Review

One health approach of campylobacteriosis in Egypt: An emerging zoonotic disease

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Abstract

World Health Organization (WHO) defined zoonotic diseases as diseases transmitted from animals to humans and vice versa with or without vector, where more than 75% of the human’s diseases have been transmitted from animals or their products. Nevertheless, campylobacteriosis is still one of the most important food borne zoonotic diseases that is likely to challenge global public health all over the world. In Egypt, campylobacteriosis causes severe losses in comparison with other food borne pathogens like Salmonella or Escherichia coli. The potential sources of Campylobacter transmission are poultry backyards and meat, cattle meat, raw milk and water. The main clinical manifestations of human’s campylobacteriosis are gastroenteritis and later on nervous signs. Prevention and control strategic plans of campylobacteriosis are very crucial.

Key words: Campylobacter spp.; Egypt; epidemiology; diagnosis; control.


(Received 21 July 2019 – Accepted 20 September 2019)

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Introduction

Campylobacteriosis has long been recognized as serious food borne zoonotic disease of worldwide public health threat. Campylobacteriosis caused by Campylobacter jejuni (C. jejuni) or Campylobacter coli (C. coli) is responsible for gastroenteritis in human [1]. Recently, infection with Campylobacter organisms is likely to challenge global public health either in developing or developed industrial countries. Different international strategies were planned to reduce the risk of Campylobacter transmission [2]. Despite public health burden associated with campylobacteriosis, the disease situation remains difficult to be exactly estimated in developing countries as a result of lacking of a national surveillance system [3]. Therefore, implementation of periodical national evaluation of the foodborne campylobacteriosis is very critical issue.

So, this review will discuss campylobacteriosis epidemiological situation in Egypt, reservoirs and transmission methods, the organism pathogenesis, clinical disease manifestations, isolation and identification of Campylobacters and then emphasis on the different control and prevention interventions. Finally some suggestions will be offered from the standpoint of One Health approach.

Epidemiology

Early survey on Campylobacter infection was conducted in 1987 on acute diarrheic 126 out-patients and 25 in-patient’s in southern Egypt (Aswan) where C. jejuni/coli (7%) were identified [4]. In a hospital based study in Cairo in 1991, Campylobacters were isolated from 37/143 (25.9%) of diarrheic children compared to 20/132 (15.2%) of non-diarrheic ones [5]. In 1995, Campylobacter spp. were isolated from 880 (16.8%) children with diarrhea and from 1079 (6.4%) healthy children, moreover, the isolation of Campylobacter was more frequent than Salmonella, Shigella and other bacterial enteric pathogens [6]. From 1986-1993, in Abbassia Fever Hospital, Cairo, Egypt, 6,278 patients with acute enteric infections were examined where 92 strains (63%) of C. jejuni and 54 (37%) of C. coli were isolated [7].

In 2005, military personnel with diarrhea were participated in a military exercise in the northwestern Egyptian desert and the pathogens causing diarrhea were identified in 53.6% of 129 enrolled cases. C. jejuni with other enteropathogenic bacteria, virus and protozoa were identified [8]. Similar study was conducted in 2011, on 72 personnel with travelers' diarrhea in Multinational Force and Observers camp in the Southern Sinai, Egypt and the bacteriological
examination of their stool revealed isolation of \textit{C. jejuni} from 7 (10\%) [9].

Later on, \textit{Campylobacter} spp. were identified from patients with gastroenteritis in Cairo, Egypt using conventional and polymerase chain reaction (PCR) methods in 6.6\% of human stool samples [10,11]. Recently, the epidemiology of \textit{Campylobacter} among an Egyptian pediatric population was described and the results pointed out to the variability in \textit{Campylobacter} spp. and \textit{C. jejuni} capsular polysaccharide (CPS) diversity in this population; furthermore, the high prevalence of type-6 secretion system (T6SS) among \textit{C. jejuni} isolates as there was no significant associations between clinical illness and \textit{Campylobacter} spp., \textit{C. jejuni} CPS types, or suspected virulence factors [12].

\textbf{Reservoirs and transmission methods}

Poultry is recognized as a primary source for \textit{Campylobacter} spp. transmission to humans as strain of \textit{C. jejuni} can survive in chicken droppings for up to 6 days after excretion [13]. Comprehensive studies conducted in different Egyptian governorates proved that chickens reared in farms or houses is the main source of \textit{Campylobacter} infections for contact persons [14–17]. Phylogenetic tree analysis emphasized genetic relatedness among \textit{Campylobacter} isolates from chickens and those from humans [18].

Processed chickens plays an important role for human foodborne campylobacteriosis in Egypt. Different types of \textit{Campylobacter} spp. (\textit{C. jejuni} and \textit{C. coli}) were isolated from retail fresh or frozen chicken carcasses skin and meat [15,19,20,] as well as from barbequed and products of chickens [21,22]. \textit{Campylobacter} strains isolated from chicken carcasses showed identical molecular characterization with those in handler’s employees and consumers which signifying the high possibilities of zoonotic hazards [15,20,21].

Cattle and beef meat products considered as reservoir for \textit{Campylobacter} spp., highlighting the importance of non-poultry farms as possible sources of human infection [23]. The population genetics approach revealed that the vast majority (97\%) of \textit{Campylobacter} diseases could be attributed to farmed animals and poultry as principal sources of human disease, while wild animals and environmental sources are responsible for just (3\%) of the disease [24].

Moreover, higher percentages of \textit{Campylobacter} spp. isolation from raw milk and milk products (Karish cheese, soft cheese and yoghurt) of Egyptian cattle and sheep were recorded [25-29].

\textbf{Pathogenesis}

Intestinal colonization and adhesion are the first and crucial stages of \textit{Campylobacter} pathogenesis. Colonization is secondary to chemotaxis process by the intestinal mucus (mucins and glycoproteins) [32]. Bacterial adhesion to the host’s intestinal epithelial surface is mediated by many proteins adhesins like CapA that located on the bacterium surface [33]. The resulting cell death is related to the production of several cytotoxins like Cytolethal Distending Toxin (CDT) [34]. This toxin has desoxy-ribonuclease activity and determines the cell cycle block and fragmentation of the nucleus causing cell damage.

\textbf{Clinical manifestations}

\textit{Campylobacter} in poultry induces only diarrhea or sub-clinical infection. However in human, \textit{Campylobacter} incubation period ranges from 2–7 days. The average organism shedding is 1–3 weeks after incubation period. Symptoms of campylobacteriosis include gastroenteritis, diarrhoea, vomiting, stomach pain and fever [35]. The illness is usually self-limiting and symptoms could subside within one week; nevertheless complications like dehydration, hepatitis and neurological disorders may be noticed [3]. \textit{Campylobacter} infections sequelae are Guillain-Barré Syndrome (GBS), reactive arthritis, irritable bowel syndrome and Miller Fisher Syndrome. \textit{Campylobacter} isolation rates and diarrhea histories in Egyptian patients suggested that \textit{Campylobacter} associated diseases are common, as well as the widespread exposure to \textit{Campylobacter} infections is associated with production of antiganglioside antibodies that prompted paralysis and GBS [36]. Deaths were recorded especially in young, elderly as well as immunosuppressed persons.

\textbf{Isolation and identification}

Isolation and identification of \textit{Campylobacter} spp. are usually done as Quinn et al. [37]. Temperature tolerance test is important to demonstrate the ability of
isolates to grow under microaerophilic conditions (25°C, 37°C and 42°C) after 72 hrs incubation. For *Campylobacter* isolation, samples are inoculated in thioglycolate broth and incubated under microaerophilic conditions (5% O₂, 10% CO₂ and 85% N₂) at 37-42°C for 48-72 hrs. After enrichment, positive broth should be plated onto selective media containing blood and selective antibiotics (compete intestinal flora) like Butzler, Blaser and Skirrow media. Microscopic examination under phase contrast microscope is used for detection of characteristic *Campylobacter* darting motility. Films stained with Gram’s to demonstrate the characteristic features of *Campylobacter* organisms. Biochemical and other tests that are used for identification of *Campylobacter* isolates include: catalase and oxidase production, nitrate reduction, H₂S production, citrate utilization, urea hydrolysis, glycine tolerance, NaCl tolerance, hippurate hydrolysis tests and sensitivity to nalidixic acid and cephalothin. The 16S rRNA gene, the Internal Transcribed Spacer (ITS) region and 23S rRNA genes have been used for differentiat between *Campylobacter* spp. and strains [38].

**Control and prevention interventions**

Earlier, ciprofloxacin (member of fluoroquinolones) was used successfully for the treatment of Egyptian *Campylobacter* travellers’ diarrhea cases without resistance [39]. The emergence of resistance to quinolones in *Campylobacter* may be a threatening trend that has not been previously reported in Egypt [7]. The antimicrobial susceptibility among *C. jejuni* and *C. coli* recovered from rural Egyptian children from 1995-2000 revealed decreasing in ciprofloxacin susceptibility in *C. jejuni* and *C. coli*, but there was no resistance to macrolide (erythromycin or azithromycin) [40]. Lately, resistance of *C. jejuni* and *C. coli* strains isolated from Egyptian diarrheic children to fluoroquinolones was confirmed [41]. Human *Campylobacter* strains showed resistance 87.5% to ampicillin, 75% to streptomycin and tetracycline, 62.5% to erythromycin and 50% to chloramphenicol [14]. However, gentamcin, amikacin and chloramphenicol were the most effective antibiotics for the *in vitro* treatment of *C. jejuni* and *C. coli* isolates from Egyptian children suffering from gastroenteritis [11].

The risk of *Campylobacter* diarrhea decreases in presence of barriers to keep birds and animals out of the eating area, absence of garbage and feces on the floor of bathing facilities, stressing on mass-media public health awareness programs for changing hygiene-promoting behaviors and practices, strengthening on recent diagnostic facilities, setting up national surveillance programs as well as providing incentives from funding organizations for collaborations in *Campylobacter* research as other emerging disease in developing countries [42,43]. Public health awareness regarding the correct use of municipal and ground water for drinking or cooking only after treatment by filtration and/or boiling is important [31].

Efficient control measures at the farm contributes to reducing the risk of human infection [23]. There is a trial for preparation of *Campylobacter* bacterins in Egyptian chickens as it proved efficacy in prevention of *Campylobacter* colonization in layer flocks [44]. In human, currently there is still no approved vaccines against diarrhea associated with *Campylobacter* due to incomplete understanding of the pathogenic mechanisms of the disease. Probiotics are living bacteria have been shown promising results for prevention and control of *C. jejuni* colonization among Egyptian chicken farms [45,46].

**Conclusion**

Despite campylobacteriosis is a disease of zoonotic importance in Egypt, there is a gap of knowledge about the diseases epidemiology in different localities which hinders accurate assessment of the human health burden. There is an urgent need for collaborative surveillance and intervention national plans for the control of such infection.

From the standpoint of One Health approach, a complete health surveillance program of *Campylobacter* infections must be done nationally to provide data about the disease occurrence and common routes of transmission. Notifications of the disease in all suffering regions should be happen rapidly, as well, it is very important to collect, analyze, and interpret data to create relationship between *Campylobacter* isolates of human and those of animal’s origin. Increasing of the public health awareness, education and training of the target populations (Veterinarians, farm, abattoir and restaurant workers, household, nurses, doctors in hospitals, etc…) is very crucial. Biosecurity measures, vaccination or using natural competitive exclusion compounds (probiotics and acids) are very critical to reduce the risk of human infection in the farm and consequently reduce the level of transmission to human.

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Conflict of interests: No conflict of interests is declared.