or two rib fractures. Massive hemothorax was present in 57 patients being bilateral in three of them. Thirteen patients had hemo-pneumothorax. All patients had lung hematomas of various sizes, but nine of them had massive hematomas.

Drainage tubes were repositioned in a few cases and chest drains inserted in 10 cases during the course of hospitalization.

Thirty-eight patients treated conservatively by tube drainage recovered with no infectious complication.

Thirty patients had larger wounds, 6 of them other than in the chest. These wounds were debrided and explored under general anesthesia. In nine patients, the exploration revealed a wide defect in the rib cage. Clots and bony fragments and foreign bodies were removed from the pleura or the lung. The lung hematoma was left undisturbed. Deep lacerations in the lung were approximated if feasible. The pleural cavity was thoroughly irrigated and a drain inserted. The defect in the chest wall was closed by approximation and the soft tissue wound as a rule was left open. It was closed 3 to 5 days later in 19 patients (Table 5).

Thoracotomy was performed early following admission for removal of a large jagged splinter lying over the ascending aorta in one patient, or in the lung in another. In two patients, thoracotomy was done because of continuous bleeding through the chest tubes. The bleeding had originated from a chest wall injury in both patients.

Another 5 patients in this series had undergone thoracotomy elsewhere, three at the field hospital for massive bleeding and two had a bullet removed from the lung in another base hospital (Table 6).

Late thoracotomy was performed in 7 patients during

TABLE 4. *Mortality in the First Group of 81 Wounded.*

Cause of Death	Nos Patients
Bleeding	6
Pulmonary Embolism	2
Brain Injury	1
Respiratory Insufficiency	1
Total	10

TABLE 5. *Surgical Procedures in 63 Wounded, (Chest Injury in 61 Wounded).*

Procedure	Nos Patients
Wound Debridement	15
Debridement-Exploration	9*
Intercostal Drainage Only	38**
Thoracotomy	16
Repeated Aspirations	
Following Drainage	10
Delayed Primary Suture	19

*6 of these patients had wounds other than in the chest.

**In 10 of these patients, diagnosis and drainage of the hemothorax was done in this hospital, in 28 patients, at field hospital.

their hospital stay, because of a clotted hemothorax and non expanding lung in 4 patients and to remove a splinter from the lung in another. Exploratory thoracotomy was performed in two additional patients not included in this series, suspected of developing cardiac tamponade or septic pericarditis. The exploration was negative in both patients (Table 6).

Respiratory support was needed for short periods of time in four patients following the debridement-exploration procedure. They were transferred to the Intensive Respiratory Care Unit. All four recovered completely.

Progress was checked by frequent roentgenograms of the chest and blood gas determinations. Physiotherapy was used intensively. Penbritin and Orbenin, 4 g/day orally were given for about two weeks following the penicillin and streptomycin injections.

Pleural taps were performed in 10 patients for residual fluid in the chest and chest drains were inserted in 10 other patients during their hospitalization, (hemothorax in seven patients and pneumothorax in three patients) (Table 5).

Results

Fever was noted in all patients. It subsided slowly and gradually in a few days. There was not a single instance of wound infection. One patient developed throm-

TABLE 6. *Indications for Thoracotomy in 16 Wounded*

	Nos Patients
Immediate	
Splinter removal	2
Bleeding and Chest Wall Defect	2
Bleeding	3*
Bullet removal	2*
Delayed and Late	
Suspected tamponade	1
Suspected Pericarditis	1
Clotted Hemothorax	4
Splinter removal	1

*Thoracotomy performed at field hospital or at another base hospital.

bophlebitis in his left leg. All lung hematomata cleared without infection. Empyema developed in one patient who had undergone a right pneumonectomy at the field hospital during resuscitation measures for cardiac arrest and exsanguination. Chronic empyema and bronchopleural fistula were still present one year after injury. The infection rate in this group of patients is thus less than 2%.

The only death recorded in this series is not really related to a chest trauma. It occurred in the patient who had sepsis following an abdominal penetrating wound and who underwent exploratory thoracotomy as septic pericarditis was suspected.

Infectious complications after thoracic wounding were thus noted in 7 wounded in both groups of patients, (a total of 142 cases) giving an overall infection rate of 4.9%.

Comment

Bourdet and associates, in an analysis of a consecutive series of 785 cases of war chest injuries, concluded in a recent paper that infection was the most frequent complication recorded.⁴ It was also the most frequent complication noted in Beall and associates' series of 694 cases of penetrating chest injuries in civilians.¹

The 25-30% incidence of empyemata noted in World War I²⁰ and early years of World War II¹⁴ with its subsequent mortality of 30-50%¹⁵ was reduced to 10% at the end of the war,⁶ with a mortality of 20%.¹⁵ It rose again to 26% in the early part of the Korean conflict.^{14,21} It was significantly less in Patterson and associates' series¹⁶ and Virgilio's experience from Vietnam²² or still higher in Glass' experience, a 35.5% complication rate.¹¹

The incidence of wound infection was also high in the not too distant past. A series of 69 wounded in the year 1945 shows a rate of 64% of infected wounds.⁴ A series of 120 wounded from Indochina shows a 50% incidence of infected wounds among those who had their wound debrided.⁴ Wound infection was less frequent in the Algerian War. There were 7% of infected wounds only among those who had debridement of their wounds.⁴

The infectious complication following a thoracic wound has been related to one of the following causes⁴: 1) non-intervention at all in the presence of hemothorax or puncture of the pleura only; 2) inadequate debridement of the wound, and 3) thoracotomy done as primary treatment in the management of the patient.

The management of the hemothorax by systemic drainage of the pleura has become widely accepted in the Vietnam war only.^{15,16,22} Surgeons during the Korean Conflict^{14,16} were divided between those in favor of intercostal drainage and those who preferred thoracentesis which was the accepted practice in World War II.^{10,15} Vallee, who treated a large group of patients from Korea advocated aspiration of the traumatic hemothorax.²¹ He also stated that early evacuation of the pleural space and

its obliteration had prevented many cases of infection. Although widely used later in civilian chest injuries, intercostal drainage was only done in a small number of cases at the end of the Algerian War.⁴

The effectiveness and advantages of the method have been repeatedly confirmed in the abundant literature available. As an example, there were only two cases of empyema occurring in Virgilio's series of 125 wounded of the chest in Vietnam. Ninety four per cent of the cases were adequately treated by tube thoracostomy.²² In Beall and associates' series of 921 civilian penetrating chest injuries, only 9 cases of empyema were noted.²

Clotting and infection of the pleural cavity have been directly related to incomplete or inadequate drainage of the cavity.⁸

The two groups of patients reported in the present study show really no essential difference in the character of the chest injury sustained. In both, severe intrathoracic damage was present and had been caused in the majority of cases by small splinters and shrapnels. It seems right however to maintain the division into two groups as this allows for a better evaluation of the concept of primary treatment in a forward hospital, to be completed later in a base hospital. The hospital functioned as a forward hospital as well as a base hospital for the patients of the first group whereas patients of the second group were evacuated to this hospital only after having been treated first in a forward hospital installation, soon after wounding. This experience is in accordance with the policy of initial management of the wounded as practiced in Vietnam¹⁶ and shows clearly that treatment started as soon as feasible after wounding proved most

beneficial. Among other steps in management, one can reasonably state that early evacuation of the contaminated pleural fluid content suppressed effectively the development of infection in the pleural cavity.

Worth discussing is the high rate of infectious complications which occurred among those patients who underwent primary thoracotomy as initial management after injury. The treatment of the chest injury was essentially conservative in this series and was such in Vietnam.^{15,22} The severity of the injury however, dictated urgent intervention in individual cases. This primary thoracotomy evidently increased the risk of infection. It has been considered for long as a most serious intervention because of the risk of infection involved. The series from the year 1945 quoted above shows a 75% rate on infection developing among those patients who underwent thoracotomy.⁴ The series from the Indochina War shows that 90% of the primary thoracotomies became infected.⁴ In a series from Algeria, thoracotomy was done in 21% of the cases. Twenty-two per cent of these became infected.⁴ In a series of 476 chest injuries from Vietnam, initial thoracotomy was done in 10.8% of patients and infectious complications developed in 16.6%. In those treated only by intercostal drainage, a 6.1% rate of empyema was noted.¹⁶

At thoracotomy, hemostasis was secured and large intrathoracic foreign bodies were removed. The lung hematoma was left undisturbed. Deep lacerations in the lung substance were loosely approximated care being taken to avoid the formation of a closed cavity. Resection of lung parenchyma was avoided, as a rule, thus eliminating the possibility of a residual space formation.

TABLE 7. Infectious Complications Observed in Both Groups of Patients

	Nos Patients	Lung Abscess	Wound Infection Only	Wound Infection and Empyema	Empyema	Total Nos Infections	%
First Group							
Patients treated conservatively	56	1				1	1.7
Patients Operated	25		2	3		5	20
Subtotal	81	1	2	3		6	7.4
Second Group							
Patients treated conservatively	38	0	0	0	0	0	
Patients Operated	25*	0	0	0	1	1	1.58**
Subtotal	63	0	0	0	1	1	1.58
Total	144	1	2	3	1	7	4.86†

*Exploratory thoracotomy was performed in 2 patients who had no chest injury.

**1.63% in 61 patients with chest injuries.

†4.92% in 142 patients.

Injured who suffered a "traumatic thoracotomy" were encountered in the first group of patients only. This term has been used by Shefts and Doud during the World War II to describe the large open wound of the chest, wide as palm.¹⁹ These wounds were debrided down to the pleura, the bone edges were trimmed and hemostasis secured. The lung, as described above, was treated "conservatively" and an effort was made to close the chest, leaving the superficial soft parts open. Worth mentioning is the fact that closure of those open chest wounds was already being done in the second half of World War I.²²

Thoraco-abdominal injuries, in both groups, were treated separately by tube thoracostomy and laparotomy or a separate thoracotomy when needed, thus avoiding the contamination of the pleural space by intestinal contents, as advised by Carter and DeBakey.^{3,7,16}

A high incidence of infected wounds has been noted in patients who did have their wounds debrided.⁴ This leads one to believe that debridement in those cases has not been adequately carried out. A penetrating wound of the chest should be considered as a potential candidate for suction according to Hughes.¹³ Therefore, all wounds with a diameter larger than 2 cm were systematically explored under general anesthesia, in patients admitted to this hospital during the October 1973 War. Debridement of the wound revealed a wide opening in the chest wall in 9 patients. The pleural contents were aspirated and the pleura thoroughly irrigated. The drain was repositioned when necessary and the chest wall closed. This wide debridement was already commonly used in World War II.¹² The soft parts were left open and not closed primarily as in Virgilio's cases.²² They were sutured several days later with no complications.^{5,12,18}

It is believed that this relatively more active attitude which was adopted in the management of these latter cases contributed significantly to the favorable outcome and lowered considerably the incidence of infection of the chest wounds.

Conclusion

Infection following war chest injuries was common in the past and remains a major complication of these wounds.

A series of 142 wounded is reported, from the Six-Day War of June 1967 and 5 years later and from the Yom Kippour War of October 1973. The first group includes 81 injured admitted soon after wounding and the second group of 61 which were managed first in a forward hospital before being admitted to our hospital. Infection occurred in 6 patients of the first group (7.4%) and in one patient of the second (less than 2%), a total rate of 4.9%.

Factors which contributed to the low incidence of infection were: early drainage of the hemothorax, prolonged antibiotic therapy and avoidance of thoracotomy as primary treatment. Infection occurred indeed mainly

in these cases. Resection of lung tissue was avoided. Thoracoabdominal injuries were dealt with separately. Larger wounds, over 2 cm in diameter, were widely debrided and in a few instances, a wide opening into the chest was found. Delayed closure of wounds was the rule. Clotted hemothoraces were evacuated as soon as diagnosed, in accordance with the principle of securing the early complete obliteration of the pleural space.

References

1. Beall, A.C. Jr., Bricker, D.L., Crawford, H.W. and DeBakey, M.E.: Surgical Management of Penetrating Thoracic Trauma. *Dis. Chest*, 49:568-577, 1966.
2. Beall, A.C., Jr., Crawford, H.W. and DeBakey, M.E.: Considerations in the Management of Acute Traumatic Hemothorax. *J. Thorac. Cardiovasc. Surg.*, 52:351-360, 1967.
3. Borja, A.R. and Ransdell, H.: Treatment of Thoracoabdominal Gunshot Wounds in Civilian Practice. *Am. J. Surg.*, 121:580-582, 1971.
4. Bourdet, P., Rignault, D. and Fort, V.: Les Plaies de Poitrine en Chirurgie de Guerre. *Ann. Chir. Thorac. Cardiovasc.*, 10:387-391, 1971.
5. Bowers, W.F., Merchant, F.T. and Judy, K.H.: The present story in battle casualties from Korea—A 6 month's study. *Surg. Gynecol. Obstet.*, 93:529-542, 1951.
6. Burford, T.H., Parker, E.P. and Samson, P.C.: Early Pulmonary Decortication in the Treatment of Post Traumatic Empyema. *Ann. Surg.*, 122:163-190, 1945.
7. Carter, H.B. and DeBakey, M.E.: Current Observations on War Wounds of the Chest. *J. Thorac. Surg.*, 13:271-293, 1944.
8. Cordice, J.W.V.: Discussion of paper by Beall, A.C.Jr., Crawford, H.W. and DeBakey, M.E.: Considerations in the Management of Acute Traumatic Hemothorax. *J. Thorac. Cardiovasc. Surg.*, 52:351-360, 1967. Ref. #2
9. DeBakey, M.E.: The Management of Chest Wounds, *Collective Review. Intern. Abstr. Surg.*, 74:203-232, 1942.
10. Edwards, A.T.: Traumatic Hemothorax. *Lancet*, 240:97-99, 1943.
11. Glass, J.L.: Treatment of Chest Injuries in Vietnam. *Am. Surg.*, 35:227-228, 1969.
12. Heaton, L.D., Hughes, C.W., Rosegay, H., et al.: *Military Surgical Practices of the United States Army in Vietnam, Current Problems in Surgery*, Chicago, Year Book Medical Publishers, Inc., November 1966.
13. Hughes, R.K.: Thoracic Trauma. *Surg. Clin. North Am.*, 48:759-771, 1968.
14. Levitsky, S., Annable, C.A. and Thomas, P.A.: The Management of Empyema after Thoracic Wounding. *J. Thorac. Cardiovasc. Surg.*, 59:630-634, 1970.
15. Nicholson, W.F. and Scadding, J.G.: Penetrating Wounds of the Chest—Review of 291 Cases in the Middle East. *Lancet*, 246:299-303, 1944.
16. Patterson, L.T., Schmitt, H.J., Jr., and Armstrong, R.G.: Intermediate Care of War Wounds of the Chest. *J. Thorac. Cardiovasc. Surg.*, 55:16-23, 1968.
17. Romanoff, H. and Milwidsky, H.: Early Thoracotomy in the Treatment of Chest Injuries. *Harefuah*, 54:199-201, 1958.
18. Romanoff, H., Charuzi, I. and Adoni, A.: Management of Penetrating Wounds of the Chest. *Harefuah*, 77:329-331, 1969.
19. Shefts, L.M. and Doud, E.A.: The Management of Thoracic and Thoracoabdominal Wounds in the forward areas in the Sicilian and Italian Campaigns. *J. Thorac. Surg.*, 15:205-226, 1946.
20. The Medical Department of the United States Army in the World War, Washington, D.C., 1925, U.S. Government Printing Office, Vol. 15, p.2. Quoted by Levitsky, S. et al. ref. #14.
21. Vallee, A.R.: An Analysis of 2811 Casualties of the Korean Conflict. *Dis. Chest*, 26:623-633, 1954.
22. Virgilio, R.W.: Intrathoracic Wounds in Battle Casualties. *Surg. Gynecol. Obstet.*, 130:609-615, 1970.