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Review on Campylobacteriosis in Ethiopia Perspective

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Abstract: Campylobacteriosis is widespread worldwide infecting all warm blooded animals including human beings. *Campylobacter* species are a leading cause of bacterial-derived foodborne disease *Campylobacter* is a gram-negative comma shaped rods, microaerophilic and motile. *Campylobacter jejuni* and *Campylobacter coli* are the major cause of enteritis in human being and mainly transmitted to humans via handling and eating raw or undercooked meat, especially poultry. It causes watery diarrhea, abdominal pain, vomiting, fever, and nausea with nervous system complications in humans. Warm-blooded farm animals such as poultry, pigs, cattle and sheep are major reservoirs for *Campylobacter* species. Most *Campylobacter* infections are acquired by consuming or handling poultry, the ideal way to control the number of human infections would be to limit contamination of poultry and its products at different levels. Routine use of antibiotic prophylaxis to prevent Campylobacter infections is not recommended. In immune-competent individuals, *Campylobacter* enterocolitis self-limited, with mild to moderate symptoms but supportive care with oral rehydration is the preferred treatment. In Ethiopia its highly prevalent ranging from 8-13.7 in human and 9.4-72.7 in food animals. High prevalence of zoonotic *Campylobacter* species has been isolated from animal products and animal feaces. Therefore, consumption of raw meat, unpasteurized milk and untreated water should be avoided. Public awareness creation to minimize risk of campylobacteriosis is also very important.

Keywords: Campylobacter, *C. jujeni*, *C. coli*, Ethiopia

1. Introduction

Campylobacter species are a leading cause of bacterial-derived foodborne disease worldwide [1]. *Campylobacter* is a gram-negative corkscrew shaped rods and flagellated motile [2]. Among 28 *Campylobacter* species *C. jejuni* and *C. coli* are the major cause of enteritis in human [3]. *Campylobacter* are mainly transmitted to humans via handling and consumptions of raw meat and cause watery diarrhea, abdominal pain, vomiting, fever, and nausea with nervous system complications. Farm animals like poultry, pigs, cattle and sheep are major reservoirs for campylobacter species. It is mainly asymptomatic; however abortions, enteritis and infertility can occur in various species of animals [4, 5].

An ideal way to control the number of human infections would be to limit contamination of poultry and its products at different levels. Routine use of antibiotic prophylaxis to prevent *Campylobacter* infections is not as such satisfactory. *Campylobacter* enterocolitis is generally self-limited in most people [6]. In Ethiopia its highly prevalent ranging from 8-13.7 in human and 9.4-72.7 in food animals [7]. Due to its devastating public health threat international organizations like WHO, FAO and OIE are collaboratively working on Campylobacteriosis to address health risks at the human–animal–ecosystems interface [1].

2. History

It was the symptom that was described by Escherich not the species. The *Campylobacter* species were described (as Vibrio) for the first time 1913 by McFadyean and Stockman as a cause of bovine and ovine infertility and abortion. The first time *Campylobacter* spp. were isolated from humans was in conjunction with a milk-borne outbreak1938. In the late 1950s, *Campylobacter* spp. was isolated from blood samples of children with diarrhoea. Crucial step was taken in Belgium in the early 1970s when *Campylobacter* were isolated from human faeces [2]. Until, 1970s *Campylobacter* species were associated with other human infections before it were fully recognized as human pathogens. In 1968, it was isolated from human faeces and later in mid-1900s; *Campylobacter* species were also isolated from animals that developed abortion and sterility. Due to it is spiral rod shaped bacteria the name Campylobacter is derived from two Greece word 'campylos' meaning curved and 'baktron' meaning rod [2, 8].

3. Etiology

The genus *Campylobacter* consists of 28 species and 8 sub-species. *C. jejuni* is the major frequently reported *Campylobacter* species (80% to 90%) followed by *C. coli* (5% to 10%)[9]. *Campylobacter* are Gram-negative corkscrew shaped rods, motile with a width of 0.2-0.8 µm and a length of 0.5-5 µm. Some Campylobacter species are thermotolerant and grow at temperatures between 37°C and 42°C, with C. coli and C. jejuni having an optimal growth temperature of 42°C and pH 6.5-7.5. The majority of Campylobacter species are microaerophilic and need reduced oxygen (3-10%) and raised CO2 (5-10%) levels. Campylobacter is sensitive to freezing and drying but it is death rate is dependent on temperature. They can survive at refrigeration temperatures (4°C) and in meat stored frozen (at -18°C to -22°C) for several weeks [10].

4. Epidemiology

Campylobacteriosis is widespread worldwide colonizing all warm blooded animals including human beings [4]. *Campylobacter* species are a part of the gut flora in many domestic and wild animals. Warm-blooded farm animals such as poultry, pigs, cattle and sheep are major reservoirs and source infection for human being. *Campylobacter* have also been found among wild birds, wild animals and even in non-vertebrate vectors such as flies. The majority of human infections are caused by *C. jejuni* (80-90%) and *C. coli* (5-10%). *C. jejuni* is the most prevalent Campylobacter found in most animals, with the exception for pigs for which *C. coli* [9].

There is quite epidemiological difference between low, middle and high income countries which likely arise from differences in diagnostic techniques, biocontrol protocols, food practices, nutritional status, environmental hygiene, climatic condition and the abundance of natural reservoirs [10, 11]. In low and middle income countries, *Campylobacter* infections are hyperendemic among young children aged less than 2 years with up to 2 episodes per child and commonly asymptomatic in both children and adults [12]. In high income countries, asymptomatic *Campylobacter* infections are unusual but the average number of *Campylobacter* infections is less than one per lifetime [12]. Campylobacter infection is usually more prevalent to children suggesting that early life exposure might elicit the development of protective immunity however subsequent asymptomatic shedding are observed [13].

Poultry is a leading source of food-related *Campylobacter* species to humans responsible for outbreaks are consumption of poultry products [11]. Huge amount of *Campylobacters* are excreted in poultry feaces and contamination during slaughter contaminate the surrounding environment as the crop of poultry is an important niche for *Campylobacter* species. Once colonized, chickens remain colonized until they are slaughtered and thus, chicken feces are also a potential source of transmission to the environment or humans when poultry manure is used as a fertilizer [14]. Thus, abundance of poultry farms in a given area is one of the epidemiological determinants of campylobacter infections due to soil, water, dust, air and fomites contaminations [15].

Campylobacter infection is often endemic in areas with untreated drinking-water, poor sanitation and close contact with animals and environmental sources [16]. Poultry production in a free range system has a much greater risk of infection compared to conventional production and increased the difficulties in control [17]. Direct contact with farm animals and consumptions of raw farm animal products play a significant role in epidemiology of campylobacteriosis. Unpasteurized milk source from dairy cattle has also been implicated in a number of campylobacteriosis outbreaks [10]. Wild animals are potential reservoirs of Campylobacter species [9]. Among all the host species studied, wild birds are most likely to carry *Campylobacter* species. Some species of wild birds are observed as carrier but their role in *Campylobacter* transmission to human is not determined yet [18]. In general, age, farming system, sanitary measures in farms, immunodeficiency, exotic breed, food contamination, animal contact, international travel, and abundance of reservoir hosts are main determinant factors [4].

5. Source Infection and Transmission

Campylobacter are mainly transmitted to humans via handling and eating raw or undercooked meat, especially poultry [12]. Consumption unpasteurized milk, contaminated water and food, person to-person transmissions through fecal-oral or fomites are also potential source of transmission for *Campylobacter* infections [4, 15]. The usual route of *Campylobacter* transmission in animals is horizontal transmission through ingestions of *Campylobacter* with contaminated water, feed, soil and fomites (Little *et al.*, 2010). Vertical transmission from an infected bird to its offspring prior to shell formation is rare, although "pseudo-vertical transmission" from parent flocks to their chickens via fecal contamination of shells can occur [3]. *C. fetus* subspecies *venerealis* transmitted venereally in cattle [20].

6. Clinical Signs

6.1. In Animals

Campylobacter species are common colonizers of the gut flora of warm-blooded animals including livestock, domestic pets, and wild animals, and especially prevalent in avian species [21]. *Campylobacter* species can cause abortions, enteritis, and infertility in various species of animals. In chicken *C.jejuni* infection lead to prolonged inflammation, damage of the gut, and diarrhea [22]. *C. jejuni* and occasionally *C. coli* cause enteritis in cats, sheep, dogs, poultry, and calves some species of laboratory animals with more severity in young animals. Mucoid diarrhea with flecks of blood with or without fever is typical in calves. In sheep *C. fetus subsp. fetus* and *C. jejuni* cause stillbirth, abortion, weak lambs, reduction in milk production, prolonged lambing with immunity revival after re-infection [23].

6.2. In Human

Most of the human *Campylobacter* enteritis is caused by *C. jejuni* and *C. coli* manifested as gastrointestinal and extra intestinal clinical signs [4]. Gastrointestinal illness is an acute and self-limited characterized by mild watery offensive-smelling to severe bloody diarrhea, vomiting, nausea, fever. Extraintestinal manifestations of *Campylobacter* infection include meningitis, endocarditis, septic arthritis, osteomyelitis, and neonatal sepsis. The most important postinfectious complication of *C. jejuni* infection is the Guillain-Barré syndrome (GBS) an acute demyelinating disease of the peripheral nervous system which cause flaccid paralysis [24].

7. Diagnosis

7.1. Culture and Isolation

Campylobacteriosis can be diagnosis by direct examination of feces and isolation of the organisms confirmed by culture of the organism [5]. *Campylobacter* species require a microaerobic atmosphere containing about 5% oxygen, 10% carbon dioxide, and 85% nitrogen. The conventional method for isolating the common enteric *Campylobacter* species (*C. jejuni* and *C. coli*) from faeces is primary plating on selective media and incubation at 42 °C for 48 to 72 hours in a microaerobic atmosphere with commercially available anaerobic jars. Selective media blood based, or blood-free charcoal-based, and contain one or more antibiotics, can be used. Suspect colonies should be screened with oxidase test, wet mount preparation under dark-field or phase-contrast microscope, and Gram stain. Isolation of Campylobacter spp. using enrichment culture is time consuming and complex [25]. Reducing the time taken to confirm the presence or absence of Campylobacter spp. Rapid techniques such as real-time PCR can detect campylobacters from complex samples but blood in enrichment culture can inhibit the PCR reaction, if applied directly to enriched samples [25].

7.2. Identification

Identification of Campylobacter species requires tests including morphological appearance, biochemical reactions, growth temperature, tolerance tests and antibiotic sensitivity to cephalothin and nalidixic acid. Polymerase chain reaction (PCR) can be applied in the diagnosis of campylobacteriosis, using either species-specific or multiplex reactions based on ribosomal 16S gene sequences, and microarray-based identification tests, have been developed [5].

8. Prevention and Control

Most *Campylobacter* infections are acquired by consuming or handling poultry, the ideal way to control the number of human infections would be to limit contamination of poultry flocks and its products at different levels. Prevention of many outbreaks of *C. jejuni* infection could be accomplished with avoidance of the consumption of unpasteurized milk; this should be emphasized to pregnant women, the elderly, immunocompromised persons, persons who travel to low or middle income countries and campers should be cautioned against drinking untreated water [1].

8.1. At Farm Level

Campilobacteriosis is common in domestic and wild animals and therefore in the environment. For this reason, it is important to reduce contamination of chicken rearing houses from such sources. Use of hygiene barriers at the entrance to poultry houses, controlling the entry of farm personnel, the provision of hand-washing facilities, the performance of boot dips, and the use of house-specific boots and over shoes have all been shown to be effective [22]. Segregation of *Campylobacter*-positive flocks from negative flocks at the slaughter house, and slaughtering of the positive flocks an effective method of reducing spread of contamination. Disinfection measures of their food and water, treatment of their manure, and isolation of the contagiously ill. Emptying and cleaning water troughs more regularly have been shown to reduce the risk of colonization of cattle by *Campylobacter* [1].

8.2. At the Food Animals Processing Level

The intestinal tracts of chickens contains huge amount of campylobacter potential contaminant of the slaughter house, environment and their food products. At this point, treatment with organic acids, UV light, chemical dip tanks for carcasses help to reduce the number of *Campylobacter* organisms [26]. Scalding, freezing or irradiating reduces bacterial numbers by killing the pathogens and limiting the level of cross-contamination in the kitchen [26].

8.3. At Home Level

Safe food-preparation and appropriate consumption habits is important in the prevention of infections of *Campylobacter* species [27]. Adequately cooking and the use of a meat thermometer help to ensure that temperatures adequate to kill *Campylobacter* species organisms are achieved. Cutting boards and utensils used in handling uncooked poultry or other meats should be washed with hot soapy water before being used for preparation other foods that are eaten raw. Separation of ready to eat, raw food and hand washing should be applied. Persons with any acute diarrheal illness should avoid preparation and handling of food until their illness resolves. Avoidance of eating raw meat, unpasteurized dairy products, and exposure to animals such as pet animal with diarrhea should be avoided. All people, especially those who handle pets or other animals, should wash their hands before eating [26, 27].

9. The Status of Campylobacters in Ethiopia

In Ethiopia, there are only few reports on the prevalence of *Campylobacters* isolated from humans and food animals [28, 29]. However, prevalence ranging from 8-13.7 in human and 9.4-72.7 in food animals have been reported (Table 1). The first study of human campylobacter prevalence in Ethiopia done in 1992 at diarrhoeic patients at Tikur Anbessa hospital reported that prevalence of 13.7 *Campylobacters* from total of 630 examined patients [30]. Similarly, study conducted at Jimma on 430 children who had diarrhoea reported prevalence of *Campylobacter* 11.6% from stool specimen [28].

A study conducted in urban and rural farm animal in Jimma in 2004 on 485 various food animals (cattle, poultry, pigs and sheep) to isolate *Campylobacter* species were isolated 192 (39.6%) from fecal specimens. The highest isolation rate was recorded among chickens (68.1%), followed by pigs (50.0%), sheep (38.0%) and cattle (12.7%). Among these 192 *Campylobacter* species isolated, 135 (70.3%) were identified to be *C. jejuni*, 51 (26.6%) were *C. coli* and 6 (3.1%) were *C. lari* [29]. Similarly, another survey done in Addis Ababa and in and around Bishoftu in 2007 on 540 raw meat samples from different food animals isolated *Campylobacter* species from 50 (9.35%) samples. The highest prevalence was reported in chicken (21.7%) followed by sheep meat (10.5%), pork meat (8.5) goat meat (7.6%) and beef (6.25). Among the 50 isolates of *Campylobacter* species 78% were *C. jejuni,* 18% and 4% *C. coli* [31] (Table 1).

A cross-sectional study conducted on apparently healthy sheep and goat slaughtered at a private export abattoir in Bishoftu in 2008 reported 40 (10.1%) prevalence of *Campylobacter* species out of 398 carcasses examined, of the 40 thermotolerant *Campylobacter* isolates, *C. jejuni* and *C. coli* accounted for 29 (72.5%) and 11 (27.5%), respectively [32]. On other hand, *Campylobacter* survey on 220 chickens and 210 humans in Bahir Dar in 2008 revealed prevalence of thermophilic *Campylobacters* of 8% and 72.7% in humans and chickens respectively. In humans, 94.1% of the isolates were *C. jejuni* and 5.9% were *C. coli*. *C. jejuni* was a predominant species of thermophilic *Campylobacters* [33]. Study undertaken at Debre Birhan in 2012 on 70 fecal and 310 carcass samples found that 33 (10.6%) with 87.9% *C. jejuni* and 12.1% *C. coli* from fecal samples whereas, 15 (21.4%) *Campylobacter* isolates were found from 70 carcass samples from which *C. jejuni* and *C. coli* accounted for 93.3 and 6.7% respectively [34]. A cross sectional study conducted on 384 raw bovine meat samples in Addis Ababa in 2013 isolated in 36 (9.4%) *Campylobacter* species that showed that 28 (78%) *C. jejuni* and *C. coli* 8 (22%) [7]. In, Gambella, Out of 368 fecal samples taken from farm animals, overall prevalence of 56.5% with 83.7% *C. jejuni*, 12.9% *C. coli* and 3.4% *C. lari* was reported [35].

Table 1. *Status of campylobacter in Ethiopia.*

Area	Origin of sample	Prevalence	*C.jejuni*	*C.coli*	*C.lari*	References
Tikur Ambesa H	Human	13.7	-	-	-	[30]
Jimma	Human	11.6	-	-	-	[28]
Jimma	Food animal	39.6	70.3%	26.6%	3.1%	[29]
Bishoftu	Food animal	9.35	78%	18%	4%	[31]
Bishoftu	Sheep and goat	10.1	72.5%	27.5%	-	[32]
Bahir-dar	Human	8	94.1%	5.9%	-	[33]
	Chicken	72.7	92.5%	7.5%		
Debre-birhan	Sheep	15.7	90.6%	9.4%	-	[34]
Addis Ababa	Cattle	9.4	78%	22%	-	[7]
Gambella	Food animal	56.5	83.7%	12.9%	3.4%	[35]

10. Conclusion and Recommendations

Attempts of studies on *Campylobacter* in Ethiopia are encouraging. High prevalence of *Campylobacter* infections have been reported from different parts of Ethiopia both in human and animals. High prevalence of zoonotic *Campylobacter* species (*C.jejuni* and *C.coli*) has been also isolated from animal products and animal feaces. However, more surveillance in covering wider areas in collaboration with international organizations and stake holders is highly recommended. Consumption of raw meat, unpasteurized milk and untreated water should be avoided, Public awareness creation to minimize risk of campylobacteriosis is also very important.

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