Outbreak of Streptococcus pneumoniae disease in children in Baghdad city

Ass. Prof. Dr. Talib Falih Hassen

Nassiria Technical Institute – Nassiria – Iraq

Summary :

Eighty – two children with *Streptococcus pneumoniae* diseases were admitted to central hospital of children in Baghdad city , during the period from January 2004 to December 2004 . The age of children ranged from one day to ten years . The types of diseases are follows : pneumonia 24 (29.2 %) , urinary tract infection 21 (25.6 %) bacteremia 18 (21.9%) , Otitis media 15 (18.2%) and meningitis 4 (4.8 %) . Of the 82 cases studied (32.9 %) were less than 2 years . From the subjets 48 (58.5 %) were male patients and 34 (41.4%) female patients , most of cases were occurred in winter months . The most effective antibiotics are ciprofloxacin and cefotaxime while Ampicillin and penicillin were less efficaious against *Streptococcus pneumoniae* . The major of isolates were have capsule and hemolytic activity (95.1 %) (96.3 %) respectively while only 40 (48.7%) from isolates were β-lactamase producing .

Introduction:

Streptococcus pneumoniae **is a pathogenic bacteria that affect children and adults. world-wide . It is an important cause of community-acquired infections, especially among young children [1]. *Streptococcus pneumoniae* is a common cause of life – threatening infection such as, pneumonia, meningitis, otitis media and infections of the bloodstream [2] , Risk for pneumococcal diseases is highest in children and person of any age who have chronic medical conditions such as heart disease or diabetes or conditions that suppress the immune system [3] . *Streptococcus pneumoniae* is the leading cause of bacteremia , meningitis , pneumonia , and upper respiratory tract Infection would wide . Invasive pneumococcal disease affects mostly children and lmmuno compromised Individuals. [4, 5, 6, 7]**

Antibiotic – resistant strain of *Streptococcus pneumoniae* are becoming more prevalent throughout the world . [8, 9]

The present study was undertaken to establish the diseases caused by *Streptococcus pneumoniae* and detect its virulence factors.

Materials and methods:

Eighty – two pediatric patients were included in the study; they were admitted to central hospital of children in Baghdad city during the period from January 2004 to December 2004, Information obtained at the time of admission-included age, sex, antibiotic intake before admission.

Isolates of *Streptococcus pneumoniae* :

Samples from blood , CSF , sputum , urine , ear swab and various as pirates of normally sterile sites were obtained from patients , Bacteriological studies on the specimens were performed in the department of microbiology in the same hospital .

The specimens were inoculated on brain heart infusion (Oxoid) , blood and chocolate agar and incubated aerobically in candle jar at 37 °c to 24-48 hours , Immediately , latex agglutination test (using slidex meningitic kit – 5 bio Merieux france). Gram stain, cytological and biochemical examination were done to identification the bacterium using standard techniques. [2]

Identification of isolates :

Identification of *Streptococcus pneumoniae* was confirmed on the basis of colony morphology , culture characteristics and their biochemical reactions and appearance of α-hemolysis and optochin susceptibility on blood agar . In addition to latex agglutination test [10].

Susceptibility testing:

Susceptibility to antibiotics were tested by the standardized disc diffusion assay on Mueller – Hinton agar containing 5% sheep blood according to the NCClS recommendation [11] . An inoculums density equivalent to 0.5 McFarland standards was prepared in trypicase soy broth. Plates were inoculated with a sterile cotton swab and incubated overnight at 35 °c in a 5% Co_2.

Detection of some virulence factors of *Streptococcus pneumoniae* :

*** capsule :**

Modified capsule stain was done according to [10]

*** β-lactamase producing :**

Iodometeric test and acidimetric test methods has been used to detect the β-lactamase according to [11]

*** hemolytic activity of *Streptococcus pneumerniae***

Hemolytic pattern on 5% sheep blood agar and hemolysis is enhanced by stabbing the inoculating loop into the agar several times , colonies can then grow throughout the depth of the agar producing subsurface oxygen – sensitive hemolysins (streptolysin – O) [12]

Results:

***Streptococcus pneumoniae* is an important community – acquired pathogen capable of causing multiple infections diseases, Table (1).shows The most important diseases caused by *Streptococcus pneumoniae* are pneumonia , urinary treat infection , bacteremia , otitis media and meningitis (29.2%) , (25.6%) , (21.9%) , (18.2%) and (4.8%) respectively . Table (1) show too that *Streptococcus pneumoniae* was responsible about eighty – two cases of infections . Table (2) shows sex distribution of *Streptococcus pneumoniea* diseases were 48 (58.5%) male patients and 34 (41.4%) female patients .**

Type of diseases	No . of cases	%
Pneumonia	24	29.2
Urinary tract infection	21	25.6
Bacteremia	18	21.9
Otitis media	15	18.2
Meningitis	4	4.8
Total	82	100

Table (1) : Frequency of different diseases caused by *Streptococcus pneumoniae*

Type of diseases	Total No .	%	male No .	%	female No .	%
Pneumonia	24	(29.26)	17	(70.8)	7	(29.1)
Urinary tract Infection	21	(25.60)	10	(47.6)	11	(52.3)
Becteremia	18	(21.95)	12	(66.6)	6	(33.3)
Otitis media	15	(18.29)	6	(40.0)	9	(60.0)
Meningitis	4	(4.87)	3	(75.0)	1	(25.0)
Total	82	(100%)	48	(58.5%)	34	(41.4%)

Table (2) : Sex distribution of streptococcus pneumoniae diseases (No.of cases %)

Pneumonia , bacteremia and meningitis were occurred predominant in male (70.8%) , (66.6%) and (75%) respectively while urinary tract infection , otitis media were occurred predominant in female (52.3%) and (60.0%) respectively.

Most cases were occurred in less than 2 years age group while minimum cases were occurred in age group (2-less than 4) years Table (3) . Most of cases of *Streptococcus pneumoniae* diseases were occurred in winter months Fig. (1) .

Table (3) : Relationship between age of patients and type of diseases caused by *Streptococcus pneumoniae*

Type of diseases	Total	Age group *				
		1	2	3	4	5
Pneumonia	24	7	5	3	4	5
Urinary tract Infection	21	8	2	6	4	1
Becteremia	18	10	3	2	2	1
Otitis media	15	2	1	3	2	7
Meningitis	4	-	-	2	1	1
Total	82 (100%)	27 (32.96 %)	11 (13.4%)	16 (19.5%)	13 (15.8%)	15 (18.2%)

1. Less than 2 years
2. 2- Less than 4 years
3. 4- Less than 6 years
4. 6- Less than 8 years
5. 8- 10 years

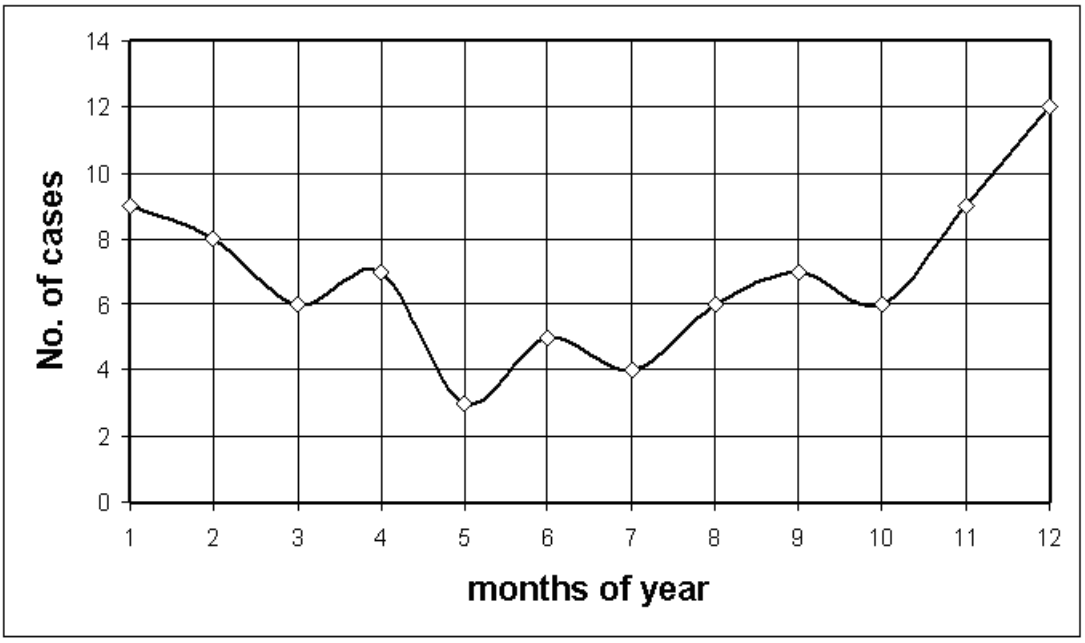

Fig. (1) : Relationship between *Streptococcus pneumoniae* diseases and months of year

On the basis of susceptibility testing ciprofloxacin and cefotaxime were highly efficacious for all *Streptococcus pneumoniae* isolates , while Ampicillin and penicillin were less efficaious against *Streptococcus pneumoninae* isolates, Table (4) .

Table (4) : Sensitivity pattern of 82 isolates of *Streptococcus pneumoniae*

Antibiotics	No. of Sensitive Isolates	(%)
Penicillin	42	(51.2)
Ampicllin	38	(46.3)
Cephalexin	61	(74.8)
Cefotaxime	73	(89.0)
Chloramphenicol	69	(84.1)
Vancomycin	67	(81.7)
Erythromycin	57	(69.5)
Ciprofloxacin	75	(91.4)

***Streptococcus pneumoniae* have some virulence factors .The total isolates of *Streptococcus pneumoniae,* which have some virulence factor, were shown in Table (5).**

All isolates were isolated from sputum , blood , ear swab and CSF have capsule (100%) , and hemolytic activity (100%) , but 55.5% of *Streptococcus pneumoniae* were isolated from blood , (52.3%) were isolated from urine and (50.0%) were isolated from sputum were able to produce β-lactamase enzyme generally high percentage from isolates were have capsule and hemolytic activity (95.1%) , (96.3%) respectively while (48.7%)from isolates were β-lactamase producing .

Type of disease	Total isolates	Virulence factors					
		Capsule		Hemolytic activity		B-lactamase producing	
		No .	%	No .	%	No .	%
Pneumonia	24	24	(100)	24	(100)	12	(50.0)
Urinary tract Infection	21	17	(80.9)	20	(45.2)	11	(52.3)
Bacteremia	18	18	(100)	18	(100)	10	(55.5)
Otitis media	15	15	(100)	13	(86.6)	5	(33.3)
Meningitis	4	4	(100)	4	(100)	2	(50.0)
Total	82	78	(95.1 %)	79	(96.3 %)	40	(48.7 %)

Table (5) : Relationship between virulence factors and diseases caused by *Streptococcus*

Discussion :

Our data demonstrated that pneumonia was the predominant manifestation of systemic *Streptococcus pneumoniae* diseases. Similar reports from various part of the world [13 , 14]

The second most common diseases by this bacteremia was urinary tract infection in present study , this result disagreement with [15]

Bacteremia occur in approximately 25% of patients and resulting as complication of pneumonia disease , *Streptococcus pneumoniae* is the leading cause of bacteremia , in our study bacteremia represent 18 (21.9%) from all cases this result go with other studies [4 , 5 , 6]

In addition to that, the yearly incidence of pneumococcal bacteremia is highest in European countries [7] , One of the important disease caused by *Streptococcus pneumoniea* was otitis media (middle ear infection) [16]

Our results shown that this bacterium responsible for (18.2%) cases of otitis media from all cases of pneumococcal meningitis usually arsis in the setting of a sustained bacteremia that permits bacterial penetration across the blood – brain barrier and into the sub arachrioid space [20] in present study this bacterium caused only 4 cases of meningitis and this result not similar with other reports because they mentioned that *Streptococcus pneumoniae* the common cause of meningitis [17]

The majority of our cases found in male patients , others have made similarly observation [23 , 24] The incidence of *Streptococcus pneumoniae* infectious various dramatically by age being highest among children younger than 2 years and among aged 65 years or older [18] from 82 cases 27 (32.9%)cases aged from 1 day to less than 2 years similar findings have been observed by other studies [18 , 19]

The seasonal variation which a high incidence of *Streptococcus pneumoniae* disease in winter months this result has also been noticed by others [20] and may be due to distribution of viral infections and crowding favor transmission and subsequent infection with *Streptococcus pneumoniae* in winter months .

In the past decade a large number of new antibiotics have become available which are highly active against *Streptococcus pneumoniae* . The antimicrobial sensitivity pattern of our isolates showed that the most isolates are sensitive to ciprofloxacin and cefotaxime and second antibiotics were effective to this bacterium are chloramphenicol and vancomyin while less effective antibiotics were penicillins similar findings , have been observed by other workers [17 , 21] while in other reports penicillin was highly effective against *Streptococcus pneumoniae* [22] .

penicillin and cephalosporins and other β-lactam antibiotics kill *Streptococcus pneumoniae* by binding irreversibly to high molecular weight enzymes located in the bacterial cell wall , these enzymes , also known as penicillin binding proteins are responsible for synthesizing peptidoglycan for new cell wall formation , chromosomal gene changes can alter the structure of these enzymes herby decreasing the binding affinity for penicillin and cephalosporin and resulting in resistance [23] .

The capsular polysaccharide of *Streptococcus pneumoniae* is the major reason why the organism is able to evade phagocytosis from polymorph nuclear cells and macrophages [1] , this go with our results because all isolates

which cause diseases have capsule hemolysins of *Streptococcus pneumoniae* that is cytotoxic for phagocytes and respiratory epithelial cells and cause inflammation [1] , and its role in the pathogenesis of *Streptococcus pneumoniae* , In our study most isolates have hemolytic activity and this play role in pathogenesis of this bacterium. 40(48.7%) isolates only were found . β-lactamase producing in our study because the resistance to penicillin and cephalosporins is not mediated by β-lactamase producing only and the resistance to β-lactam antibiotics may be by decreasing the binding affinity for penicillin pending protesns resulting in resistance [23] .

الخلاصة العربية :

أجريت الدراسة على اثنان وثمانون طفلاً مصاباً بالعقديات الرئوية والذين ادخلوا إلى مستشفى الأطفال المركزي في مدينة بغداد للفترة من كانون الثاني ٢٠٠٤ إلى كانون الأول ٢٠٠٤ وتراوحت أعمار الأطفال المصابين من يوم واحد الى عشرة سنوات ، أوضحت الدراسة أن الأمراض التي تسببها العقديات الرئوية هي التهاب الرئة . (٢٩.٢ %) والتهاب المجاري البولية (٢٥.٦ %) تجرثم الدم (٢١.٩ %) ، التهاب الإذن الوسطى (١٨.٢%) والتهاب السحايا (٤.٨%) ، وظهرت اغلب الإصابات في الفئة العمرية اقل من سنتين ، وجد أيضاً أن نسبة الإصابة في الذكور (٥٨.٥%) أعلى مما هو عليه عند الإناث (٤١.٤ %) ، كذلك ظهرت اغلب الإصابات في أشهر الشتاء ، ووجد أيضاً أن المضادات الحياتية السبروفلوكساسين والسيفوتاكسيم ذو فاعلية تثبيطية ضد اغلب عزلات هذه البكتريا . وظهر في هذه الدراسة أيضاً أن اغلب عزلات هذه البكتريا تمتلك الكبسولة والفعالية الحالة الدم ، (٩٥.١%) ، (٩٦.٣%) على التوالي ، كما وجد ان ٤٠ عزلة مثلت نسبة (٤٨.٧ %) كانت منتجة لأنزيم البيتالاكتاميز .

Referances :

1- **Weber , D . J . and Rutala , W . A ., " *Streptococcus pneumoniae* infections : Micrbiology , Epidemiology , Treatment and prevention" . *Medscapc* . 17. 2004 .**

2- **Brooks , G . F . ; Butel , J . S . and Morse , S . A ., Jawetz , *Microbioogy 21th ed* . *Appelton and Lang* .2004**

3- **Gupte , S . , *The short Textbook of medical microbiology 8th ed* . *Jaypee* . 2002 .**

4- **Leowski , J ., "Mortality from acute respiratory infections in children under 5 years age ; global estimates" . *world Health statistics Quarterly* 39 : 138 – 44 , 1986 .**

5- **Kertesz , D . A . Difabio , J . L . ; Brandileone , M . C . Castaneda , E . ; Echaniz , A . G . ; Hettmann , "Invasive *Streptococcus pneumoniae* infection in latin American Children : results of the Pan American Health organization surveillance study" . *Clin. Dis* . *Infect* . *Dis* . 26 , 1355 – 61, 1998 .**

6- **Plouffe . J . f . ; Breiman , R . R . and facklam , R . R . , "Bacteremia with *Streptococcus pneumoniae* inadults : implications for therapy and prevention" . *Journal of the American Medical Association* 275 , 194-198 , 1996 .**

7- Fedson , D . S . , Scott , G ., "The burden of pneumococcal disease amony adults in dereloped and developing countries : what is and is not known" .*Vaccin*e 17 , Suppl 1,11-8 . 2000

8- Kaplan , S . L . ; and Moson , E . O . , "Mangment of infectious due to Antibiotic – Resistant *Streptococcus pneumoniae*" . *Clin* . *Microbiol* . *Rev* . 11 : 628-644 , 1998.

9- Baquero , F ; Rodriquez , A . G . ; Lomas , J . G . ; and Aquilar , l . , "Antimicrobial Resistance of 1 , 113 *Streptococcus pneumoniae* isolates from patients with respiratory tact infections in Spain : Results of a 1-years (1996-1997) multicenter surreillance study" . *Antimicrob* . *Agents and Chemother* . 43 : 357 – 359 , 1999 .

10- Harley , J . P . and prescott , L . M ., *Laboratory exercises microbiology* . *3rd ed* . MC Graw – Hill , Bost : 484 , 1996 .

11- Koneman , E . W . : Alten , S . D . ; Janda , , W . M . ; Schreckenbery P . C . ; Winn , W . C . , *Color plate and textbook of diagnostic microbiology 4th ed* . 405-429. L . B . Lippincott company , Washington . 1992

12- Baron , E . J ; and finegold , S . M . , Bailey and Scotts , *Diagnostic microbiology 8th ed* C . V . Mosby Company . 1994 .

13- AL-Sharbati , S . S . , *Meningitis in Baghdad epidemiology and Laboratory study* . MSC . Thesis Submitted to collage of medicine , Baghdad university , 7-9 , 1989 .

14- Flamaing , J : Verhaegen , J . ; and Peeter mam's , W . E ., "*Streptococcus pneumoniae* bacteremia in Belgium : differential characteristics in children and the elderly population and implications for vaccine use" . *J* . *Antimicrob Chemother* . 50 : 43 – 50 . 2002 .

15- AL- Hemidawi , T . F . , *Hemolytic activity of Escherichia coli isolated from urinary tract infections and lts resistance to antibiotics* . thesis submitted to AL – Mustansiryh university pp 67 – 70 , 2005 .

16- Nagai , K . ; Davies , T . A . ; Dewasse , B . E . ; pankuch , G . A . ; Jacobs , M . R . and Appelbaum P . C . , "In vitro development of resistance to ceftriaxone , cefprozil and azithromycin in *Streptococcus pneumoniae*". *J* . *Antimicrobiol. Chemother* , 46 : 909-915 . 2000 .

17- Rao , B . N . ; Kashbur , I . M . ; shembesh , N . M . and El-Bargathy , S . M . , "Etiology and occurrence of acute bacterial meningitis in children . in Benghazi , Libyan Arab Jamahiriyah" . *Eastern Med* . 4 (1) 51-54 . 1998 .

18- Robinson , K . A . ; Baughman , W . and Rothrock G ., "Epidemiology of Invasive *Streptococcus pneumoniae* Infections in the united states 1995-1998" . *JAMA* . 285 : 1759-1735 . 2001

19- AL- Timimi , N . M ., *meningitis* , *Epidemiological , Clinical investigational study* , thesis submitted college medicine , Basrah University 101-117 . 1991

20- Kim , P . E . ; Musher , D . M . ; Glezen , W . D .; Rodriquez M . C . ; Nahm , W . K . and Wright , C . E . , "Association of invasive pneumococcal disease with season , atmospheric conditions , air pollution , and isolation of respiratory

viruses". *Clinic . Infect . Dis .* 22 : 100-106 . 1996

21- David , T . J , "Bacterial meningitis" , *J . Pediatr* . 9:1–5 . 1991

22- Neeling , A . J . ; Overbeek , B . P . ; Horrevorts , A . M . ; Ligtvoet , E . E . And Goettsch W . G . , "Antibiotic use and resistance of *Streptococcus pneumoniae* in the Netherlands durng the period 1994 – 1999" . *J . Antimicrob . Chemother* . 48 : 441-444 . 2001 .

23- Klugman , K . P ., "Pneumococcal resistance to antibiotics" . *Clin Microbiol Rev* . 3 : 171-196 . 1990 .