Bacterial Infections Caused by *Achromobacter xylosoxidans*

Mohammed Kadum Al-Araji Samah Ali
College of Pharmacy, Al-Mustanseriyia University, Baghdad, Iraq.
Corresponding author: E-mail: mohammedkadum52@yahoo.com

Abstract

Achromobacter xylosoxidans was first time isolated in Iraq from patients admitted to Medical city in Baghdad from july 2010 to july 2011 whose majority were compromised, Eleveenth patients were infected by this microorganism in different body sites and frequently isolated in combination with other organisms and finding in all well-described cases in which its pathogenic role is clearly demonstrated and may be confused with Pseudomonas species in laboratory diagnosis.The laboratory characteristics were done by culturing in different media and by biochemical reactions and showed a differents in their characteristics from Pseudomonas species.

Key word: *Achromobacter xylosoxidans,* infections.

الاخماج البكتيرية المتسببة بفعل البكتريا الكروموبكتر زايلوسوكسدنس

الخلاصة

لأول مرة في العراق يتم عزل جرثومة المتنصلة نوع زايلوموكسيدنس من مرضى ادخلوا مستشفى مدينة الطب في بغداد للفترة تموز ٢٠١٠ والى تموز ٢٠١١ غالبيتهم مصابين بأمراض مزمنة، وقد تم ذلك من خلال تشخيص أحد عشر إصابة بهذه البكتيريا المرضية والمعزولة من مختلف مناطق الجسم وغالباً ماتكون مشتركة مع أصناف أخرى من البكتيريا وخصوصاً البكتيريا الزائفة، وقد كان الإعتقاد السائد سابقاً بأنها هي نفس جرثومة الزائفة خلال التشخيص المختبري حيث يحدث الخلط في التشخيص المختبري بين انواع المتنصلة وبين انواع الزائفة، لكن مايميز المتنصلة هي كونها لها خصائص مختبرية مختلفة عن البكتيريا الزائفة من حيث زراعتها على اوساط زرعية مختلفة والخواص الكيمياوية منها وبعد اجراء كافة الفحوصات للخواص المختبرية لكل جرثومة تبين انها تختلف عن جرثومة الزائفة ومن خلال المعالجة تبين ايضاً انها مقاومة لأعداد كبيرة من مضادات الحياة المتوفرة حالياً في العراق.

Introduction

Achromobacter xylosoxidans is Gram-negative rod aerobic, motile, oxidase-positive and catalase-positive, its oxidizes xylose and glucose[1]. This organism causes apportunistic infection in patients who are compromised and usually are exists in water environment and may be confused with Pseudomonas in their similarities in some biochemical reactions .This microorganism is rarely isolated from clinical material and was initially characterized by Holmes et al [2] and further studied and named byYabuuchi and Ohyama [3].

Achromobacter is frequently isolated in nosocomial infections and is especially prevalent in intensive care units, where both sporadic cases as well as epidemic and endemic occurrence is common. *A. baumannii* is a frequent cause of nosocomial pneumonia,

especially of late-onset ventilator associated pneumonia. It can cause various other infections including skin and wound infections, bacteremia, and meningitis,

The purpose of this study that *A.xylosoxidans* is firstly isolated in Iraq (Baghdad city) causes severe acute infections in both compromised and non compromised patients and isolated from different body sites. In November, 2004, the CDC reported an increasing number of *A. baumannii* bloodstream infections in patients at military medical facilities in which service members injured in the Iraq/Kuwait region during Operation Iraqi Freedom (OIF) and in Afghanistan during Operation Enduring Freedom (OEF) were treated. (1)Most of these were multidrug-resistant. Among one set of isolates from Walter Reed Army Medical Center, 13 (35%) were susceptible to imipenem only, and two (4%) were resistant to all drugs tested. One antimicrobial agent, colistin (polymyxin E), has been used to treat infections with multidrug-resistant *A. baumannii*; however, antimicrobial susceptibility testing for colistin was not performed on isolates described in this report. Because *A. baumannii* can survive on dry surfaces for up to 20 days, they pose a high risk of spread and contamination in hospitals, potentially putting immune-compromised and other patients at risk for drug-resistant infections that are often fatal and, in general, expensive to treat.

Materials and Methods

Patients:

Eleventh patients were admitted to Medical city hospitals in Baghdad from july 2010 to july 2011 complained from different diseases with different ages and sexes as shown in table (1). Most of the patients were greater than 50 years of age and had an underlying illness at the time that *A. xylosoxidans* was isolated. The organism was considered the primary pathogen in most patients requiring therapy. The characteristic of *A.xylosoxidans* are listed in Table (2).

Isolation and Identification of Bacteria :

All specimens were examined microscopically and plated on several agar media, including MacConkey agar and Blood agar, plates, and incubated under , aerobic and anaerobic at 37°C for 24 up to 72 h.The colonies were identified by direct Gram stain and all biochemical tests were done by API-20 system (bioMérieux) to confirm the identification of *A. xylosoxidans* isolates, and other biochemical tests and fermentation of carbohydrates reaction see table (2).

Antimicrobial susceptibility test:

Considering one isolate per patient, and considering that each isolate showed the same antimicrobial profile during the whole study period, To assess the sensitivity to piperacillin, piperacillin–tazobactam, cefotaxime, cefepime, ceftazidime, ciprofloxacin, levofloxacin, chloramphenicol, imipenem,, trimethoprim–sulfamethoxazole, gentamicin, rifampin, and tetracycline, an agar diffusion method (Kirby–Bauer) and MIC technique were used see table (3). *A. xylosoxidans* isolates were included for the antimicrobial susceptibility analysis. These isolates were obtained from several clinical samples, i.e., sputum, blood, vascular catheter, burn wound, and urine.

Interpretative criteria for susceptibility for all of the methods used in the study were in accordance with

Clinical and Laboratory Standards Institute (CLSI) criteria(4)

Results

As shown in Table (1) Patients were admitted admitted to Medical city in Baghdad in October 2010 for treatment from *A.xylosoxindas* infections The organism was considered the primary pathogen in most patients requiring therapy.

Patients infected by *A. xylosoxidans* were characterized for age, age of acquisition of first infection, co-infection, lung function, and death. The clinical data of the eleven patients are summarized in Table (1).

A.xylosoxidans and moderate number of *klebsiella pneumonia* were present in sputum samples were sending to laboratory diagnosis. Treatment for this infection done by claforan vial 1gm twice dialy and clindamycin, but did poorly and expired on hospital day seven.

A.xylosoxidans and Pseudomonas aeruginosa and Staphylococcus aureus were isolated from cultivation of burns swab samples, these all bacteria were identified by API test..

Some patients were complained from sever urinary tract infection, urine samples were sending to laboratory diagnosis and the result of cultivation showed mix growth of *A.xylosoxidand* and *E.coli*. She treated with parentral carbencillin antibiotic according to sensivity test was done,

A 69-year old male was admited in july 2010 to Medical city Baghdad for generalized exoliative dematitis and bilateral otitis externa.Past history revealed treatment of the exoliative dermatis for 6 years with prednisone and a history of asthma and diabetes mellitus. During the patients hospital stay, cultures from purulent discharge from both ears grew. *A.xylosoxidans*, *proteus mirabilis* and *staphylococcus aureus were* isolated from purulent discharge from both ears .

During his hospitalization in July 2010, the patient had a transurethral prostatectomy. Histological examination revealed an infiltrating well-differentiated adenocarcinoma of the prostate. Two of three urine specimens taken before surgery grew. *A.xylosoxidans* on culture and other specimen gew the same organism and a microaerophilic, gram-positive coccus. The patient was treated with carbenicillin did well and was discharged 2 weeks after surgery with nitofurantoin treatment.

In November 2010 *A.xylosoxidans* and *Escherichia coli* Were isolated from a discharge from his right ear while the patient was taking oral ampicillin.In January 2011, while the patient was taking oral erythromycin. *A.xylosoxidans* and *E.coli* were isolated again from a discharge from his right ear .Currently, the patient is not receiving treatment, and repeat surgical intervention is being considered.

A variety of microorganisms was isolated from peritoneal fluid and the patient was treated appropriately, with clearing of the peritoneal fluid. In January 2011, three cloudy peritoneal fluid (dialysate) specimens collected within 48 h of admission grew *A.xylosoxidans*. Two of three dialysate cultures also grew *Staphylococcus epidermidis*. The patient was treated with parental carbenicillin, with rapid clearing of the fluid. He was discharged from the hospital and is currently doing well.

The organism grew well on MaCconkey agar and was citrate,

oxidase, and catalase positive.Glucose was oxidized slowly as was xylose, whereas other carbohydrates were not. Tests for urease, lysine decarboxylase and arginine dihydrolyase were negative. *A. xylosoxidans* isolates were multidrug-resistant, showing resistance to tocephalosporins, including cefepime (MIC > 16 μg/mL), ceftazidime (MIC > 16 μg/mL), and cefotaxime (MIC > 32 μg/mL), to carbapenem (imipenem MIC > 8 μg/mL; meropenem MIC > 8 μg/mL), to aminoglycosides (gentamicin MIC > 8 μg/mL), to ciprofloxacin (MIC > 2 μg/mL), to, and trimethoprim–sulfamethoxazole (MIC > 2/38 μg/mL). On the other hand, these ten isolates were sensitive to piperacillin (MIC < 4 μg/mL) and piperacillin–tazobactam (MIC < 4/4 μg/mL). All six chronically infected patients carried multidrug-resistant isolates, and chloramphenicol (MIC < 16 μg/mL). Also, these isolates were sensitive to piperacillin and piperacillin–tazobactam.

Table (3) summarized the antibiotic susceptibilities of our six isolates as determined by the standard disk diffusion method. Most isolates were sensitive to carbencillin and Trimethoprim/sulfamethoxazole. *A. xylosoxidans* infected patients (case group) were compared with those of chronically *P. aeruginosa* infected patients (control group); thus, two groups were matched for age, gender, body weight, FEV_1, and *P. aeruginosa* infection status. *A. xylosoxidans* had never been isolated from any patient of the control group. Nutritional status was calculated as the body mass index (BMI, kg/m^2). We found no significant differences in the forced expiratory volume in 1 s (FEV_1) and body mass index (BMI) (11), when comparing the case group of *A. xylosoxidans* chronically infected patients with the control group of *P. aeruginosa* chronically infected patient.

Discussion

The clinical impact of *A. xylosoxidans* infection is not clear, as well as its lung colonization. Our data are not indicative of increased morbidity linked to this infection/colonization. Besides, our study design does not indicate effects on the clinical status from chronic/intermittent/sporadic *A. xylosoxidans* infection. We found no significant difference in the FEV_1 and BMI comparing chronically *A. xylosoxidans* infected patients with chronically *P. aeruginosa* infected patients during the study period. The mild lower mean FEV_1 observed in patients with chronic *A. xylosoxidans* infection could also have been influenced by other covariates, such as diabetes.

All chronically *A. xylosoxidans* infected patients were co-colonized also by *P. aeruginosa* and, generally, 43.3% of patients present also *P. aeruginosa* infection. In the study of Van Daele *et al*. (12), there is indicated the strong tendency by *A. xylosoxidans* to install itself in a lung already infected by *P. aeruginosa*. But, in this study, only patients colonized by *P. aeruginosa* were enrolled. Our data also indicate this tendency by *A. xylosoxidans* but, differently from the study of Van Daele *et al.*, our population also included patients not co-colonized by *P. aeruginosa*. Thus, we can affirm that *A. xylosoxidans* can infect a lung also not previously colonized by *P. aeruginosa*. As a consequence of the increasing use of antibiotics concomitant to acute pulmonary exacerbations in pneumonia

patients due to *Streptococcus pneumonia* infection, *A. xylosoxidans* as well as other non-fermentative Gram-negative bacteria are showing growing drug resistance. Our data support this evidence because of frequent previous colonization with *P. aeruginosa*.

It is well known that, for most of the non-lactose fermenting, Gram-negative rods, the disk diffusion antibiogram is not validated by the CLSI. In fact, there are several interpretation problems, such as unclear inhibition zone borders. Consequently, in the present study, a microbroth dilution assay was also carried out and no differences were found between the two methods. In 1971, Yabuuchi and Ohyama described a nonfermentive, gram-negative, peritrichous rod that they isolated from purulent ear discharges of seven patients with chronic otitis media and proposed the name *Achromobacter xylosoxidans* [3]. The minimal characteristics for the identifications of *A.xylosoxidans* are as follows; motile, gram-negative, asporogenous, straight rods with peritrichous flagella, positive reaction for oxidase, catalase and Simmons citrate, oxidation of xylose and glucose but not of maltose and other carbohydrates , and negative tests for urease, lysine decarboxylase and arginine dehydrolylase .

Table (4). observed that the *A.xylosoxidans* can be differentiated Pseudomonas spp. In their biochemical reactions.

The antibiotic sensitivity pattern, although indistinguishable from that of some *pseudomonads* is considered fairly typical. Most of our strains see Table (3) were resistant to the currently used aminoglycosides but were sensitive to polymyxin B and Trimethaprime/ sulfamethaxazole.

All of our strains were sensitive to carbenicillin, but were resistant to other semisynthetic penicillins.Some strains were sensitive to chloramphenicol, tetracycline and colistin. Clinically *A.xylosoxidans* has been isolated from many types of specimens, most frequently from the urine,blood,respiratory tract, spinal fluid and ears see Table (4).

Unfortuntely sufficient clinical information is missing from most descriptions. Thus it is difficult to assess the clinical significance of its isolation. The fact that *A.xylosoxidans* is frequently isolated in combination with other organisms makes it even more difficult to determine its pathogenic role. However, there are a few well-described cases in which its pathogenic role is clearly demonstrated. The source of *A.xylosoxidans* and its natural habitat are unknown;two of their strains were isolated from a swimming pool and from a chlorhexidine solution.In conclusion *A.xylosoxidans* causes apportunistic infections in patients with underlying illness. The organism probably exists in a water enviroment and can be confused with pseudomonas species. The organsim is usually sensitive to carbenicillin, commonly sensitive to chloramphenicol, tetracycline and trimethaprime/ sulfamethaxazole and resistant to other penicillins and currently used aminoglycosides.

In conclusion, the results of the present study can represent a further step toward the understanding of the epidemiology of these microorganisms and of a possible correlation between the microbiological data and clinical outcomes of *A.xyloxidans* infected patients. Appropriate antimicrobial treatment led to clinical and

microbiological cure in all cases, with no related mortality or relapses

References

1-Centers for Disease Control and Prevention (CDC) (2004). "Acinetobacter baumannii infections among patients at military medical facilities treating injured U.S. service members, 2002-2004". MMWR Morb Mortal Wkly Rep **53** (45): 1063–6.

2-Holmes,B.; J.J.S.Snell and S.P.Lapage. (1977). Strains of Achromobacter xylosoxidans from clinical material J.Clin.Pathol 30:595-601

3-Yabuuchi,E. and A.,Ohyama . (1971). Achromobacter xylosoxidans,n,sp. From human ear discharge Jpn.J.Microbiol 15:471-481.

4-National Committee for Clinical Laboratory Standards (NCCLS).(2002). Methods for dilution antimicrobial susceptibility tests for bacteria that grow aerobically, 5th edn. Approved Standard M7-A5. NCCLS, Wayne, PA.

Table 1 Characteristics of A.xylosoxidans infection

Case	Age/Sex	Site of isolation	Infections disease	Antibiotics therapy before isolation	No.of culture	Concomitant organism	Underlying disease	Outcome
1	49/Female	Chest	Chest infection	None	2	Strept.pneomoniae	Idiopathic thrombocytopenic purpura	Improved
2	50/Female	Burn	Burn infection	None	3	Ps.aeuginosa.Staph. aureus	35%body surface burn	Improved
3	21/Male	Appenciditis	Acute appenciditis	None	1	A.xylosoxidans	Wound infection	Improved
4	22/Female	U.T.I	Urithritis	None	1	E.coli	Urinary tract infection	Improved
5	68/Male	Ca,pancrease	pneumonia	None	2	K.pneumoniae	Pneomiae and Ca.pancrease	Died
6	55/male	Ear discharge	Chronic otitis media	*(1)* Ampicillin *(2)* Erythromycin	2	E.coli	Multiple ear surgeries and chronic alcohol	Improved
7	53/Male	Peritoneal fluid	Peritonitis	None	3	Staph.epidermidis	Chronic renal failure and chronic peritoneal dialysis.diabetes mellitus	Improved
8	57/Male	Sputum	Lung abscess	None	2	K.pneumoniae	Metastetic carcinoma in lung and in liver	Died
9	25/Female	Throat	Pharynitis	None	1	Staph.aureus	Pregnancy	Improved
10	69/Male	Ear discharge	External otitis	None	1	P.mirabilis andStaph.aureus	Recurrent exfolative dermatitis and diabetes mellitus	Improved
11	68/Male	Urine	U.T.I	None	3	Microaerophilic gram-positive coccus	Metastitic prostate carcinoma	Improved

Table 2 Biochemical Characteristics of A.xylosoxidans

Characteristic	No.of isolates positive	Total No.tested	% Positive
Gram-negative asporogenous straight rod	11	11	100
Peritrichous flagella	11	11	100
Motility	11	11	100
Growth on	11	11	100
MaCconkey agar	11	11	100
Growth on Cetrimide agar	10	11	99
Oxidase	11	11	100
Catalase	11	11	100
Citrate, Simmons	9	11	81
Urease	0	11	0
Indole	0	11	0
L-lysin decarboxylase	0	11	0
L-Arginine dihydrolase	0	11	0
1-Ornithine decarboxylase	0	11	0
Voges-proskauer	2	11	18
Acetamide	2	11	18
Nitrate reduction to nitrite	9	11	81
Nitrate reduction to nitrogen gas	4	11	46
Oxidation, fermentation glucose medium open	9	11	81
Oxidation, fermentation glucose sealed and acid production	0	11	0

Table 3 Antibiotic susceptabilities of A,xylosoxidans

Antibiotic	**Susceptibility in each case**		**Total No.of strains**
	Sensitive	**Resistance**	
Ampicillin	**1**	**10**	**11**
Carbenicillin	**11**	**0**	**11**
Cephalothin	**0**	**11**	**11**
Colistin	**2**	**9**	**11**
Gentamicin	**1**	**10**	**11**
Kanamycin	**1**	**10**	**11**
Tobramycin	**1**	**10**	**11**
Amikacin	**0**	**11**	**11**
Tetracycline	**2**	**9**	**11**
Trimeth./sulfa	**5**	**6**	**11**
Chloramphenicol	**3**	**8**	**11**
PolymyxinB	**5**	**6**	**11**
Nalidixic acid	**0**	**11**	**11**
Nitrofurantoin	**0**	**11**	**11**
Neomycin	**1**	**10**	**11**

Table 4 Clinical sources of A.xylosoxidand

Source	U.K	U.S.A.	Canada	E.Union	Japan	Australia	India	Total
Ears	16	-	-	5	8	-	-	29
Resp.tract	6	1	-	1	12	-	12	32
Peritoneal	5	-	-	-	-	-	-	5
Dialysis fluid	-	-	-	-	-	-	-	0
Brain and spinal fluid	4	-	6	-	-	-	22	32
Skin,wounds and burns	7	2	-	2	1	-	7	19
Blood	-	2	-	-	-	1	32	35
Urine	1	1	-	-	19	-	23	44
Pus,stool, eye and vesicle	4	1	5	1	-	-	-	11
Swimming pool, antiseptic solutionand banked blood	-	4	-	-	-	-	-	4
Unknown	12	-	-	-	-	-	-	12
Total No.of strains	55	11	11	9	40	1	96	223