



## Empyema

*Richard E. Scammon*

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COURTESY OF CITIZENS AID SOCIETY

I. WELCOMEMembers of Minneapolis Surgical Society.

The Hospital Staff joins with our associates in your society in bidding you welcome to this and any other meeting you care to attend. Held Thursday during the regular school year in this room. Luncheon 11:45 to 12:15. Meeting 12:15 to 1:15.

II. WELCOMENew InternsPediatrics

Derifield, Randall, Hutchinson, Minn.  
M.B. - U. of Minn., 1934.  
1 year rotating internship - Mpls.  
General Hospital.

Surgery

Lind, Carl John - Minneapolis.  
B.S., B.A., M.D., - Univ. of Minn. 1933.  
1933-1934 - Detroit Receiving Hospital.

Medicine

Holman, John - Franklin, Texas.  
A.B. - Univ. of Texas, 1926.  
M.D. - Tulane University, 1934.  
1934-1935 - San Diego County Hospital,  
San Diego, California.  
C.C.C. Camp Waxachie, Texas -  
Sept. - Dec. 1935.

Medicine

Nissen, Archie - New Ulm, Minnesota.  
B.S. - Univ. of Minnesota, 1934.  
10 months' internship - St. Luke's  
Hospital, Kansas City, Mo.

Medicine

Mathieson, Donald - St. Paul, Minn.  
B.A. - Univ. of Minnesota, 1930.  
1 Year Internship - Eitel Hospital,  
Minneapolis.

Pediatrics

Dowidat, Raymond, Minneapolis, Minn.  
A.B. - Univ. of Minnesota, 1931.

Pediatrics

Hartnagel, Grant - Red Wing, Minn.

The Interns go "round and round and come out here."

Left

Olson, Stuart - to Northern Pacific  
Hospital, Glendive, Montana.  
Platou, Ralph - to Babies' Hospital,  
New York City, N. Y.  
Karlstrom, Arthur - to Abbott Hospital,  
Minneapolis.  
Stransky, Theodore - to Mandan, N.D.  
Adams, Carolyn - to "her mother's  
business."

Fellowship changes - Next Week.

III. ABSTRACTACUTE EMPYEMA

H. A. Carlson

The treatment of pleural suppuration by providing drainage with the thrust of a knife or cautery was known to Hippocrates. Yet, more than 2,000 years later, there was so little confidence in the surgical management of empyema that when Dupuytren, the ablest French surgeon of his time, was stricken with this disease (1835) he refused operation with the remark that he would "rather die by the hand of God than with the help of a physician."

During the past century, however, real progress has been made with the result that the mortality of empyema has been reduced, the period of healing shortened, and chronicity, to a large extent, prevented. The attainment of these ends has depended upon the recognition of fundamental principles as well as attention to details in the technique of treatment.

Mortality

Graham and Berck and Heuer have demonstrated conclusively that the mortality of acute empyema varies from year to year and parallels the mortality of the primary disease. The mortality of empyema, therefore, depends more upon the virulence of the infection than upon the method of treatment employed. This fact should always be kept in mind in evaluating mortality statistics such as those included in table I.

<u>Clinic</u>	<u>Year Reported</u>	<u>Cases</u>	<u>Method of Treatment</u>	<u>Mortality %</u>
Danna, New Orleans	1931	35	Aspiration and air replacement	5.7
Muller, Philadelphia	1931	99	Various	6.1
Klages, Halle	1933	98	Aspiration and rib resection with Thiersch valve	7.0
Cohen, New York	1932	123	Rib resection	9.0
Hart, Baltimore	1929	50+	Tidal irrigation	10.0+
Foster, New Haven	1929	153	Rib resection, negative pressure drainage	11.0
Graham & Berck, St. Louis	1933	86	Aspiration and rib resection	11.0
Brenneman & McEnery, Chicago	1932	94	Aspiration (chiefly)	12.8
Ochsner & Gage, New Orleans	1931	124	Various	15.3
Schildt, Upsala	1931	289	Rib resection	18.6
Heuer, Baltimore	1923	425	Rib resection	16.0
Heuer, Cincinnati	1932	158	Closed intercostal drainage	22.0
Lloyd, New York	1907	225	Rib resection	20.0
Wilensky, New York	1915	225	Various	23.0
Connors, New York	1931	40	Packing	25.0
Ladd & Cutler	1924	42	Closed intercostal drainage	28.0
Ladd & Cutler	1924	226	Rib resection	15.9
Brown, Philadelphia	1923	171	Rib resection	21.5
Brown, Philadelphia	1923	54	Intercostal incision	40.3
University of Minnesota Hospital '34		70	Various	12.8

Factors influencing the mortality of empyema are listed below:

(1) Primary disease:

Mortality of Empyema (156 cases)

University of Minnesota Hospitals (1920-1924 and 1929-1933, inclusive)

<u>Classification</u>	<u>No.</u>	<u>Died</u>	<u>Mortality %</u>
Acute empyema complicating pneumonia	70	9	12.8
Acute empyema secondary to lung abscess	10	7	70.0
Acute empyema following septicemia or endocarditis	3	3	100.0
Postoperative empyema	2	1	50.0
Tuberculous empyema	20	6	30.0
Empyema secondary to neoplasm	6	6	100.0
Chronic nontuberculous empyema	45	4	8.8

During 1934 and 1935, there were 33 cases of acute empyema complicating pneumonia treated on the surgical service (no deaths). There were 3 cases secondary to lung abscess (1 death) and one case secondary to perinephritic abscess (died).

(2) The etiological organism:

Causative Organisms (Heuer)

Pneumococcus	10.0
Streptococcus pyogenes	23.0
Streptococcus haemolyticus	16.0
Staphylococcus	17.0

Causative Organisms (Locke)

Pneumococcus, Type I	11.0
Pneumococcus, Type II	36.0
Pneumococcus, Type III	38.5
Pneumococcus, Type IV	29.9

Pneumococcus, Total ..... 17.5

Hemolytic streptococcus	34.0
Nonhemolytic streptococcus	5.2
Staphylococcus	24.0
Undetermined organisms	39.3

Total, not Pneumococcus..... 23.2

(3) The age of the patient:

The data of Heuer, Foster and others confirm the doctrine that the mortality is relatively higher in infants and younger children, relatively lower in older children and young adults, and higher in the middle-aged or aged.

(4) Complications

According to Graham, Schildt and others death from uncomplicated empyema is very rare. When death occurs, it is usually due to a persistence of the primary disease or the development of a complication, such as: pneumothorax, pericarditis, mediastinitis, peritonitis, phlegmon of the chest wall, mastoiditis, meningitis, pyemia or septicemia. In many instances, the empyema may be looked upon merely as a local manifestation of a widespread disease.

Period of Healing

Comparative statistics of the period of healing are entirely unreliable because there has been no standard definition of what constitutes healing. The onset of the disease must in many cases be guessed from the history. The "period of healing" as given by some authors should be more correctly called "the period of drainage." The following figures, therefore, give only a rough idea of the period of healing. Graham and

Berck - early aspiration followed by open thoracotomy. The empyema cavity was healed 37 days after the beginning of treatment. Klages - rib resection combined with closed drainage (valve mechanism), average period of drainage 29 days. Brenneman and McEnergy - aspiration method, period of hospitalization 90 days.

Chronicity

Statistics on the incidence of chronic empyema are also inaccurate because of inadequate follow-up studies and because different definitions of chronicity are given by different authors. Hedblom considered an empyema chronic when it had existed for 3 months. According to Schildt, a chronic empyema was one which showed no tendency to spontaneous healing in 18 months or one in which a thoracoplastic procedure had already been considered as indicated. The figures given in table IV failed to prove very conclusively that one method is more satisfactory than another in preventing chronicity. Factors responsible for chronicity as outlined by Schildt are as follows: a larger empyema cavity, streptococcus infection, poor condition of the patient, interstitial pulmonary changes, foreign bodies, bronchial fistula, inadequate drainages, thickening of the walls of the cavity.

<u>Incidence of Chronic Empyema</u>					
<u>Author</u>	<u>Year Reported</u>	<u>Cases</u>	<u>Method of Treatment</u>	<u>Chronic Cases %</u>	<u>Remarks</u>
Heuer	1932	158	Closed drainage	0.0	
Hart	1929	50	Tidal irrigation	0.0	Two cases of osteomyelitis of rib.
Foster	1930	153	Rib resection with negative pressure drainage	0.6	
Schilling	1923	290	Closed drainage	1.7	
Cestan	?	1,208	Rib resection Aspiration	1.8 6.0	"Punkton und Drainage."
Hansen	1923	228	?	4.0	
Dowd	1909	186	?	4.3	
Binney	1928	126	Chiefly closed drainage	4.7	
Bye	1923	41	Various	4.9	
Bull	1923	?	Closed drainage	5.0	
Schildt	1931	289	Rib resection	5.0	
Falbing	1910	63	Rib resection	6.3	
Suermondt	1924	95	Rib resection	9.4	

### Principles of Treatment

The principles of treatment which are considered fundamental in the treatment of empyema have been outlined differently by different authors but the principles laid down by Harrington appear to include the salient points referred to by others. They are:

- (1) Adequate drainage
- (2) Avoidance of open pneumothorax
- (3) Rapid sterilization of the diseased area
- (4) Early obliteration of the cavity by expansion of the lung
- (5) Good medical care with particular attention to the nutrition of the patient.

The fourth of these principles dealing with re-expansion of the lung and healing of the empyema cavity has been the subject of an experimental and clinical study made recently at the University of Minnesota (Carlson). It was found that healing occurs in empyema in a manner similar to the healing of other infected cavities by a growth of granulation at the angles of the cavity and approximation of the walls of the cavity by contraction of the newly formed connective tissue. This process continues progressively as a rule until the cavity is completely obliterated. The process of healing ap-

pears to be fundamentally the same regardless of the method of drainage employed.

On the other hand, re-expansion of the lung may coincide with healing or may occur entirely independent of it depending on the method of treatment. When continuous, negative pressure is employed. Re-expansion of the lung occurs by virtue of the differential pressures created and the degree of re-expansion depends upon the relationship between the differential pressure and the resistance to expansion offered by the elastic lung and the thickened visceral pleura. If the differential pressure suffices to expand the lung to the chest wall, adhesions between the visceral and parietal pleura may form at the point of contact.

When open drainage is employed, re-expansion of the lung has been alleged to occur for 3 reasons: (1) negative intrathoracic pressure, (2) positive intrapulmonary pressure, and (3) the growth and contraction of granulation tissue at the angle of fusion in the process of healing. Only the third of these explanations is tenable. The negative intrathoracic pressure created is incapable of expanding even a normal lung. The positive intra-pulmonary pressure resulting from the use of blow

bottles is effective only temporarily. Films taken before and after the use of blowing exercises demonstrate that the lung returns to its original position as soon as blowing is discontinued. In the presence of true open drainage, re-expansion occurs not because of any "natural tendency of the lung to expand" but because of the natural tendency of granulation tissue to contract. Pulmonary re-expansion in the presence of a true open drainage, therefore, depends upon obliteration of the empyema cavity by adhesions.

#### Methods of Treatment:

A number of different methods of treatment have been recommended but most of them may be included in one of three groups:

- (1) Aspiration with or without air replacement.
- (2) Intercostal catheter drainage with siphon, water seal, suction or tidal irrigation.
- (3) Rib resection, usually with open drainage, sometimes combined with packing, valve drainage or negative pressure drainage.

#### Outline of methods of treatment employed on surgical service at University of Minnesota Hospitals:

- (1) Aspiration is indicated in the early stage when the pus is thin, before the empyema has become encapsulated by adhesions, before the mediastinum has become stabilized and in the synpneumonic stage. It is recognized that empyema may often be cured by aspiration alone but that the routine use of this method may result in prolongation of the period of sepsis, the period of healing and the period of hospitalization.
- (2) Intercostal catheter drainage is employed most commonly in putrid empyema secondary to lung abscess or in streptococcic empyema before the pus has become thick whenever continuous drainage is preferred to intermittent aspiration.

Recently, a two catheter technique has been used permitting a reversal of the flow of exudate and irrigation solution if one of the tubes becomes plugged. In our experience, catheter drainage eventually must be followed by rib resection in two-thirds of the cases because of inadequate drainage.

- (3) Rib resection and open drainage is employed when there is an encapsulated cavity of small or moderate size containing thick pus. Pus is considered to be thick when on standing the cellular sediment composes more than 90% of the total volume. Rib resection is often employed in the second or third week of a pneumococcus empyema but may also be indicated for drainage in other types of empyema when the pus becomes thick.
- (4) Rib resection with continuous negative pressure is indicated when the empyema cavity is a large one containing thick pus. The object of this form of treatment is to provide continuous, complete drainage and at the same time to re-expand the lung to the chest wall permitting the visceral pleura to become adherent to the parietal pleura, thus rapidly reducing the size of the cavity.

The technique consists of resecting a short segment of rib at a dependent point, inserting a tube composed of rubber and fabric having an internal diameter of one-half inch. The tube is drawn through a rubber sponge and trans-fixed at the level of the skin with a safety pin. The wound is sealed with an abundant supply of vaseline strip to protect the skin from pressure caused by the pin. The sponge is then applied tightly to the chest wall by means of adhesive tape making an air-tight system.

Negative pressure may be obtained by means of water bottles but the apparatus that has been found to supply a constant controlled negative pressure most satisfactorily consists of a water suction pump, a negative pressure valve (mercury), a manometer and a

catch bottle. With this apparatus, the desired pressure (usually -20 to -30 cm. of water pressure) can be applied continuously.

Further points in technique:

1. Before treating a case of acute empyema, it is desirable to know (1) the nature of the primary disease and whether it is still active; (2) the gross appearance of the pus; (3) the infecting organism; and (4) the presence or absence of bronchial fistula or other complications.

2. A sample of pus removed by aspiration is saved in a test tube in order to compare the gross appearance with pus removed at the succeeding aspirations.

3. At operation a specimen of the parietal pleura is excised for microscopic section. The possibility of tuberculous empyema should be kept in mind, especially when no pyogenic organisms are found on culture of the pus.

4. If a short incision is used in performing rib resection, it is not necessary to suture the wound.

5. Dakin's solution is employed for irrigating the cavity. Before injecting Dakin's solution, it is necessary to rule out the presence of bronchial fistula. Saline is used for irrigations until the possibility of bronchial fistula is excluded. Injections of large quantities of solution and injections of solution under pressure are avoided.

6. The drainage tube is left in place until the cavity is practically obliterated. The tube is removed when the cavity measures 5 cc. to 10 cc. or when the cavity is no larger than the tube.

7. The volume of large cavities may be estimated by means of x-ray films. The volume of a smaller cavity is measured by determining the quantity of solution it will hold when the patient is placed in such a position that the opening in the chest corresponds to the highest point of the cavity.

Bibliography

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3. Harrington, S. W.  
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4. Hedblom, C. A.  
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Ann. Surg., 72: 288 (September) 1920.
5. Heuer, G. J.  
Acute empyema.  
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6. Klages, F.  
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Eine Klinische Studie, Upsala lakeref. forh., 37: 1-205, 1931.
9. Carlson, H. A.  
To be published -  
J. Thor. Surg.



10. Carlson, H. A. and Bowers, W. F.  
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11. Data in tables - from Carlson and  
Bowers.

#### IV. MOVIE

##### Treatment of Empyema

After the experiences of the  
Empyema Commission of the  
World War,

Courtesy of Mead and Johnson.

3 reels.

#### V. LAST WEEK

Date: 12-19-35

Place: Recreation Room,  
Nurses' Hall

Time: 12:15 to 1:20

Program: Movie: Normal blood cells  
in vitro.  
Eclampsia

Present: 92

Discussion: J. C. Litzenberg  
I. McQuarrie  
O. H. Wangenstein  
Leonard Lang