

Serotype-specific analysis of bacteraemic pneumococcal pneumonia in adults

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Introduction

Approximately 10 % of patients hospitalized with community-acquired pneumonia are bacteraemic. *Streptococcus pneumoniae* accounts for approximately 60 % of all causes of bacteraemic CAP and bacteraemic pneumococcal pneumonia (BPP) is the major cause of mortality, representing up to 70% of all CAP deaths. The severity of the disease's clinical course is influenced by many factors such as age, presence of underlying conditions and also by the microbe's characteristics.

Aim of the study

The objectives of this study were to describe the risk factors, clinical course and laboratory features of bacteraemic pneumococcal pneumonia (BPP) in adults, comparing patients hospitalized in two university hospitals. In addition, another aim of the study was to find the potential influence of different *S. pneumoniae* serotypes on disease outcome.

Materials and Methods

This retrospective, descriptive clinical study included adult patients (over 18 years of age) with BPP hospitalized at two Czech university hospitals (Prague and Pilsen) during 2000 - 2008. Clinical data were obtained from hospital records and microbiological characteristics of the specimens were determined at the National Institute of Public Health in Prague.

Results

Demographics

Demographic parameters	Bulovka UH	Pilsen UH
Number of patients	67	68
M:F ratio	41:26	40:28
Health-care associated pn.	6	7
ICU admission	22	33
Lethal outcome	13	8
Continuing or subacute care	11	9
Dismissed to home care	43	51

During the study period, 135 cases of BPP were identified in both study sites with median age 57 years (IQR 45.5 - 70), predominately in males (81 cases).

Intensive care was provided to 40.7 % and the disease had an adverse outcome in 15.6 % with the highest case fatality ratio (27.3 %) in patients over 65 years old. Among the patients who died, 12 of 21 were admitted to the ICU. The 9.6 % of identified BPP cases was of nosocomial origin.

Underlying conditions and comorbidities

Most frequently identified underlying conditions	Bulovka UH	Pilsen UH
Smoking (including ex-smokers)	25/58	43/63
Alcohol abuse	11/60	9/64
Chronic heart condition	18/60	19/66
Chronic lung condition	15/59	27/68
Chronic kidney condition	7/60	11/65
Chronic liver condition	11/61	7/65
Cerebrovascular disease	8/59	5/65
Diabetes mellitus	9/61	16/68
Hematological malignancy	5/56	7/68
Solid malignancy	4/58	9/68
Immunosuppressive treatment	7/60	10/67

In our study group there was not identified any case of asplenia and only 1 case of HIV infection.

Symptoms

Signs at admission	Bulovka UH	Pilsen UH
Fever	52/58	44/58
HR > 95/min	36/49	41/58
RR > 22/min	14/54	21/40
Haemoglobin saturation < 91 %	17/35	41/56

Symptoms	Bulovka UH	Pilsen UH
Shortness of breath	28/60	50/65
Altered mental status	13/57	20/64
Cough	37/49	47/51
Pleuritic chest pain	22/22	29/41
Cefalea	7/47	10/24
Gastrointestinal symptoms	20/52	20/46
Haemoptysis	5/57	2/64

Clinical course and laboratory findings

Laboratory features	Bulovka UH	Pilsen UH
Leukocytosis (> 15 × 10 ⁹)	32/63	29/68
Leukocytopenia (< 3 × 10 ⁹)	7/63	7/68
Hematocrit (< 0.35)	7/58	9/68
Hyponatraemia (< 130 mmol/L)	5/43	15/67
Hyperglycaemia (> 10 mmol/L)	3/51	8/67
Urea (> 10 mmol/L)	19/57	43/67
CRP < 100 mg/L	13/59	9/68
CRP 100-300 mg/L	18/59	21/68
CRP >300 mg/L	28/59	38/68

Due to the presence of bacteraemia, a common complication was the development of septic shock with the necessary administration of catecholamines (20 %). Typical local complications of severe cases were very frequent (see table above text). Intrapleural instillation of streptokinase was used in 4 of these patients.

Complications	Bulovka UH	Pilsen UH
Mechanical ventilation	11/62	13/68
Tracheostomy	4/41	12/64
Vasopressor use	14/62	13/68
Parapneumonic effusion	35/62	40/68
Pleural fluid puncture/drainage	5/62	11/64
Empyema	2/57	4/68
Atelectasis	22/59	10/68

Serotypes of *S. pneumoniae*

Serotype	Bulovka UH			Pilsen UH		
	No.	ICU	Death	No.	ICU	Death
4	13	3	1	9	6	0
1	7	1	0	11	4	1
3	8	5	2	9	6	0
8	7	1	0	9	5	0
14	6	0	0	5	3	1

Specific pneumococcal serotypes could be determined in 130 out of 135 patients. All isolates were susceptible to beta-lactam antibiotics (MIC's of penicillin ≤ 0.06 mg/l) and resistance to other tested antibiotics was very rare.

Disease severity evaluation

PORT/PSI* Class	Bulovka UH			Pilsen UH		
	No.	ICU	Death	No.	ICU	Death
I	8	1	0	2	1	0
II	8	0	0	9	3	0
III	11	1	0	5	2	0
IV	16	4	1	29	12	3
V	16	13	9	20	14	3
ND	8	3	3	3	1	1

* Pneumonia severity index uses demographics, the coexistence of co-morbid illnesses, findings on physical examination and vital signs, and essential laboratory findings.

PORT/PSI had a good accuracy for predicting a fatal outcome and ICU admission. The PORT/PSI with cut-off value of more than 4 had a good sensitivity for identification of patients with low-risk of death since there were no lethal outcomes in patients within PORT/PSI classes 1-3 and only 6 patients out of 55 required intensive care.

Multivariate analysis of factors predicting ICU admission

A logistic regression analysis (enter method) of all previously described chronic conditions, symptoms, laboratory and microbiological features identified a significantly higher risk of ICU admissions in patients with solid malignancy, chronic lung and heart conditions, and local complications (effusion and bilateral consolidation). More importantly, the most significant risk factor was the infection represented by serotype 3.

Effect	P value	Odds ratio	95.0 % CI for OR	
			Lower	Upper
Hospitalization at Bulovka UH	0.037	0.282	0.086	0.927
Age	0.003	0.939	0.900	0.979
Health-care assoc. pn.	0.149	4.892	0.578	36.863
Solid malignancy	0.040	0.123	0.017	0.909
Chronic heart disease	0.008	7.385	1.674	32.585
Chronic lung disease	0.000	15.359	3.457	68.239
Altered mental status	0.063	3.458	0.935	12.782
Parapneumonic eff.	0.000	14.059	4.051	48.800
Bilateral consolidation	0.001	7.438	2.209	25.052

Multivariate analysis of factors predicting death

Effect	P value	Odds ratio	95.0 % CI for OR	
			Lower	Upper
Hospitalization at Bulovka UH	0.007	8.817	1.835	42.366
Age	0.024	1.066	1.008	1.126
Health-care assoc. pn.	0.004	13.103	2.300	74.637
Chronic kidney disease	0.004	13.103	1.224	29.759
Altered mental status	0.024	6.035	1.224	29.759
Serotypes 1, 5, 7F	0.579	0.497	0.042	5.899
Serotypes 3, 3, 6A, 6B, 8, 19 F, and 23 F	0.025	0.127	0.021	0.776

Discussion and conclusion

Even in the age of fully equipped ICUs, bacteraemic pneumonia still remains a serious disease with risk of complications and unfavourable prognosis, particularly in the elderly. In accordance with previously published data our study results confirm that the risk of adverse outcome of patients were influenced by underlying conditions (smokers and ex-smokers, homelessness) as well as comorbidities (especially chronic heart, lung and renal diseases, malignancies) and infecting serotype (especially serotype 3).

Early identification of patients at risk leads to improvement of managing BPP. Moreover, stratification of the disease severity by PORT/PSI proved to be useful in identifying patients requiring admission to ICU and with risk of death. The study also demonstrates that scoring systems developed for the assessment of CAP could be used in defining severity of bacteraemic pneumococcal pneumonia. From a clinical viewpoint, the difference in mortality also stresses the importance of thorough clinical assessment at time of admission in addition to calculating severity scores for the adequate management and prognostic estimation of CAP patients.

In conclusion, the study results suggest the recommendation of vaccinating risk groups. Potential vaccine coverage with 23-valent polysaccharide vaccine was 91.6% and 71.7% with 13-valent conjugated vaccine. The empirical antibiotic therapy in CAP should effectively cover *S. pneumoniae* and the susceptibility of the isolated strains to betalactam antibiotics enables the use of penicillin in empirical treatment of pneumococcal infections in the Czech Republic.