Comparative Immunology, Microbiology and Infectious Diseases 42 (2015) 8–14

Contents lists available at ScienceDirect

Comparative Immunology, Microbiology and Infectious Diseases

journal homepage: www.elsevier.com/locate/cimid

Review

Aeromonas in Arab countries: 1995–2014

Khalifa Sifaw Ghenghesh[a,*], Amal Rahouma[b], Abdulaziz Zorgani[b], Khaled Tawil[b], Abdurazzaq Al Tomi[c], Ezzadin Franka[b]

[a] *El-Nakheel Compound, El-Sherouk City, Cairo, Egypt*
[b] *Faculty of Medicine, University of Tripoli, Tripoli, Libya*
[c] *Biotechnology Research Center, Tripoli, Libya*

ARTICLE INFO

Article history:
Received 3 March 2015
Accepted 29 July 2015

Keywords:
Aeromonas
Arab countries
Humans
Animals
Food
Water
Molecular testing methods
Antimicrobial resistance and treatment

ABSTRACT

The aim of this review is to provide information on the prevalence, clinical syndromes, and antimicrobial resistance and therapy of *Aeromonas* spp. infections in Arab countries. The data were obtained by an English language literature search from 1995 to 2014 of Medline and PubMed for papers using the search terms "*Aeromonas* + name of Arab country (i.e. Algeria, Egypt, etc.)". Additional data were obtained from a Google search using the aforementioned terms. The organisms have been reported from diarrheal children, patients with cholera-like diarrhea, an outbreak of acute gastroenteritis and from different types of animals, foods and water source in several Arab countries in the Middle East and North Africa with predominance of *A. hydrophila*, *A. caviae* and *A. sobria*. Using molecular techniques few studies reported genes encoding several toxins from aeromonads isolated from different sources. Among the antimicrobials examined in the present review third generation cephalosporins, fluoroquinolones and aminoglycosides showed excellent activity and can be employed in the treatment of *Aeromonas*-associated human infections in Arabic countries. Whenever possible, treatment should be guided by the susceptibility testing results of the isolated organism. In the future, studies employing molecular testing methods are required to provide data on circulating genospecies and their modes of transmission in the community, and on their mechanisms of resistance to antimicrobials. Microbiology laboratories and research centers are encouraged to look for these organisms in clinical, food and water sources to attain a better understanding of the public health risks from these organisms in Arab countries.

Contents

* Corresponding author at: El-Nakheel Compound, El-Sherouk City, Suez Road, Cairo, Egypt.
E-mail address: ghenghesh_micro@yahoo.com (K.S. Ghenghesh).

http://dx.doi.org/10.1016/j.cimid.2015.07.002
0147-9571/

Introduction

Members of the genus *Aeromonas* are ubiquitous in aquatic environments and are well established agents of disease in fish and other cold blooded animals. In developing countries they have been associated with a wide spectrum of diseases in humans that include, among others, septicemia, wound infections, gastroenteritis and aspiration pneumonia following contact with water and after floods [1]. In addition, they are frequently isolated from different types of foods and several food-borne outbreaks associated with aeromonads have been reported [2,3]. Furthermore, aeromonads have been frequently detected in patients with traveler's diarrhea [4,5].

Aeromonads are Gram-negative, oxidase-positive, facultative-anaerobic rod-shaped bacteria in the family *Aeromonadaceae*. There are at least 17 hybridization groups or genospecies and 14 phenospecies in the genus *Aeromonas* [6]. Globally, only three species (i.e. *A. hydrophila*, *A. veronii* biovar sobria and *A. caviae*) are predominantly isolated from clinical, food and water sources [1,7].

Aeromonas spp. produce several toxins that have been associated with their virulence. These include pore forming aerolysin (*aer*) and hemolysin (*ahh1*), a cytotoxic enterotoxin (*Act*), a heat-labile cytotonic enterotoxin (*Alt*), and a heat-stable cytotonic enterotoxin (*Ast*) [8–12].

The aim of this review is to provide information on the prevalence of aeromonads in different sources, clinical symptoms, antimicrobial resistance and treatment of human infections due to *Aeromonas* spp. in Arab countries. The data presented in this review were obtained by an English language literature search from 1995 to 2014 of Medline and PubMed for papers using the search terms "*Aeromonas* + name of Arab country (i.e. Algeria, Egypt, etc.)". Additional data were obtained from a Google search using the aforementioned terms.

Aeromonas human infections

An outbreak of acute gastroenteritis due to *A. sobria* that involved 69 patients was reported from Benghazi, Libya [13]. Isolation of aeromonads from diarrheal children have been reported from several Arab countries with prevalence rates between 2% and 35% (mean = 12%). However, only three studies examined the presence of *Aeromonas* spp. in non-diarrheal children with prevalence rates between 0.0% and 18% (mean = 14.5%). In addition, there were no investigations examining aeromonads in adults. Table 1 shows the prevalence of *Aeromonas* spp. in diarrheic and non-diarrheic children in several Arab countries. From this table it can be noticed that prevalence rates contrast broadly among nations and inside the same nation. This may be because of contrasts in the area and year of study, number of patients and kind of populaces investigated (e.g. rural or metropolitan) and bacteriological techniques used in the isolation of the organisms (e.g. use of enrichment medium).

Studies from Egypt reported a significant isolation of aeromonads from diarrheal children compared with non-diarrheal children [14,16]. On the other hand, studies from Libya and Saudi Arabia reported no significant difference between the two groups [17,22]. The variation in the isolation of *Aeromonas* spp. from symptomatic and asymptomatic children has been reported from other developing countries [1]. In a cohort of children living in a rural setting in the Nile River Delta of Egypt, Mansour et al. observed that 25% (5/20) of children with *Aeromonas*-associated diarrhea continued shedding the organisms for at least two weeks of the follow-up period after the diarrhea episode ended [15]. This may in part explain the isolation of aeromonads at similar rates from diarrheal children and asymptomatic controls.

Ghenghesh et al. [17] identified *Aeromonas* spp. isolates from children with diarrhea and from healthy controls to the species level using Aerokey II [23]. Of the 62 isolates examined 14 (22.6%) were *A. hydrophila*, 16 (24.2%) *A. veronii* biovar sobria, 30 (48.4%) *A. caviae* and 3 (4.8%) *A. schubertii*. Predominance of *A. caviae* among aeromonads from stool samples has been reported from other developing countries [1].

Few studies provided information on clinical symptoms associated with *Aeromonas* diarrhea in pediatrics. These include fever in 35–40% of patients, vomiting in 15–39%, and dehydration in 5% [15,17]. Presence of mucus and blood in stool samples of symptomatic children was reported in 43.5% and 26%, respectively [17]. Symptoms of cholera-like diarrhea have been reported in 3 patients with *Aeromonas* infection in Tripoli, Libya [24]. To avoid the confusion that may arise from identifying *Aeromonas* species as *V. cholerae*, bacteriology laboratory staff should be alerted to look for these organisms in suspected cases of cholera.

Aeromonads have been isolated from Finnish and Japanese tourists with traveler's diarrhea after traveling to Morocco and Egypt, respectively [4,25]. Watery or slimy diarrhea lasting 2–20 (mean = 5.9) days was observed in all Finnish patients with *Aeromonas* spp. as the sole pathogen [4]. In some patients fever, nausea, headache or abdominal pain were present.

Aeromonas spp. were isolated from 6% (5/85) of food handlers in a five star hotel in Tripoli, Libya [26]. Of the five isolated aeromonads 3 were *A. caviae* and 2 were *A. sobria*. The *Aeromonas*-positive food handler was suffering from diarrhea on the day of stool collection. No other enteric pathogens (i.e. *Salmonella* spp., *Shigella* spp., *Campylobacter* spp., enteropathogenic *Escherichia coli* and rotavirus) were detected in his stool. All other subjects were healthy. The isolation of these organisms from foodhandlers in hotels may pose a health risk to travelers using such establishments.

Aeromonas spp. have also been isolated from extra-intestinal infections. In Saudi Arabia, Al Harbi et al. [27] examined 112 bile samples to identify the microflora in the gallbladder of patients undergoing laparoscopic cholecystectomy for gallstones. One sample was found positive for *Aeromonas* spp. and *Enterobacter cloacae*.

Table 1
Prevalence of *Aeromonas* spp. in diarrheic and non-diarrheic children in several Arab countries.

Country	No. (%) positive/tested		Dominant species	Reference
	Diarrheic children	Non-diarrheic children		
Egypt	29 (8.3)/350	0.0 (0.0)/50	*A. sobria*	[14]
Iraq	6 (4.2)/142	ND[a]	NA[b]	[15]
Libya	23 (14.6)/157	28 (17.8)/157	*A. caviae*	[17]
Libya	9 (5.5)/169	ND	NA	[18]
Libya	10 (4.2)/239	ND	NA	[19]
Palestine/Gaza	100 (35)/286	ND	NA	[20]
Palestine/Gaza	3 (2.3)/132	ND	NA	[21]
Saudi Arabia	7 (14)/50	24 (16)/150	NA	[22]

[a] ND = Not done.
[b] NA = Not available.