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Original Article

Prevalence and Types of Bacterial Infections of the Upper Respiratory Tract at a Tertiary Care Hospital in the City of Tripoli

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Abstract

Aim: The study aimed to determine the bacterial etiology of upper tract respiratory infection in Abu-Sitta Hospital, Tripoli, Libya. **Subjects and Methods:** A total of 470 sputum specimens and 60 throat swabs were collected over a period of 1 year (From January 2014 to December 2014) from patients presented with clinical signs of upper respiratory tract infection at Abu-Sitta Hospital. Enrolled patients were sorted as inpatients or outpatients and by gender. Data were entered and analyzed using SPSS version 22.0. Variables were expressed as percentages. Differences in age and gender were analyzed using Chi-square test. **Results:** Of the total 530 screened samples, 80.5% were culture positive, where bacterial pathogens were detected in 83.7% of sputum specimens and in 56.5% of throat swabs. *Streptococcus pneumoniae* was the most prevalent (48%), followed by *Pseudomonas aeruginosa* (23%), *Staphylococcus aureus* (13%), *Enterobacter* (8%), *Citrobacter freundil* (5%), and latest with *Klebsiella* (3%). **Conclusions:** The spectrum of pathogenic bacterium causing upper respiratory infection in Abu-Sitta Hospital is considerably wide, with *S. pneumoniae* and *P. aeruginosa* being the major causative bacteria.

Keywords: Bacteria, respiratory infection, Tripoli

Introduction

Respiratory tract infection (RTI), including upper and lower respiratory tracts, is one of the most important infectious diseases worldwide that may lead to high risk of morbidity and mortality in both developed and developing countries.[1] RTI especially those occur in upper respiratory tract (URTI) is shown with great frequency in both children and adults and has notable economic effect, related to lost output in the workplace and to the frequent antibiotic prescriptions by physicians.[2] In developed countries such as the United Kingdom, around 8 million people are infected by some types of chronic lung diseases that kill one person in each five persons.[3] However, the situation is more complicated in other developing countries, mainly African countries. The World Health Organization has estimated that 9% of Libyan children under-five deaths in 2000–2003 were caused by pneumonia.[4]

URTIs is a contagious disease that remains for hours to few days of exposure. Studies have reported that URTIs symptoms may stay even longer.[5] Several signs and symptoms of URTIs have been mentioned including runny nose, coughing, sneezing, fever, vomiting, sore throat, loss of appetite, and watery eyes.[6] Although the causes of URTI have been attributed to viral, many studies have also shown that the cause of URTI can be also bacterial.[7] *Streptococcus pneumoniae, Haemophilus influenzae, Klebsiella pneumoniae, Staphylococcus aureus, Streptococcus pyogenes,* and *Moraxella catarrhalis* are the most common bacteria implicated as causative agents of URTIs.[8,9]

Considering the high morbidity and mortality rates of URTI in developing countries, and limited number of studies on the prevalence of URTI among patients in Libya, this study was

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aimed to determine the microbial agents of human upper RTIs in Abu-Sitta Hospital in Tripoli city, Libya.

Subjects and Methods

Study population

This is an observational study conducted from January 2014 to December 2014. The study population included patients admitted to the medical laboratory of Abu-Sitta Hospital, Tripoli, Libya, with specialist determined clinical evidence of URI. All patients were informed of the study purpose and were assured that all information will remain confidential. This study was approved by the Scientific Committee of Faculty of Medical technology, University of Tripoli, Libya.

Sample collection

Samples were collected from 530 patients (468 sputum, 62 wet throat swab). First, the collected samples were labeled with patients information including age, gender, and clinical symptoms and then were immediately taken to the microbiology laboratory for isolation and identification of presence of any potential bacterial pathogen using morphological, microscopy, and biochemical tests. The sputum samples were collected into well-labeled sterile, wide-mouthed glass bottles with screw cap tops. The swabs were transported directly to the laboratory. For a collection of throat samples, the tongue was depressed by the handle of a spoon to observe the mouth for the presence of inflamed membrane, pus, or exudates.

Bacterial isolates

In the microbiological laboratory, each sample was inoculated onto chocolate agar, blood agar, and eosin methylene blue agar. The inoculum on the plates was streaked out to separate colonies with sterile wire loop. The culture plates were incubated for 24–48 h at 37°C. After incubation, microscopic and macroscopic observations of colonies on culture plates were achieved, and suspect colonies were subcultured on a suitable solid culture media for purification. All pure cultures were identified depended on their cultural and morphological features on differential and selective media.[10] Data were entered and analyzed using SPSS version 22.0 (SPSS Inc., Chicago, IL, USA). Variables were expressed as percentages. Differences in age and gender were analyzed using Chi-square test.

Results

A total of 530 samples (sample per each participant) were collected, of which 59% were female and 41% were male patients, giving male: female ratio of 1:0.7 [Table 1]. The mean age of the participants was 28 ± 15.8 years with a minimum and maximum age of 8 and 69 years, respectively. The ages of the participants were categorized into three groups: below 20 years, between 20 and 45 years, and above 45 years. Majority of the patients were in the age group <20 (42%) years. A female preponderance was observed in all age groups. Seventy-three percent of these patients were seen and treated at outpatient clinics and the remaining were inpatients [Table 1].

About 80.5% of all patients had positive cultures for respiratory tract pathogen, 83.7% of the total sputum specimens, and 56.5% of the total throat swabs [Tables 1 and 2].

Six different types of bacteria were recovered: *Streptococcus pneumoniae* was the most prevalent (48%), followed by *Pseudomonas aeruginosa* (23%), *S. aureus* (13%), *Enterobacter* (8%), *Citrobacter freundii* (5%), and latest with *Klebsiella* (3%) [Table 3].

With regard to gender variation, females show higher percentage of infection acquisition and ultimately following the same bacterial strain predominance pattern with *streptococcus pneumonia* at the top and *Klebsiella* at the bottom [Table 4].

As for age variation, no differences can be noted in the bacterial prominence order among the defined three age groups, yet overall participant aged below 20 years showed the highest

Table 1: The characteristics of patients enrolled in the study

Variable	Percentage	χ^2	*P*
Gender			
Male	41	0.0037	0.979
Female	59		
Age (years)			
<20	42	0.0007	0.991
20-45	22		
>45	36		
Patients state			
Outpatients	73	0.0251	0.874
Inpatients	27		
Culture			
Positive	80.5	0.0119	0.913
Negative	19.5		

Analysis was done by Chi-square test. $P<0.05$ was considered statistically significant

Table 2: Number of samples collected and growth observed from sputum and throat swab

Specimens	Number of samples	Growth observed and percentage
Sputum	468	392 (83.7)
Throat swab	62	35 (56.5)
Total	530	427 (80.5)

Table 3: Bacterial species isolated from patients with upper respiratory tract and their percentages

Bacterial pathogenic strain	*n* (%)
Streptococcus pneumoniae	205 (48)
Pseudomonas aeruginosa	98 (23)
Staphylococcus aureus	56 (13)
Enterobacter	34 (8)
Citrobacter freundii	21 (5)
Klebsiella	13 (3)
Total	427 (100)

percentage of infection acquisition, whereas participants aged 20–45 years old presented the least percentage [Table 5].

Discussion

The primary goal of this study was to ascertain the current prevalence of bacteria causing URI in Abu-Sitta Hospital, Tripoli, Libya. The secondary objective was to find out the influence of age and gender variables on the general pattern of causative pathogenic bacteria.

S. pneumoniae was the most frequently recovered pathogen (48%), followed by *P. aeruginosa* (23%), *S. aureus* (13%), *Enterobacter* (8%), *C. freundii* (5%), and latest with *Klebsiella* (3%). Numerous studies have previously reported these isolates as a major cause of RTI in human. In Libya, a study carried out in 2006 including 322 patients revealed that *S. aureus* were the most prevalent organism, followed by *Streptococcus pyogenes* and *Klebsiella pneumoniae*.[11] Earlier international studies reported the prevalence of *Streptococcus spp* to be 22% in Iceland, 14% in Brazil, 11% in Cameroon, and 8% in the Netherlands.[12-15] The number of positive pathogenic cultures in relation to the total number of enrolled participants was considerably high in our study as compared to similar studies done worldwide; such a result is highly attributed to the fact that the place where the study took place is a specialized hospital for respiratory diseases.

Most of the bacteria isolated during the study such as *S. pneumonia, P. aeruginosa, S. aureus, and Enterobacter spp,* fall in either nosocomial or community-acquired pattern of infection, suggesting that proper protective actions could limit bacterial involvement in URTIs.

Contrary to other reported studies,[16,17] our study found that gender or age had no effect on the ratio of infection acquisition.

Table 4: Distribution of isolated bacterial strains based on gender

Bacterial strain	Gender		Total, *n* (%)	*P*
	Female, *n* (%)	Male, *n* (%)		
Streptococcus pneumoniae	133 (54)	72 (40)	205 (48)	0.975
Pseudomonas aeruginosa	52 (21)	46 (26)	98 (23)	0.993
Staphylococcus aureus	26 (10)	30 (17)	56 (13)	0.989
Enterobacter	17 (7)	17 (9)	34 (8)	1.00
Citrobacter freundii	12 (5)	9 (5)	21 (5)	0.961
Klebsiella	8 (3)	5 (3)	13 (3)	0.561
Total	248 (100)	179 (100)	427 (100)	0.981

Analysis was done by Chi-square test. $P<0.05$ was considered statistically significant

Table 5: Distribution of isolated bacterial strains based on age

Bacterial strain	Age (years)			Total, *n* (%)	*P*
	<20, *n* (%)	20-45, *n* (%)	>45, *n* (%)		
Streptococcus pneumoniae	89 (49)	43 (46)	73 (48)	205 (48)	0.852
Pseudomonas aeruginosa	44 (24)	20 (21)	34 (23)	98 (23)	0.753
Staphylococcus aureus	27 (15)	10 (11)	19 (12)	56 (13)	0.739
Enterobacter	12 (6)	9 (10)	13 (9)	34 (8)	0.801
Citrobacter freundii	8 (4)	7 (8)	6 (5)	21 (5)	0.978
Klebsiella	3 (2)	4 (4)	6 (3)	13 (3)	0.558
Total	183 (100)	93 (100)	151 (100)	427 (100)	0.857

Analysis was done by Chi-square test. $P<0.05$ was considered statistically significant

Conclusions

The spectrum of the pathogenic bacterium causing upper respiratory infection in Abu-Sitta Hospital is considerably wide. As per the revealed pattern of predominant causative bacteria, no significant change noted for either age or gender variations.

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Conflicts of interest

There are no conflicts of interest.

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ملخص المقال باللغة العربية

انتشار وأنواع الالتهابات البكتيرية في عدوى الجهاز التنفسي الأعلى في مستشفى الرعاية الثالثية في مدينة طرابلس

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الهدف: هدفت الدراسة إلى تحديد المسببات الجرثومية لعدوى الجهاز التنفسي العلوي في مستشفى أبو ستة، مدينة طرابلس، ليبيا.

العينة والطرق: تم جمع ما مجموعه 470 عينة من البلغم و60 مسحة من الحلق خلال فترة سنة واحدة (من يناير 2014 إلى ديسمبر 2014) من المرضى الذين تعرضوا لعلامات سريرية للعدوى في الجهاز التنفسي العلوي في مستشفى أبو ستة. تم فرز المرضى المسجلين كمرضى مقيمين أو مرضى العيادات الخارجية وحسب الجنس. تم إدخال البيانات وتحليلها باستخدام SPSS الإصدار 22. تم التعبير عن المتغيرات كنسب مئوية، كم تم تحليل الاختلافات في العمر والجنس باستخدام اختبار مربع كاي.

النتائج: من إجمالي 530 من العينات التي تم فرزها، 80.5٪ أظهرت مزرعة إيجابية للبكتريا، حيث تم اكتشاف مسببات الأمراض البكتيرية في 83.7٪ من عينات البلغم وفي 56.5٪ من مسحات الحلق. كان العقدية الرئوية الأكثر انتشارا (48٪)، تليها الزائفة الزنجارية (23%)، المكورات العنقودية الذهبية (13%)، الأمعائية (8%)، الليمونية الفروينديه (5%)، وأخرها الكلبسيلة (3%).

الاستنتاج: طيف البكتيريا المسببة لأمراض الجهاز التنفسي العلوي في مستشفى أبو ستة بطرابلس واسعة إلى حد كبير، مع العقدية الرئوية والزائفة الزنجارية كونهما البكتيريا المسببة الرئيسية.

الكلمات المفتاحية: باكتيريا، عدوي الجهاز التنفسي، طرابلس.