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Review

Nosocomial Parasitic Infections

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ABSTRACT

Nosocomial infections develop a minimum of 48 h after hospital admission in patients who are free from infections at the time of admission. In addition to other agents that cause infection, the etiology of nosocomial infections involves various parasites. In light of literature data, the aim of this review was to address the agents that cause nosocomial parasitic infection.

Keywords: Hospital-acquired infections, nosocomial infection, parasites

INTRODUCTION

Nosocomial infections develop a minimum of 48 h after hospital admission in patients who are free from infections at the time of admission. Nosocomial infections extend the hospitalization period and increase patient costs (1). The agents that cause nosocomial infection are reported to be bacterial, viral, and fungal agents in many studies, whereas parasitic agents are generally ignored.

Waterborne Nosocomial Parasitic Agents

There can be many sources of nosocomial infections in a hospital. The most prominent among the important and controllable causes of nosocomial pathogens is the water supply of the hospital. Waterborne contagion can occur in hospitals due to showering, drinking the water, and using contaminated medical equipment washed with tap water. Hospital water sources include water tanks, showers, and tap water. There are some protozoans that run the risk of causing waterborne transmission or that have actually caused outbreaks in hospitals. Major outbreaks of waterborne *Toxoplasma gondii* have already been reported. Therefore, *T. gondii* can be an agent that potentially causes waterborne nosocomial parasitic infection (2). Diarrhea cases were seen, due to *Encephalitozoon intestinalis*, in the ward of immunosuppressed children in Spain between 2012 and 2013, and protozoans were subsequently isolated from the hospital's water tank (3). In another study conducted in South Africa, free-living amoebae, at a rate of 79.4%, were isolated from water and biofilm samples collected from various departments and units of a hospital. Therefore, free-living amoebae could be a potential nosocomial agent for both immunosuppressed patients and hospital employees (4). Another protozoan that can be transmitted by water is *Cryptosporidium*. Just how severe an infection can be is shown by an outbreak caused by chlorine-resistant *Cryptosporidium* oocysts in the public water supply in Milwaukee in 1993. The outbreak affected 403,000 individuals and caused 69 deaths (5). Immunosuppressed patients in hospitals are easy targets for *Cryptosporidium* infection. *Cryptosporidium* infections can become chronic in immunosuppressed patients. This can lead to severe extraintestinal complications (6). Nosocomial *Cryptosporidium* infections can cause outbreaks as *Cryptosporidium* can be transmitted by food, direct contact, and, occasionally, hospital equipment. They generally affect patients with human immunodeficiency virus (HIV), transplant patients, patients with malignancies, and children (7). In an outbreak in China that involved 6284 pediatric patients who were admitted to three different hospitals with non-gastrointestinal complaints between 2007 and 2009, *Cryptosporidium* species were detected in 102 cases. However, the source could not be identified (8). To prevent the risk of *Cryptosporidium* oocyst, drinking water can be kept at a temperature of ≥72.4°C, or water treatment systems with a 1 µm filter can be used (9).

Transfusion-Transmitted Nosocomial Parasitic Agents

Another possible cause of nosocomial contagion is transmission by transfusion. The most well-known blood parasite that can be transmitted via transfusion is the *Plasmodium* species. Increasing the number of journeys to endemic areas results in an increased risk of transfusion-transmitted malaria (10). In Turkey, donors are tested for certain viral diseases and syphilis, and, as per law no. 2857, it has become obligatory to test for agents that cause malaria in blood donors. However, some limitations were implemented in the circular of the General Directorate of Treatment Services (dated October 8, 1997), and it was deemed appropriate to continue testing for malaria parasites only in donors who have a risk of contracting malaria (11). There are no recent reports of transfusion-transmitted malaria in Turkey. In a study conducted

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in 2012, only 2.97% of the 202 donors who were rejected due to the risk of malaria were found to be malaria positive (12). *Plasmodium vivax*, *Plasmodium malariae*, *Plasmodium falciparum*, and *Plasmodium ovale* in investigating the agents that cause transfusion-transmitted malaria globally were, until recently, reported as the agents, whereas the presence of transfusion-transmitted *Plasmodium knowlesi* was reported in recent years in endemic areas (13). In some regions in America, *Babesia microti*, which is a blood parasite transmitted by ticks, is the most frequently seen microbial agent that is transmitted by transfusion. A total of 160 transmission cases due to transfusion were reported in the USA between 1979 and 2009 (14). *T. gondii* is another protozoan that can be transmitted by transfusion. In a meta-analysis conducted in Iran, the seroprevalence of *T. gondii* was reported to be 34.4% in a blood donor group of 4538 individuals (15). *Leishmania* spp. and *Trypanosoma* spp. are protozoans that are rarely transmitted by transfusion. There are reports of transfusion-transmitted *Trypanosoma* infections in endemic areas within Central and South America, as well as Mexico (16). In addition, there are a few reported cases of kala-azar that are thought to be have been transmitted by transfusion. The majority of the kala-azar cases are pediatric patients (17). One case in the advanced age group, which comprises a few patients, was reported in Greece in 2012. A 77-year-old patient with chronic renal failure who was treated in an intensive care unit died, and the postmortem biopsy showed amastigotes in the bone marrow. Upon investigation of the etiology, it was found that the patient had undergone cholecystectomy 3 months previously and received two units of blood transfusion. One of the donors was *Leishmania* positive according to the serological test result conducted; therefore, it was concluded that the infection was transmitted by transfusion (18). The use of leukocyte reduction filters to prevent the transmission of *Toxoplasm*a, *Trypanosoma*, and *Leishmania* by transfusion in hospitalized patients is recommended (16, 19, 20).

Transplantation-Transmitted Nosocomial Parasitic Agents

Transmission by transplantation is another cause of the nosocomial transmission of parasites. Cases of malaria have been reported after kidney, liver, heart, and bone marrow transplants. The malaria agents were reported to be *P. vivax*, *P. falciparum*, *P. ovale*, and *P. malariae* (21). *T. gondii* infections are parasitic infections that can also be seen in the recipient after solid organ transplantation. The highest rate of transmission from a toxoplasma seropositive donor to the recipient is seen after heart transplants (50%), followed by liver (20%) and kidney transplants (<1%) (22). The mortality of *T. gondii* infections seen in the recipient in the post-transplantation period is high. This is because the recipient usually develops a disseminated infection. The rate was reported to be 64.5% in the follow-up of patients after kidney transplantation and 50% after heart transplantation (23, 24). There are some reports of leishmaniasis cases after transplantation. Leishmaniasis cases are usually associated with kidney transplantation (77%). However, there are also several reports of cases occurring after liver, heart, lung, pancreas, and bone marrow transplantation (25). *Strongyloides stercoralis* is a rare parasitic agent that is transmitted after transplantation. There are a few reports involving donor-derived *S. stercoralis* infection in the recipient. These infections, which result in a high mortality rate, are mostly transmitted from donors that come from areas where *S. stercoralis* is endemic (26). One of the known transmission routes of *Trypanosoma cruzi* is by transplantation (27). However, successful transplantations with the administration of prophylactic treatment from a *T. cruzi* seropositive donor to a seronegative recipient have been reported in recent years. Salvador et al. (28) reported that *T. cruzi* DNA is negative 6 months after the completion of prophylaxis in a seronegative patient who received benznidazole prophylaxis following lung transplantation from a seropositive donor.

Hospital Equipment-Acquired Parasitic Agents

Nosocomial parasitic infections can sometimes be acquired from contaminated hospital equipment. There are reports of *Plasmodium*, a genus of protozoans, being transmitted by injectors, contaminated gloves, and contacting bedside glucometers (29-31). *S. stercoralis* has also been reported to be transmitted from contaminated endoscopes (32). Therefore, hospital staff should rigorously check to prevent transmission from hospital equipment.

Parasitic Agents in the Etiology of Nosocomial Diarrhea

In the etiology of nosocomial diarrhea, in addition to bacterial and viral agents, intestinal parasites have also been reported at various concentrations. In a study conducted in Saudi Arabia, protozoans have been reported at a rate of 19.8% in the etiology of nosocomial diarrhea in patients admitted in surgery wards. *Cryptosporidium parvum*, *Blastocystis hominis*, *Giardia lamblia*, and *Entamoeba histolytica* were found at the rates of 6.6%, 6.6%, 3.5%, and 3.1%, respectively (33). In another study, *C. parvum* and *E. histolytica* were isolated at the rates of 2.5% and 6.2%, respectively, from the stool samples of children aged <5 years admitted to the pediatric ward of a hospital in Iraq with nosocomial diarrhea (34). There are other studies that investigate intestinal parasites in hospitalized patients. Intestinal parasites were detected in 18.8% and 4.8%, respectively, of asymptomatic male and female patients who were admitted to a psychiatric hospital in Ghana. These parasites were reported to be *E. histolytica*/*dispar* cysts, *G. lamblia* trophozoites, *C. parvum* oocysts, *Hymenolepis nana* eggs, *Trichuris trichiura* eggs, *Ascaris lumbricoides* eggs, and *S. stercoralis* larvae (35). In a study conducted in Turkey by Östan et al. (36) in 2004, nosocomial parasitic agents, including *Enterobius vermicularis*, *Giardia intestinalis*, *B. hominis*, *E. histolytica*, and *Dientamoeba fragilis*, were detected in 33.3% of the patients who were admitted to some wards and the intensive care unit in Manisa Public Hospital.

Nosocomial Transmission of Ectoparasitic Infection Agents

There are several infestations that occur due to ectoparasites in hospitals. Scabies, which is an ectoparasitic infection caused by *Sarcoptes scabiei*, is among these infestations. Infestation occurs by close contact, sexual intercourse, and, more rarely, due to sleeping in the same bed. Scabies typically clinically manifests with skin lesions and pruritus that aggravates at night. The form of scabies seen in patients receiving immunosuppressive treatment, patients with HIV infection, and patients with mental retardation is usually Norwegian scabies or crusted scabies (37). The host has 5–15 microorganisms in typical cases of scabies, whereas the host may have millions of microorganisms

in Norwegian scabies (38). There are many studies that report outbreaks of nosocomial scabies. One of these outbreaks is the scabies outbreak that affected 460 patients and 185 hospital employees in a university hospital in the Netherlands in 2015 (39). Another outbreak was reported in the dementia ward of a geriatric hospital in Japan. A patient with senile dementia staying in the dementia ward was diagnosed with scabies, and during the following 288 days, scabies was seen in 20 patients among 65 individuals in the same ward (40). In Switzerland, a skin rash in a patient with acquired immunodeficiency syndrome who was admitted to the intensive care unit with pneumonia and sepsis diagnosis was thought to be a delayed hypersensitivity reaction due to antibiotic treatment. The patient was then diagnosed with crusted scabies in the rehabilitation center to which he was transferred 7 weeks later. The 1640 individuals who were possibly exposed to the agent during the 7-month period after this patient was diagnosed with crusted scabies were administered prophylactic scabies treatment. The scabies agent was detected in 19 individuals that consisted of hospital employees, patients, and their relatives (41). Healthcare workers play a significant role in the prevention of nosocomial scabies. These workers should not ignore unexplained skin rash and pruritus in both themselves and their patients, but consult the relevant persons upon its detection. Patients diagnosed with scabies should be isolated and treated. Healthcare workers and other patients who have come into contact with these patients should also be administered prophylactic treatment (42). If Norwegian scabies is seen in a hospital, the necessary precautions should be taken in laundry rooms in which the patient's clothes are washed. Patient's rooms should also be cleaned (37).

Myiasis is a clinical occurrence that develops as a result of the infestation of the body of an animal or human by dipterous fly larvae. Nosocomial myiasis is rare. The predisposing factors for this infestation include paralysis, debilitation, diabetes, and vascular diseases, as well as the presence of blood and mucus. Most of the cases are reported in the summer when the fly population increases. Agents that cause nosocomial myiasis were reported to be flies from the Calliphoridae, Sarcophagidae, Muscidae, Cuterebridae, and Phoridae families. Myiasis cases are generally reported during adulthood, whereas infantile nosocomial myiasis cases are rarely reported (43, 44). Flies that cause myiasis can be present due to other infestations in the hospital. In the USA, nasal myiasis caused by *Lucilia sericata* in two comatose patients in the intensive care unit was associated with a mouse infestation in the food storage areas of the hospital (45). The clinical course of myiasis cases is generally good. Removing larvae mechanically and washing the affected tissues are generally sufficient for treatment (46). However, there is a risk of penetration into the intracranial cavity in cases of risky anatomical localizations, such as nasal and auricular myiasis (47, 48). Myiasis was suspected as being the cause of death of a patient in Iran who was diagnosed with nosocomial nasal myiasis caused by *L. sericata* in the postoperative period (49). Precautions, such as placing mechanical barriers that prevent flies from entering through windows and vent holes, as well as inspecting food storage areas for other infestations that attract flies, can be taken to prevent nosocomial myiasis (50).

CONCLUSION

Although parasitic infections are commonly seen worldwide, they are usually ignored in the etiology of nosocomial infection. However, various agents that cause nosocomial parasitic infections were reported in some studies. Therefore, clinicians should definitely consider parasitic infections in the etiology of nosocomial infection, and hospital infection control committees should take measures against parasitic infections. Finally, in-hospital training sessions on this issue should be planned by the training units.

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