Treatment of pleural empyema secondary to pneumonia: thoracocentesis regimen versus tube drainage

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Abstract

Background **Pleural empyema is a well known complication of pneumonia. Attitudes differ, however, about the best treatment of this condition and the place of drainage, early operation, and local antibiotics.**

Methods **In a retrospective study 94 consecutive patients with verified empyema caused by pneumonia were admitted to the department of either pulmonary medicine or thoracic surgery. Treatment was either by a lavage regimen (daily thoracocentesis, saline rinse, systemic antibiotics, and in some patients instillation of local antibiotics) in the medical ward (51 patients) or by tube drainage and systemic antibiotics in the surgical unit (43 patients).**

Results **The stay in hospital was significantly shorter in the medically treated patients than in the surgical group—2·3 *v* 5·0 weeks respectively. Furthermore, pleurocutaneous and bronchopleural fistulas developed more frequently in patients treated by tube drainage than in those treated with the thoracocentesis regimen alone (13 (30%) *v* 5 (10%) and 6 (14%) *v* 2 (4%) for each complication respectively). The overall mortality was 8·5%, with no differences between treatments.**

Conclusions **Treatment with a lavage regimen plus local and systemic antibiotics seems to be associated with a lower frequency of complications and a shorter duration of hospital stay than tube drainage and systemic antibiotics. These results should be confirmed by a prospective, randomised study.**

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Pleural empyema is a well recognised complication of pneumonia. Before the development of antibiotic drugs the incidence of empyema was considerably higher than today. Patients were treated by open drainage and the mortality was high.[1–5] Effective antibiotics and improvements in surgical techniques mean that mortality has fallen to 5–15%,[6–8] but pleural empyema is still considered to be a serious disease that usually results in a lengthy and complicated hospital stay.[9]

While most doctors agree on the value of systemic antibiotics and the necessity of draining pleural fluid, opinions differ over the type of pleural drainage, whether antibiotics or fibrinolytic enzymes, or both, should be instilled locally in the pleura, and the value of early surgical intervention.[6–18]

These differences in opinion are exemplified at our hospital, where a patient with an empyema admitted to the department of thoracic surgery is treated with tube drainage, while drainage of the empyema in the department of pulmonary medicine is performed via repeated thoracocentesis and usually instillation of antibiotic into the pleural space. Systemic antibiotics are administered routinely by both teams. No prospective studies have been performed, however, comparing these two treatment regimens.

This study aimed to evaluate the outcome of these two treatment regimens in patients with empyema caused by pneumonia.

Methods

During the five years from 1984 to 1989, 94 consecutive patients with pleural empyema secondary to pneumonia were admitted to the departments of thoracic surgery and pulmonary medicine at Bispebjerg Hospital. The hospital is a referral centre for patients with pulmonary diseases from Copenhagen City. Data were collected retrospectively from the patients' records, including those from the referring hospitals. For those who died, the death certificate was acquired from the national register. In both departments the diagnosis of empyema was based on chest radiographs and thoracocentesis with microbiological examination of the pleural fluid. If the pleural fluid was purulent or the microbiological samples positive either at microscopy or on culture, the patient was considered to have an empyema.

The 51 patients admitted to the department of pulmonary medicine were treated with daily thoracocentesis and saline rinsing (0·9% sodium chloride), whereby 50 ml of sterile saline (0·9%) were instilled into the pleural space and immediately withdrawn through the thoracocentesis needle. The procedure was repeated until the fluid became clear (a total of 100–500 ml of saline), after which antibiotics were instilled. Systemic antibiotics, primarily penicillin-G or ampicillin, were also given in all cases. The 43 patients admitted to the department of thoracic surgery were treated primarily with tube drainage and systemic antibiotics. Intercostal tubes were 12 mm silicone rubber

Table 1 Clinical details of 94 patients with empyema

	Total group	Medical treatment	Surgical treatment
Sex: male	63 (67%)	37	26
Age (y)	59	58	60
(median (10th–90th centile))	(30·4–80·8)	(30·4–75)	(31–80·8)
Complicating conditions:			
None	23	11	12
Diabetes mellitus	7	4	3
Cardiac decompensation	6	2	4
Cancer	12	8	4
Chronic obstructive pulmonary disease	7	6	1
Alcoholism	28	18	10
Intravenous drug abuse	6	1	5
Other	5	1	4
Symptoms*			
Fever	70/85 (82%)	37/46 (80%)	33/39 (85%)
Cough	53/74 (72%)	36/46 (78%)	17/28 (61%)
Pain	48/47 (65%)	28/47 (60%)	20/27 (74%)

*Number with symptom/number recorded.

tubes placed laterally in an intercostal space above the empyema as determined from the chest radiograph. If this treatment did not succeed further surgical intervention was considered, including rib resection or thoracostomy with decortication.

Instillation of antibiotics into the pleura was a recommended procedure in the medical unit and was undertaken, if considered feasible, by the physician performing the initial thoracocentesis. Antibiotics were then delivered in a volume of 20 ml via a 2 mm gauge, 10 cm long, steel cannula, after first rinsing the pleura with saline. Local instillation of antibiotics was not routine in the surgical unit but was performed via the intercostal drain in some cases. In both wards systemic antibiotics were used according to sensitivity testing after culture of the pleural fluid.

STATISTICS

The χ^2 test or Fisher's exact test was used for comparison of frequencies, while the Mann–Whitney U test was used for nominal data, $p < 0{\cdot}05$ being considered significant.

Results

Owing to the retrospective nature of the study it was not possible to be confident about the comparability of the treatment regimens in the two departments. The patients' clinical details are recorded in table 1. Most patients had other complicating diseases. Table 2 describes the empyema according to the microscopic and macroscopic appearances. It was not possible to perform computed tomography.

Table 2 Characterisation of pleural empyemas

	No	(%)
Location:		
Right side	57	(61)
Extension:		
Diffuse	33	(35)
Localised	55	(57)
Not defined	6	(8)
Pleural fluid:		
Macroscopic appearance		
Not recorded	26	(28)
Exudative	25	(27)
Purulent	35	(37)
Bloody	8	(9)
Microscopic appearance		
Polymorphonuclear leucocytes dominating	67/71	(94)

The results of the microbiological examination of the pleural fluid in the two groups of patients are summarised in table 3. Information was missing in 19 patients, while two patients had no bacterial growth in their pleural fluid. More than one bacterial species was isolated from 47% of the patients. Staphylococci were isolated more often from patients who had intercostal tubes in place at the time of sampling.

At the second examination of the pleural fluid, within one week of the first, 90% of the patients treated in the medical ward had sterile pleural contents compared with only 2% of the surgically treated patients ($p < 0{\cdot}001$).

Details of the treatment of the two groups of patients are summarised in table 4. Three of the 51 patients treated in the medical ward failed to respond sufficiently to repeated thoracocentesis and local antibiotics and were therefore transferred to the surgical unit for pleural drainage by tube and subsequently rib resection (in all three). The rest of the medically treated patients continued with the original treatment regimen. Fifty four per cent were considered completely cured of their empyema, while 38%

Table 3 Microbiology of primary culture of pleural fluid in 94 patients with empyema

Staphylococcus aureus	10
S epidermidis	10
Beta haemolytic streptococci	8
Non-haemolytic streptococci	3
Pneumococci	14
Enterococcus faecalis	2
Corynebacteria sp	3
Haemophilusinfluenzae	6
Eikenella corrodens	1
Escherichia coli	4
Klebsiella sp	4
Other Enterobacteriaceae	3
Pseudomonas aeruginosa	3
Fusobacterium spp	14
Bacteroides sp	6
Veillonella sp	1
Anaerobic/microaerophilic streptococci	15
Anaerobic Gram positive rods	6
Candida albicans	1
Aspergillus sp	1
Two pathogens	31
Three pathogens	13
No growth	2
No information	19

Table 4 Treatment of pleural empyema in 94 patients

	Medical treatment (n = 51)	*Surgical treatment (n = 43)*	*p*
Pleural drains (no (%))	3 (6)	43 (100)	
System antibiotics:			
Total No of courses	99	148	<0·0001
No per patient	1·9	3·7	<0·0001
Local antibiotics:			
None (no (%))	23 (45)	31 (71)	<0·02
Penicillin G	20	6	
Ampicillin	2	1	
Dicloxacillin	3	4	
Cefradine	1	—	
Cefuroxime	—	1	
Metronidazole	2	—	
Operation:			
None (No (%))	48 (94)	9 (21)	
Rib resection	3	18	
Decortication	—	15	
Thoracoplasty	—	1	

had some sequelae, including radiographic abnormalities (pleural calcifications).

Thirty four of the patients treated in the surgical ward underwent further surgery (table 4), while in 16 the tubes could not be removed—they were discharged from hospital with intercostal drains in situ. Forty six per cent of this group were considered cured, while 45% had sequelae, including radiographic abnormalities. Use of more than one systemic antibiotic was more common in these patients (table 4). In contrast, local antibiotic instillation was used more often (55%) in patients in the medical group (table 4).

Eight patients, four in each group, died as a direct result of their infection (table 5). Tube drainage was associated with more bronchopleural and pleurocutaneous fistulas ($p = 0·17$ and $p = 0·02$ respectively). Hospital stay was significantly shorter in the medically treated patients (median 2·3 weeks) than in the surgical group (median 5·0 weeks; $p < 0·001$).

Discussion

Treatment of pleural empyema depends on the staging of the disease—that is, the duration of the infection before diagnosis, the appearance and location of the pleural fluid in the pleural space, and the results of microbiological investigations. The published reports contain few data on these aspects of empyema, thereby preventing useful comparison of the different treatments and their outcome.

Most of the bacterial species isolated at the first culture in this study were commensals of the upper respiratory tract, suggesting that the infection was via the bronchial tree. Anaerobes were found in 37% of the patients either in pure or mixed culture, similar to other studies using routine anaerobic laboratory techniques.[3 19 20] This has been the case only in reports published since 1970, after which time greater attention was paid to anaerobic culture.[19] The continuous presence of bacteria in the pleural fluid in patients with intercostal drains, as well as the fact that staphylococci were isolated more often in these patients, suggests that tube drainage encourages infection to persist and may even induce secondary infection.

Table 5 Outcome of treatment for pleural empyema in 94 patients

	Medical treatment (n = 51)	*Surgical treatment (n = 43)*	*p*
Died from empyema (No (%))	4 (8)	4 (9)	>0·05
Bronchopleural fistula (No (%))	2 (4)	6 (14)	0·17
Pleurocutaneous fistula (No (%))	5 (10)	13 (30)	0·02
Chronic drain	1/46	16/33	0·0001
Duration of hospital stay (weeks) (median 10th and 90th centile)	2·3 (0·6–8·0)	5·0 (1·2–18·7)	<0·001

With regard to hospital stay in surgically treated patients (decortication or rib resection, or both), Muskett *et al*[12] reported a mean duration of 34 days, which corresponds with five weeks in our surgically treated group. In the series of Mavroudis *et al* 19% of patients with empyema required rib resection, thoracotomy, or an Eloesser procedure, while 72% of patients were managed with either thoracostomy or thoracocentesis.[6] In our study 6·5% of the patients admitted to the medical ward subsequently required surgery, compared with 39% of those admitted directly to the surgical unit. Almost certainly the incidence of surgical intervention depends not only on the presentation of the patient but also on the attitudes of the thoracic surgeons. Because this is not a prospective study these factors cannot be considered closely.

The mortality rate of 8·5% in our study is similar to that in other recent studies (10–15%).[7–9] Morin *et al*[11] reported a post-operative mortality of 4% after early decortication or decortication and lobectomy, and a postoperative hospital stay of two weeks. However, the preoperative hospital stay in their patients ranged from 20 to 540 days. The much shorter hospital stay and lower rate of complications associated with medical treatment in our study might be explained by differences in the severity of the empyema—that is, the more severe cases were referred to the surgical department. This cannot be excluded here and only a prospective randomised study can clarify this.

The principle of treatment with local instillation of antibiotics into the pleural space is supported by experimental and clinical studies. In an experimental guinea pig model it was shown that implantation of tobramycin impregnated beads into the pleura reduced significantly *Staphylococcus aureus* colony counts in vivo compared with control groups that had not been given antibiotics.[21] In a clinical study patients treated by cyclical irrigation of the pleural space with antibiotics had a shorter hospital stay and duration of wound drainage than those who underwent decortication or thoracoplasty.[16] Systemic administration of antibiotics achieves adequate drug concentrations in normal, uninfected pleural fluid but fails to do this in the case of empyema,[22] which may explain the advantage of the local instillation of antibiotics.

In conclusion, treatment with systemic antibiotics, repeated thoracocentesis, saline rinsing, and local instillation of antibiotics seems to be appropriate for many patients with

empyema secondary to pneumonia. Treatment with tube drainage leads to an extended hospital stay and a high frequency of complications. This retrospective study could not ensure that the severity of disease was similar in the two treatment groups but highlights the need for a prospective randomised trial of medical and surgical treatment regimens in empyema.

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