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Epidemiological and Bacteriological Features of the Cholera Outbreak in Iran (2005)

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During the summer of 2005, an outbreak of cholera struck Iran, infecting 1118 individuals and killing 11 patients. The epidemic started from the Southern regions and rapidly disseminated across the country. In spite of early confirmation of the epidemic and emergent actions by the Ministry of Health, the disease continued to spread during the first few weeks. Unlike most previous epidemics in Iran and other countries in the region, which were caused by Vibrio cholerae O1 biotype El Tor serotype Ogawa, the most common causative agent was identified to be the Inaba serotype. The likely source of the disease came from the neighboring countries; examination of drinking water, irrigation water and agricultural products showed that consumption of raw unclean vegetables was the most common route of transmission. The outbreak frightened millions of Iranian citizens and caused millions of dollars in economic damage. The question is how we can predict and prevent possible future cholera epidemics and what we should do when they occur.

Key words: Cholera, bacteriological feature, Iran, outbreak

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INTRODUCTION

During early summer 2005, there were reports from across Iran describing patients with a severely dehydrating diarrhoeal disease. Soon, fear of another outbreak of cholera filled the country and the health authorities took immediate action in warning and educating the public and diagnosing and eliminating the disease. Cholera, an acute intestinal infection caused by the comma-shaped gram-negative bacillus Vibrio cholerae, is a historically feared epidemic diarrhoeal disease that remains a major problem in many parts of Africa, Asia and Latin America (Seas *et al*., 2000; Shears, 2001; Khazei *et al*., 2005). Although the disease was described in the 16th century, the organism was isolated by Robert Koch and Pacini in the late 1800s (Kaper, 1995).

Since 1961, the world has been experiencing the seventh pandemic of cholera, the causative organism of which is *V. cholera*e O1 of the El Tor biotype. Beginning in late 1992 in India and then in Bangladesh, there appeared an epidemic cholera due to a new serogroup, O139 (Kaper, 1995). The data on the pandemic indicate that it is still not possible to predict when and where a new epidemic of cholera will start. It also shows that appropriate therapy would reduce the mortality to values below 1% and that changes in the bacteriological characteristics of this ancient disease are still taking place (Seas *et al*., 2000).

Several epidemics are reported almost every year especially during summer months- in Iran and other Middle-eastern and South Asian countries (Khazei *et al*., 2005; Faruque *et al*., 2005; Sugunan *et al*., 2004; Mosley *et al*., 1970; Pourshafie *et al*., 2000; Tuyet *et al*., 2002; Faruque *et al*., 2003; Habeck, 2001; Bart *et al*., 1970). Serological studies have shown that almost all of these outbreaks are caused by Vibrio cholerae O1 biotype El Tor serotype Ogawa (Khazei *et al*., 2005; Faruque *et al*., 2005; Sugunan *et al*., 2004; Mosley *et al*., 1970; Pourshafie *et al*., 2000), while serotype Inaba is reported infrequently (Saha *et al*., 1996). The most serious epidemic in Iran occurred in 1966 (http://www.who.int/mediacentre /factsheets/fs107/en/index.html) and then in 1998. According to the annual national reports of the Center for Disease Control (CDC) in the Ministry Of Health (MOH), in Iran, Primary Health Care (PHC) coverage has been increased markedly within the last decade and some of the sanitary services such as safe drinking water are under strict supervision even in deprived rural areas. The refugees from neighboring countries-especially Afghanistan- were suspected to be the source of infection and unclean vegetables and ice were identified as the possible route of transmission. Aim of this research was determination of bacteriologic feature of cholera outbreak in Iran and comparison theses results with other studies also determination of geographical distribution of cholera outbreak in throughout of Iran.

MATERIALS AND METHODS

In this descriptive, epidemiological research, the related data about all individuals Diagnosed with cholera during the epidemic of summer 2005 has been gathered from the CDC. The number of patients in each province, their demographic data and the death toll were included. Since there is always the possibility of a new outbreak, cholera is one of the few infectious diseases in Iran that must be reported immediately to the CDC by any physician who encounters a patient with a suspected clinical diagnosis. Therefore, a comprehensive databank is available in CDC for the disease. In addition, the results of the laboratory studies conducted on probable vehicles including drinking water, irrigation water and agricultural products- were reviewed.

A suspected case was defined as an individual residing in the endemic area who presents with acute watery diarrhea. A stool sample from all patients with the clinical diagnosis of cholera was sent to the provincial medical laboratory for confirmation, serotyping and antibiogram. All confirmed samples were then sent to the central reference laboratory in Tehran for further confirmation. If both these tests were positive for *V. cholera*, the patient was considered a confirmed case. Data that are related to the Confirmed cases are registered and archived in the CDC databank.

RESULTS

It is difficult to pinpoint the first case of the recent outbreak. In 25 June 2005, a 26 month-old Iranian child was admitted in the Southern city of Bushehr with a possible diagnosis of cholera. Ten days later, two Pakistanis were reported to have the same symptoms in the Southeastern city of Chabahar, near the Iran-Pakistan border. Serological studies showed that the former was caused by O1 biotype El Tor serotype Ogawa, while in the two latter cases, the Inaba serotype was isolated.

Soon, the disease spread across the country. Most cases were reported in Tehran (216 cases), Hamadan (187 cases) and Qom (152 cases) provinces-all located in central Iran. Almost all Iranian provinces were struck by the epidemic; however, some were just infected sporadically.

The Ministry of Health took immediate action when the occurrence of another cholera epidemic was confirmed. Since the most common transmission route of

cholera is known to be unclean drinking water (World Heath Organization, fact sheet), the drinking water in cities and villages with reported cases of cholera was examined. All samples have been sufficiently chlorinated and no contamination was found. Therefore, tests were focused on farms and ranches that used unclean or sewage water for irrigation. Samples of irrigation waters and the vegetables, crops and other agricultural products showed the infection of vegetables with *V. cholera*.

After identifying unclean raw vegetables as the route of transmission, governmental authorities barred the distribution of some vegetables; fruit stores were not allowed to sell them and restaurants were prohibited from serving salads.

Educational programmes were broadcasted by national television and all medical centers especially in the harder struck areas- became on alert status. The MOH reported the number of infected and deceased persons on a daily basis. The demographic data of the patients are provided in Table 1. The total number of confirmed cases at the end of the epidemic was 1118, of which 11 had died. Laboratory studies revealed that in most cases, the organism was resistant to cotrimoxasole and tetracycline, but sensitive to doxycycline, furazolidone and ciprofloxacin. The most surprising finding was that almost all cases (1104 patients, 98.7%) were caused by the El Tor O1 serotype Inaba, which was not the dominant type of pathogen in the country before.

Table 1: The demographic data of the cholera patients during the 2005 epidemics in Iran

Criteria	Freq.	Percent
Sex		
Male	582	52.10
Female	536	47.90
Age Group (years)		
< 1	23	2.10
1-9	93	8.30
10-19	171	15.20
20-29	331	29.60
30-39	193	17.20
40-49	113	10.10
50-59	77	6.80
60 =	117	10.50
Area		
Urban	889	79.50
Rural	229	20.50
Hospitalization		
Outpatient	879	78.60
Inpatient	239	21.40
Nationality		
Iranian	1090	97.50
Afghani	25	2.20
Pakistani	3	0.30
Outcome		
Cured	1107	99.02
Death	11	0.98
Total	1118	

After about three months of public fear, economic damage and most importantly, morbidity and loss of human lives, in 12 September 2005 the MOH formally announced that the disease was under control.

DISCUSSION

Cholera continues to be an important public health problem among many poorer and more vulnerable communities despite the fact that the bacteriology, epidemiology and public health aspects of the disease were described in detail over a century ago (Shears, 2001).

There has been a sharp increase in the number of cholera cases reported to WHO during 2005. A total of 131943 cases, including 2272 deaths, have been notified from 52 countries. Overall, this represents a 30% increase compared with the number of cases reported in 2004. The number of cases notified from Asia continued to increase, reaching 6824 cases (Weekly Epidemiological Record, 2006).

During 2005, WHO participated in the verification of 64 outbreaks of diarrhoeal disease in 41 countries worldwide; of these events, 49 were confirmed as outbreaks of cholera occurring in 36 different countries. Although 75% of verified outbreaks occurred in Africa, several countries in Central Asia were also affected. In 19 outbreaks, the CFR (case-fatality rate) ranged from 1 to 4.9%; in six outbreaks, it ranged from 5 to 9.9%; in another 6 it ranged from 10 to 19.9%; and in 1 outbreak, the CFR reached 40%. The CFR was below the accepted 1% reference level in only four outbreaks (Weekly Epidemiological Record, 2006). Fortunately, in our study, the outbreak was rapidly brought under control as a result of the countries transparent information policy and the governments efficient response. And CFR was 0.98%.

Officially, notified cases from Asia increased by 18% over those notified in 2004. A total of 6824 cases and 37 deaths were reported from nine Asian countries. The Indian subcontinent reported 46% of all cases notified from Asia, with India notifying a total of 3155 cases and 6 deaths. However, many more cases are occurring in South-East Asia: these have been reported as acute watery diarrhoea. The Philippines reported 139 cases of cholera that occurred as a result of localized outbreak. Indonesia reported a total of 1338 cases of cholera and 19 deaths; none of the cases occurred in the areas of the country affected by the tsunami in 2004. There is heightened concern about the occurrence of an epidemic-prone diarrhoeal diseases in central Asia, of which Afghanistan has reported a total of 33 laboratory confirmed cholera cases (Weekly epidemiological record, 2006).

In end of our study that was about cholera out break in Iran, 1118 cases of cholera were reported. Additionally, after this study, WHO reported further 15 cases of cholera in Iran Afghanistan also reported more than 150000 cases of acute watery diarrhoea in 26 provinces: Which, according to WHO case definition, are considered to be cholera (Weekly Epidemiological Record, 2006).

Although there is no way to undoubtedly prove that the roots of the recent cholera confirm that, the main source came from Afghanistan or Pakistan. First, there was an extensive outbreak of cholera in the neighboring Afghanistan in early June 2005, about one month before the epidemics in Iran (www.who. int/csr/ don/ 2005_06_21/ en/index. html)

However, no valid study was performed to determine the bacteriologic characteristics including serotype- of the causing agent.

Second, the first cases of cholera in Iran (in Chabahar and Qom cities) were reported among travelers who had come from Afghanistan and Pakistan. It could be predicted from the beginning that the epidemic may hit Iran as well; this was evident in some warnings provided by officials in the Ministry of Health. However, the outbreak was rapidly brought under control as a result of the country's transparent information policy and the government's efficient response.

The threat of a cholera outbreak could have thus been turned into an opportunity to increase public health awareness and to reduce the burden of the disease.

Although the health authorities relentless activities in providing facilities for case-finding, diagnosis and treatment of patients were appreciable, decisions such as barring the distribution of all kinds of vegetables did not appear warranted. The Ministry of Agriculture later reported that these measures had damaged the national economy, costing approximately 10 million US dollars to the farmers. Mass education in public media on how to wash, rinse and cook vegetables could have been a more appropriate and sufficient measure.

Sampling of drinking and irrigation waters showed that the transmission route was not the drinking water. It was an expectable result, because if the drinking waters of the residential areas were infected, the incidence rate must have been much higher. On the other hand, serological studies showed that irrigation water and vegetable samples were contaminated with Inaba serotype, which is clearly consistent with the outbreak causative agent.

The occurrence of the Inaba serotype makes the recent epidemic an exception in the history of the disease in Iran. Since the first two patients diagnosed with this serotype in Chabahar were not Iranians, it may be concluded that the source of the epidemic was from outside the country and that the 26 month old Bushehri child was just a sporadic case of disease. However, in other Serological studies have shown that almost all of these outbreaks are caused by Vibrio cholerae O1 biotype El Tor serotype Ogawa (Khazei *et al*., 2005; Faruque *et al*., 2005; Sugunan *et al*., 2004; Mosley *et al*., 1970; Pourshafie *et al*., 2000), while serotype Inaba is reported infrequently (Saha *et al*., 1996).

Considering the experiences of the recent and previous cholera epidemics, the following measures are recommended to predict and prevent outbreaks:

- With the initial reports from the neighboring countries regarding disease occurrence, the threat of a new epidemic should be considered seriously.
- A specific committee must be assigned to monitor and report the condition of specific diseases in the neighboring countries.
- A field surveillance system must be established by an epidemiological screening group.
- Case finding stations-especially along the borders- must be reinforced.
- At the advent of an outbreak, crossing the borders must be restricted.
- When prevention is required, the remained chlorine in the drinking waters must be increased to 1 ppm.
- When cholera appears in a community it is essential to ensure three things: hygienic disposal of human faeces, an adequate supply of safe drinking water and good food hygiene. Effective food hygiene measures include cooking food thoroughly and eating it while still hot; preventing cooked foods from being surfaces or flies and avoiding raw fruits or vegetables unless they are first peeled (World Heath Organization. Fact sheet).
- Public awareness on washing hands after defecation and particularly before contact with food or drinking water, is equally important.
- An interdepartmental centre should be established to coordinate activities on cholera control. It is important that cholera control programmes continue to incorporate medium- term and long-term prevention activities.
- Re-education courses on epidemic control-especially cholera - must be held on a regular basis for medical, paramedical and laboratory personnel.

There is clear trend that cholera is re-emerging in parallel with the ever-increasing proportion of vulnerable populations who live in unsanitary situations. Globally cholera remains a threat for social development. Almost all of the developing countries in the out world are facing either a cholera outbreak or the threat of an epidemic.

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REFERENCES

Bart, K.J. *et al*., 1970. Seroepidemiologic studies during a simultaneous epidemic of infection with El Tor Ogawa and classical Inaba Vibrio cholerae. J. Infect. Dis. 1970; 121 (Suppl): 17.

Faruque, S.M. *et al*., 2003. Reemergence of epidemic Vibrio cholerae O139, Bangladesh. Emergency Infectious Dis., 2003; 9: 1116-1122.

Faruque, S.M. *et al*., 2005. Self-limiting nature of seasonal cholera epidemics: Role of host-mediated amplification of phage. PNAS, 102: 6119-6124.

Habeck, M., 2001. Cholera strikes Afghanistan. Lancet Infect. Dis., 1: 74.

Kaper, J.B., J.G. Jr. Morris and M.M. Levine, 1995. Cholera. Clini. Microbiol. Rev., 238: 48-86.

Khazei, H.A. *et al*., 2005. A six year study on Vibrio cholerae in Southeastern Iran. Japanese J. Infect. Dis., 58: 8-10.

Mosley, W.H. *et al*., 1970. The 1968-1969 cholera-vaccine field trial in rural East Pakistan. Effectiveness of monovalent Ogawa and Inaba vaccines and a purified Inaba antigen, with comparative results of serological and animal protection tests. J. Infect. Dis., 121 (Suppl): 1-9.

Pourshafie, M.R. *et al*., 2000. Molecular epidemiological study of Vibrio cholerae isolates from infected patients in Tehran, Iran. J. Med. Microbiol., 49: 1085-1090.

Saha, P.K. *et al*., 1996. Nontoxigenic Vibrio Cholerae O1 Serotype Inaba Biotype El Tor associated with a cluster of cases of cholera in Southern India. J. Clini. Microbiol., 34: 1114-1117.

Seas, C. and E. Gotuzzo, 2000. Vibrio Cholerae. In: Principles and Practice of Infectious Diseases. Mandell, G.L., J.E. Bennett and R. Dolin (Eds.), New York: Churchill Livingston, pp: 2266-2272.

Shears, P. Recent developments in cholera. Curr. Opin. Infect. Dis., 14: 553-558.

Sugunan, A.P. *et al*., 2004. A cholera epidemic among the Nicobarese tribe of Nancowr y, Andaman and Nicobar, India. American Journal of Tropical Medicine and Hygiene, 71: 822-827.

Tuyet, D.T. *et al*., 2002. Clinical, epidemiological and socioeconomic analysis of an outbreak of Vibrio parahaemolyticus in Khanh Hoa Province, Vietnam. J. Infect. Dis., 186: 1615-1620.

Weekly Epidemiological Record, 2006. No. 31, 81: 297-308.