Bacterial Pneumonia at King Abdulaziz University Hospital: A Comparison between Hospital- and Community-Acquired

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Key Words

Pneumonia, hospital-acquired, community-acquired · Causative organisms · Treatment · Mortality

Abstract

Objectives: To compare community- and hospital-acquired pneumonia (CAP, HAP) with respect to causative organisms, antimicrobial susceptibility, mortality and risk factors associated with high mortality. **Methods:** From March 1998 to December 1999, the medical charts of patients at King Abdulaziz University Hospital older than 14 years of age with a diagnosis of pneumonia were reviewed. The following data regarding the patient's age, sex, type of pneumonia, admission to intensive care unit (ICU), type of organism isolated, antibiotic susceptibility, outcome, presence of hypotension, tachycardia, tachypnea, disturbed level of consciousness, and renal failure were recorded.

Results: A total of 324 patients were studied (248 HAP, 76 CAP). *Haemophilus influenzae*, *Moraxella catarrhalis* and *Streptococcus pneumoniae* were the commonest isolates in CAP, while *Pseudomonas* spp. and *Enterobacter* spp. were more common in HAP. Pathogens isolated from CAP were more susceptible to ampicillin, co-amoxiclav, ciprofloxacin, cefuroxime, tetracycline and erythromycin, whereas isolates of HAP showed more sensitivity to aminoglycosides and imipenem. Mortality was higher in HAP compared to CAP: 50 versus 21%, respectively ($p < 0.001$). Risk factors associated with high mortality were a more advanced age, tachycardia, hypotension, a disturbed level of consciousness, renal failure and ICU admission. **Conclusion:** Older less expensive antibiotics can still be used in the treatment of both CAP and HAP, while the newer more expensive antibiotics should be kept in reserve to prevent the development of resistance.

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Introduction

Infectious diseases contribute significantly to patient morbidity and mortality: pneumonia is the sixth leading cause of death in industrialized countries [1, 2]. In the long-term care setting, infection of the respiratory tract is the leading cause of hospitalization and mortality [3]. The costs associated with pneumonia are staggering. It is not only the cost of treatment, but also the economic impact of days lost at work [4, 5]. Knowledge of the prevalence of the organisms within a community and their resistance patterns are important to guide the initiation of empiric treatment. The aim of this study was to compare hospital- and community-acquired pneumonia (HAP and CAP) at King Abdulaziz University Hospital with regard to its causative organisms, antibiotic susceptibility, risk factors associated with high mortality, and mortality.

Method

From March 1998 to December 1999, the medical charts of patients at King Abdulaziz University Hospital over the age of 14 years were reviewed. Diagnosis of pneumonia was made according to the American Thoracic Society criteria [6]. Sputum cultures made at the hospital were reviewed and those sputum cultures positive for bacteria were analyzed. Sputum specimens taken from intubated patients and specimens positive for acid-fast bacilli were excluded. Sputum samples were processed by Gram stain and culture. Only samples showing greater than 25 polymorphonuclear leukocytes and less than 10 squamous epithelial cells per low power field were cultured [7]. Cultures were performed on 5% sheep's blood agar (oxid) and chocolate agar. The plates were incubated at 37°C for 24 h in a 5% CO₂ atmosphere. Bacteria isolated from sputum cultures were considered to be presumptive etiologic pathogens if they were compatible with the predominant organisms present on Gram stain and if cultured in abundant growth or pure growth. The isolated organisms were identified using a standard method [8]. Gram-negative aerobes were identified using the API 20 E (Analyta, Inc.).

Cases were classified into HAP (defined as positive sputum cultures taken more than 72 h after admission) and CAP (defined as positive sputum cultures taken less than 72 h after admission or those done on an out-patient basis). The following data were collected: patient's age, sex, nationality, and admission to intensive care unit (ICU). The type of organisms isolated, antibiotic susceptibility, use of empirical antibiotics, the presence of hypotension (defined as systolic pressure less than 90 mm Hg and diastolic less than 60 mm Hg), tachycardia (pulse rate more than 120 beats per min), tachypnea (respiratory rate more than 30/min), hypoxia (P_{O₂} less than 10 kp), a disturbed level of consciousness, a raised serum creatinine level during positive sputum culture, and outcome were recorded.

The in vitro antibacterial susceptibility of the bacteria isolated was determined by the disk diffusion method according to the guidelines of the National Committee for Clinical Laboratory Standards (NCCLS) [9]. Briefly, five representative colonies taken from the purity plates were suspended in sterile saline and diluted to a No. 0.5 McFarland turbidity standard. A sterile cotton swab dipped into this inoculum was used to streak Mueller-Hinton agar or Mueller-Hinton agar supplemented with 5% sheep's blood and chocolate agar (Baltimore Biological Laboratories). The antibiotic disks were then applied onto the surface of the agar plates using a disk dispenser. The inoculated agar plates were then incubated at 37°C for 24 h. After incubation the diameter of the zone of inhibition was measured and the results interpreted in accordance with the criteria recommended by the NCCLS. Statistical analysis was done using SPSS computer software; p value < 0.05 was considered significant.

Results

From a total of 11,069 patients greater than 14 years of age admitted to the hospital during the study period, 348 positive sputum cultures were recorded, making a rate of positive sputum culture of 31.4/1,000 admissions. Three hundred and twenty-four cases fulfilled the criteria and were included in the study. Almost 50% of them were Saudi. Two hundred and forty-eight of 324 (77%) were hospital-acquired and 76 of 324 (23%) were community-acquired with a mean age of 56.4

Table 1. Type of organism in HAP and CAP

Type of organism	HAP (n = 248)		CAP (n = 76)		p value
	n	%	n	%	
<i>Streptococcus pneumoniae</i>	1	0.4	2	3	0.07
<i>Staphylococcus aureus</i>	39	15	11	14	0.2
<i>Haemophilus influenzae</i>	42	16	39	51	<0.001
<i>Moraxella catarrhalis</i>	14	5	8	11	0.07
<i>Pseudomonas</i> sp.	74	29	7	9	<0.001
<i>Klebsiella</i> spp.	20	8	5	6	0.8
<i>Proteus</i> spp.	1	0.4	–	–	–
<i>Enterobacter</i> spp.	19	8	1	1	0.07
<i>Enterococci</i>	1	0.4	–	–	–
<i>Escherichia coli</i>	9	4	–	–	–
<i>Citrobacter</i> spp.	2	0.8	–	–	–
<i>Acinetobacter</i> spp.	10	4	2	3	0.7
<i>Stenotrophomonas maltophilia</i>	12	5	1	1	0.1
Others ¹	4	2	1	1	0.8

¹ *Streptococcus viridans*, *Serratia* spp., group G streptococci.

years (range 14–95 years) and 49.8 years (15–102 years), respectively (p 0.01). The male sex predominated in both types of infection, 1.7:1 for hospital-acquired and 1.1:1 for community-acquired (p 0.08). As shown in table 1, *Haemophilus influenzae*, *Moraxella catarrhalis* and *Streptococcus pneumoniae* were isolated more in community-acquired infection while *Pseudomonas* sp. and *Enterobacter* sp. were isolated more in hospital-acquired infection. Pathogens isolated from the community-acquired infection were more susceptible to ampicillin, co-amoxiclav, ciprofloxacin, cefuroxime, tetracyclin and erythromycin while isolates of the hospital-acquired infection were more sensitive to gentamycin, amikacin, and imipenem as shown in table 2. Two hundred and ninety-two of 324 (90%) were started on empirical antimicrobial agents. Mortality was significantly higher in hospital-acquired infections: 124 of 248 (50%) versus 16 of 76 (21%) (p < 0.001). A more advanced

age, tachycardia, hypotension, a disturbed level of consciousness, renal failure and ICU admission were factors associated with a poor outcome (table 3).

Discussion

A higher rate of HAP compared to CAP was found, which could be explained by the low probability of isolating the pathogens responsible for CAP. It has been reported that the pathogen has been identified in only 50% of the cases of CAP [1]. *S. pneumoniae* and atypical pathogens (i.e. *Mycoplasma*, *Legionella* sp., *Chlamydia pneumoniae*) can account for 30% of the cases of CAP [2, 10]. Other pathogens include *H. influenzae*, *Staphylococcus aureus*, and *M. catarrhalis* [11–15]. Our study showed that *S. pneumoniae* was isolated in only 3% of the cases of CAP while *H. influenzae* was the commonest

Table 2. Antibiotic sensitivity of some isolates in CAP and HAP

Antimicrobial agents	Microorganisms				
	community-acquired			hospital-acquired	
	<i>S. pneumoniae</i> (n = 2)	<i>H. influenzae</i> (n = 39)	<i>M. catarrhalis</i> (n = 8)	<i>Pseudomonas</i> spp. (n = 74)	<i>Enterobacter</i> spp. (n = 19)
Penicillin	1 (50)	–	2 (26)	1 (2)	6 (31)
Ampicillin	2 (100)	28 (73)	8 (100)	1 (2)	1 (6)
Co-amoxiclav	2 (100)	27 (71)	–	4 (5)	5 (26)
Ciprofloxacin	–	32 (54)	8 (100)	53 (72)	13 (68)
Cefuroxime	2 (100)	38 (100)	8 (100)	1 (2)	2 (12)
Erythromycin	2 (100)	22 (58)	7 (88)	1 (2)	6 (31)
Tetracycline	1 (50)	32 (84)	7 (75)	–	–
Oxacillin	2 (100)	–	–	–	–
Vancomycin	2 (100)	1 (3)	–	–	1 (6)
Aztreonam	1 (50)	18 (48)	–	47 (63)	5 (26)
Ceftazidime	–	–	–	54 (73)	2 (12)
Ceftriaxone	2 (100)	20 (53)	6 (75)	4 (6)	3 (18)
Gentamycin	1 (50)	1 (3)	–	61 (83)	13 (68)
Amikacin	–	–	–	64 (86)	13 (68)
Imipenem	–	3 (9)	–	45 (61)	18 (94)
Piperacillin	–	–	–	56 (75)	6 (31)

Number and percent (in parentheses) are given.

Table 3. Relation of mortality to some variables

Variable	Dead (n = 141)	Alive (n = 183)	p value
Age, years	59	52	0.003
Sex (M:F)	1.7:1	1.5:1	0.7
Hypotension	37 (26)	16 (9)	<0.001
Tachycardia	59 (42)	56 (31)	0.04
Tachypnea	43 (31)	45 (25)	0.4
Hypoxia	57 (40)	60 (33)	0.1
Disturbed consciousness	70 (50)	15 (8)	<0.001
ICU admission	107 (76)	47 (26)	<0.001
Renal failure	74 (52)	27 (15)	<0.001

Number and percent (in parentheses).

cause, accounting for 51% of the cases, similar to that which had been reported from our hospital by Al Hadramy et al. [16] 10 years ago.

It has been reported that the proportion of hospitalized patients exhibiting the typical bacterial etiology ranges from 8 to 46% [17]. This wide range can be explained by the use of different methods of diagnosis and the use of antimicrobial agents at the time of specimen collection [16, 18]. A high proportion of the patients studied were using antimicrobial agents at the time of specimen collection. The prevalence of atypical pathogens could not be identified in our study because the results of this study were reviewed retrospectively. According to the proceedings of the American Thoracic Society consensus conference [19], testing for atypical pathogens should be included in selected settings, which most probably were not encountered in our patients. However, testing for atypical pneumonia pathogens has been taken in consideration in a planned prospective study to assess their

role in CAP of our hospitalized patients. Gram-negative bacilli are the commonest pathogens of HAP, a finding similar to that reported by others [20, 21]. The American Thoracic Society guidelines stress the use of empirical treatment as pathogen identification can be difficult [1]. We found that ampicillin, co-amoxiclav, fluoroquinolone, second-generation cephalosporin, erythromycin and tetracycline can be used empirically in the treatment of CAP, while aminoglycosides and imipenem can be used in HAP, a finding in agreement with the recommendations of others [1, 2, 15, 22–28]. Mortality from pneumonia (both CAP and HAP) has been reported to range from 10 to 70% [13, 29–31], with a better prognosis for CAP than HAP [32], a finding similar to our own. Old age, hypotension, tachycardia, a disturbed level of consciousness, ICU admission and renal failure were found to be risk factors associated with high mortality, a finding also reported by Scott et al. [32] and others [10, 29, 33, 34].

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