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Research Article

Parasite Contamination of Water Source at Pangkalan Masyhur Sub-district, Medan Johor District

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ABSTRACT

Background: Water utilization by humans and animals can generate biological pollutants which may contaminate the water. These contaminants come from waste products that may contain bacteria, protozoa, and other parasites. **Objective:** The aims of this study was to determine the contamination of water source by pathogens, particularly parasites at Medan, North Sumatera, Indonesia. **Methods:** This was a descriptive study with cross sectional design and simple random sampling. **Results:** We found Paramecium caudatum from nine samples (8,7%) collected from the open wells and the nearby river streams, followed by hookworm larva in one tap water sample (1%). **Conclusion:** No protozoa such as Entamoeba spp., Cryptosporidium spp., and Giardia spp. found in any of the samples. Based on this data, the abundant presence of caudatum represented the condition of high organic debris in the open wells and the nearby river streams. Additionally, the presence of hookworm larva in the tap water indicated the distribution system was contaminated with the surrounding soil.

Keywords: contamination, parasites, water, worm

1. Introduction

Clean water is a primary need of human. WHO estimated at least 1.8 billion people use water source contaminated with feces, either from human and/or animal excreta. Contaminated water is linked to transmission of diseases, including diarrhea and dysentery. Contaminated drinking-water is estimated to cause 502,000 diarrheal deaths each year [1]. Diarrhea is mostly linked to contaminated food and water, plus lack on sanitation and hygiene.

The contaminated water may contain biologic pollutants from feces, such as virus, bacteria, and other parasites. According to WHO, among the important parasites known to contaminate water source are Entamoeba histolytica, Cryptosporidium parvum, and Giardia duodenalis [2]. E. histolytica is a pathogenic amoeba commonly distributed worldwide, causing amebic colitis and dysentery [3]. This protozoa infects human through fecal-oral route, and commonly obtained from water contaminated with human feces [4]. Cryptosporidium spp. is a parasitic protozoa known to infect the intestines of humans and various animals, such as cattle, sheep, rodents, cats, dogs, birds, fish, and reptiles.

Transmission occurred by fecal-oral route through ingestion of infectious oocyst. In human, the species Cryptosporidium hominis and Cryptosporidium parvum are known to induce acute watery diarrhea, vomiting, nausea and fever in immunocompromised hosts, which can be life-threatening [5]. Outbreaks have

been reported in water playgrounds and childcare settings [6]. The flagellate Giardia spp.is associated with diarrhea and malabsorbtion in human. The manifested diarrhea usually involved the appearance of foul-smelling, greasy feces, with abdominal discomfort [7]. The main route for infection is through infective cyst in contaminated food and water [8]. Improper chlorination and poor maintenance of water treatment system will maintain the oocyst/cyst stage of these parasites in the water; hence transmission may occur [9]. Additionally, other pathogenic parasites including helminths' larvae can also pollute water through contact with contaminated soil, further suggesting the poor state of the water purity. This study aimed to determine the contamination of water source by pathogens, particularly parasites, at Region V Pangkalan Masyhur sub-district, Medan Johor district, Medan, North Sumatera in 2012. The region covered 5,5-hectare area, at the height of 2,5-37,5 meters above sea level, with the topography tends to crook to the north. This area has nearby river stream (Deli River), local small scales farming, and some of its residence still used open wells as water source. This situation creates the inclination for water source contamination by the parasites in the neighborhood.

2. Methods

This was a descriptive study with cross-sectional design and simple random sampling. Samples were collected and examined from March to August 2012. The daily main water source samples, either from tap water or open wells or the nearby river streams, were collected from each house. The collection acquired one sample per each house. Sample size calculation at 95% confidence level and precision level ± 5% at predicted population size of 140 houses was estimated as 103 samples. Water samples were collected from each of the house with a sterile plastic container, then examined immediately at Parasitology Laboratory, Faculty of Medicine, Universitas Sumatera Utara. Modified Caldwell's sedimentation technique was applied to examine the samples according to the protocol [10, 11]. In brief, 20 milliliter of each sample was centrifuged for 5 minutes at 2500 rpm. The supernatant was discarded. The remaining sediment was added with lugol, homogenized, then being directly examined under light microscope (Olympus® CX21, magnification 10x to 1000x).

3. Results

The main water sources for daily activities found in the region were as follows; 78 from tap/piped water from the local municipal waterworks, 19 from open wells, and six from the nearby river streams. From identification, we did not find any presence of *Entamoeba* spp., *Cryptosporidium* spp., or *Giardia* spp. as previously hypothesized (Table 1). We found ciliate *Paramecium caudatum* in nine samples (8.7%); six from the open wells' sources and three from the nearby river streams (Figure 1). Interestingly, we also found one sample from the tap water containing hookworm larva (1%), as shown in Figure 2.

Table 1. Direct microscopy examination result of the identified microorganisms found in the water samples

Water source	Total number	Parasite identified				
		Entamoeba spp.	*Cryptosporidium* spp.	*Giardia* spp.	*Paramecium caudatum*	*Hookworm larva*
Open wells	19	-	-	-	6	-
Tap water	78	-	-	-	-	1
Nearby river stream	6	-	-	-	3	-
Total	103	-	-	-	9	1

Figure 1. Ciliate Paramecium caudatum found in one of the samples.

Figure 2. Hookworm larva found in one sample.

4. Discussion

Entamoeba spp. infection in human is commonly transmitted in areas with poor sanitation which allows contamination of drinking water and food with feces, with estimated prevalence range from 1% to 40% of the population in Central and South America, Africa, and Asia. In this study, we did not find any *Entamoeba* spp. in the samples. This may be due to the method used, because microscopic examination sensitivity for *Entamoeba* spp. detection varied from 10 to 50%, depending on the examiner's experience [12, 13].

Cryptosporidium spp. is an enteric protozoa found in both humans and livestock. Waterborne transmission for *Cryptosporidium* spp. has been reported via both surface water and groundwater [9, 14]. In this study, we also did not find any presence of *Cryptosporidium* spp. oocyst, probably due to the same reason for the negative findings on *Entamoeba* spp. Additionally, we only performed simple direct examination, without further stainings such as Giemsa stain or acid-fast Ziehl-Neelsen to increase the sensitivity, due to budget limitation.

Giardia spp. is one of the most prevalent intestinal protozoan flagellate of the human. The transmission of *Giardia* spp. occurs either by direct contact with the feces of infected mammals or by contaminated food and water. Although there were local small farms in the area, we did not find any *Giardia* spp. in the collected samples nearby. This is probably due the similar reason mentioned for detection of *Entamoeba* spp. and *Cryptosporidium* spp. The collection of water sample was only done once for each, and probably the presence of those parasites was low below the detection sensitivity level of simple microscopic examination [15]. We did not employ any specific antigen detection methods such as direct fluorescent antibody tests,

ELISA, or other immunochromatographic assays to diagnose these parasites in this study.

In this study, the most common finding we obtained was the presence of *Paramecium caudatum.* This ciliated protist was found is water source samples from open wells and nearby river streams. *Paramecium caudatum* is ubiquitous in fresh and brackish water, usually in the sludge of organic matters or the sewage area. *Paramecia* feed on microorganisms like bacteria, algae, and yeasts, and they play an important role in wastewater biological purification processes [16, 17]. The presence of *Paramecium caudatum* indicated that the water source was full with sludge of organic matters and possible presence of abundant coliform bacteria, which may not be that clean or safe for daily use.

Interestingly, we also found one sample from tap/piped water contaminated with hookworm larva. Hookworm is nematode parasite commonly transmitted through infested soil. It may cause chronic gastrointestinal tract infection, sucking the host's blood which leads to iron deficiency anemia. Zoonotic hookworm larva can also produce cutaneous larva migrans. Hookworm larva usually contaminates soil [18]. This finding indicates that the piped water distribution system was likely leaked and under poor maintenance, exposing contact to the surrounding contaminated soil. The proper and regular maintenance of the water distribution, including the distributing pipe maintenance, is essential to ensure the quality of the delivered safe water.

Although the time of the study was considered dated, but the significance of the message derived from this is still quite relevant. Recent massive sewage drainage excavation, an on-going project in the whole Medan city, is a changing environment which may pose threat to the safe water distribution system by introduction of contaminants to pollute the water. The risk for broken pipes during excavation, and the exposure of the water to the excavation's dumps, may expose risks to safe water delivery system maintenance for the city's households.

5. Conclusion

From this study, we conclude that none of the water source samples collected from Region V Pangkalan Masyhur sub-district, Medan Johor district, Medan, North Sumatera contained any of the Entamoeba spp., Cryptosporidium spp., or Giardia spp. protozoa. The dominating finding was the presence of Paramecium caudatum. We also found one tap water sample contaminated with hookworm larva.

In this study, each sample was only obtained once from one random site of the main water source from each home. Additionally, we only employed direct method of microscopic observation with lugol, without further stainings. The method is simple, affordable, can easily be done in the field, and producing quick result. However, further studies with multiple sample collection and employment of more advanced methods are suggested to increase sensitivity and to obtain more representable results.

6. Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical considerations but are available from the corresponding author upon reasonable request.

7. Ethical Statement

This study was approved by the Research Ethics Committee of Universitas Sumatera Utara. The conduction of the study was approved for ethical clearance from the Health Research Ethical Committee of Faculty of Medicine, Universitas Sumatera, by No. 196/KOMET/FKUSU/2012.

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8. Author Contributions

All authors contributed to the design and implementation of the research, data analysis, and finalizing the manuscript.

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11. Conflict of Interest
Authors declares no conflict of interest.

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