INTERNATIONAL SOCIETY FOR INFECTIOUS DISEASES

GUIDE TO INFECTION CONTROL IN THE HEALTHCARE SETTING

Parasites

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Topic Outline

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INTRODUCTION

- There are three categories of nosocomial parasitic infections: ectoparasites, enteric parasites, tissue and blood parasites. Children, post-transplant patients, and patients infected with HIV are especially at risk for severe infection.
- Nosocomial parasitic infections are infrequently reported in developed countries which can result in underdiagnosis and unwanted delay of installment of proper preventive measures. A study in 2009 including 1,265 intensive care units in 75 countries showed that the overall incidence of parasitic nosocomial infections was 0.48%. Ectoparasitic infections such as scabies and pediculosis can cause large hospital outbreaks.
- Enteric parasites are usually endemic in an important part of the population living in under-resourced countries. In this group, parasitic nosocomial outbreaks probably are more common, but detection is hampered due to the high prevalence of parasitic infections and the limited financial resources.

Ectoparasites

- Potential nosocomial infections caused by ectoparasites include the pediculoses, scabies, mites, and myiasis.
- Infestation with the itch mite *Sarcoptes scabei* is an important cause of nosocomial infections. Scabies is transmitted directly from person-to-person via skin-to-skin or sexual contact. Infected fomites may contribute to transmission within households and institutions. About half percent of cases occur in individuals with poor hygiene. However, about 30% of scabies cases affect people who are very concerned with their hygiene. In the latter group, diagnosis can be missed or delayed. There were 23 nosocomial outbreaks reported between 1985 and 2012. Clinical manifestations are intense pruritus and burrows over the distal extremities, waist and axilla. Particularly important, Norwegian or

crusted scabies is associated with cell-mediated immunodeficiencies such as HIV/AIDS.

- The incubation period may be up to four or six weeks before itching and scratching begins. This long period often delays outbreaks recognition with further transmitting of mites by asymptomatic contacts. Larger outbreaks correlate with diagnostic delay and high mite density, such as the case of Norwegian scabies. Patients with crusted scabies can have thousands of mites on their skin as opposed to the average five to 15 harbored by the usual symptomatic person with common scabies. The presence of animals inside hospitals can be source of mites which are unusual for humans.
- Head lice infestation by *Pediculus humanus capitis* is transmitted person-to-person by direct, even if only brief, head-to-head contact. Nosocomial transmission is low apart from close patient-to-patient contact in i.e. pediatric ward playrooms or institutions. *P. humanus corporis*, agent of body lice, is transmitted via direct contact or with exchange of infested clothing or bedding. It is of negligible risk in hospital settings in developed countries. This risk is also true for transmission of the pubic louse, *Phthirus pubis*, which are transmitted via direct venereal skin-to-skin transfer.
- The pigeon mite, *Dermanyssus gallinae,* has been involved in nosocomial outbreaks. Infection with this mite causes pruritic papular rash which can be misdiagnosed as scabies. Usual source of the mite are pigeon roosts found on or near ventilatory ducts or outside air-conditioners.
- Nosocomial infestation of body tissues by larvae of various fly species, myiasis, is not uncommon. Myiasis results from deposition of eggs of gravid flies in open wounds, which can develop towards motile larvae within a few days. Treatment involves mechanical removal of larvae and wound debridement if needed. Myiasis most commonly occurs in hospitals in the tropics and subtropics with open air access to the patient, but is also reported in temperate areas during warmer months.

Enteric Parasites

- Intestinal parasites can cause diarrhea in 12-17% of nosocomial epidemics and 1% of endemic outbreaks, especially on surgical wards. Immunosuppressed patients and those with prolonged antibiotic courses are at higher risk.
- Enteric protozoans are the most common agents involved in nosocomial outbreaks. These include: *Cryptosporidium parvum*, *Giardia lamblia, Entamoeba histolytica/dispar, Blastocystis* sp., *Balantidium coli, Cyclospora cayetanensi*s, and *Isospora belli*.
- Fecal material of infected patients may contain helminthic eggs or larvae, or protozoan cysts, oocysts, or trophozoites. All protozoan cysts or oocysts are immediately infective when passed in stool. Trophozoites may only survive briefly in the environment and are killed by gastric acid; therefore, contributing less to transmission.
- *Giardia* is the most common enteric protozoan infection in the United States. Contaminated water is the most common way of transmission. Person-to-person transmission occurs occasionally and foodborne transmission is seldom.
- *Cryptosporidium* can cause diarrhea in both immunocompromised and immunocompetent hosts. In the latter, diarrhea is usually self-limited. This is an important agent causing diarrhea in the HIV population.
- Suboptimal handwashing or fomite contamination of environmental surfaces can be involved in transmission. Furthermore, the cysts are very resistant to environmental conditions and most of the disinfectants commonly used have low or none antiparasitic activity. Perinatal nosocomial transmission from mother to newborn is possible. Suspected airborne transmission from animal to human has been reported.
- Helminths can cause isolated outbreaks in solid organ transplant recipients. Infections are usually associated with water or food contamination. Enteric helminth parasites transmitted from person-to-person are *Enterobius vermicularis, Strongyloides stercoralis,* and

Hymenolepis nana. This is possible because an intermediate host is not required and eggs *(E. vermicularis, H. nana)* or larvae (S. *stercoralis)* are directly mature (infective) in stool. These features are also responsible for autoinfection. When conditions allow fecal contamination of the healthcare environment (i.e. in recreational areas) and helminth eggs are enabled to mature, other roundworms, such as hookworm, trichuris, and toxocara species, can also be the source of outbreaks. Patients shedding proglottides of *Taenia solium* in the hospital environment are a potential important source of infection. Eggs liberated from the proglottides are immediately infectious and can, when swallowed by humans, cause severe pathology of, for example, the central nervous system (cysticercosis). *S. stercoralis* can cause hyperinfection in patients on chronic immunosuppression with steroids and in those infected with HIV and HTLV-1.

- Other less frequent water-associated outbreaks include *E. histolytica/dispar, B. coli, C. cayetanensis, Microsporidium* species, the tissue parasite *Toxoplasma gondii*, and the free living *Acanthamoeba* species. Due to the small size and robust nature of the transmission stages of parasites, that is, cyst, oocyst, and spores, removal by water treatment is difficult.
- Free-living amoebae in water networks and oxygen humidifier reservoirs of hospitals have been shown to be an important reservoir of pathogens as *Legionella pneumophila.* In addition, these amoebas serve as reservoir for different mycobacterial species and Alphaproteobacteria, such as *Rhodoplanes* and *Methylobacterium.* The ability to multiply in free-living amoeba offers these bacteria protection from biocides and enhances their virulence in humans. Human infection occurs via inhalation of aerosols containing free bacteria or, alternatively, infected amoebae itself could be the infectious particles that bring the pathogens to the longs.

Tissue and Blood Parasites

- Organ transplant and blood transfusion recipients are at higher risk.
- The most common protozoan infection related to blood and blood products transfusion is *Plasmodium falciparum* followed by *P. vivax*. This is an important problem in endemic areas. Furthermore, all species of *Plasmodium* can remain potentially invasive for 7 days in preserved blood and up to 2 years in frozen blood. In most cases, post-transfusion malaria results in death.
- *Plasmodium* species can also be transmitted between hospitalized patients when physical barriers such as windscreens and bed nets are not in use. In non-endemic countries nosocomial malaria is infrequently observed. However, especially in patients hospitalized with high parasitaemia of P. *falciparum,* small amounts of blood can result easily in nosocomial transmission to other patients and/or staff. Other means of transmission are through organ transplant, needle stick injuries, improper catheter use and administration of intravenous drugs – especially in developing countries, and contact with a rogue mosquito that escaped from a mosquito colony in the laboratory setting.
- *Babesia microti,* cause of babesiosis and normally transmitted to humans via the tick *Ixodes scapularis,* can cause nosocomial infections via blood transfusions. This problem is especially recognized in North America. Advanced age, immunosuppression and asplenia are risk factors for severe disease.
- African trypanosomiasis, normally transmitted by tsetse flies, can also be transmitted by blood transfusion. Donors can remain asymptomatic for up to 6 months.
- American trypanosomiasis, caused by *T. cruzi* is predominantly transmitted via the bite of an infected triatomid bug in endemic areas and can be transmitted by blood transfusion. It is the second most common means of acquiring this infection. Transmission by needle stick injury and kidney transplantation has also been reported. For persons who have had accidental exposures, administration of a two-week

course of presumptive therapy should be considered while awaiting results.

- *Leishmania* spp. causing visceral leishmaniasis can be transmitted by blood transfusion. In blood the parasites are observed in leukocytes. In endemic areas differentiation between visceral leishmaniasis due to arthropod vector and blood transfusion infection is difficult.
- Nosocomial transmission of toxoplasmosis is most often after heart or kidney transplantation and infrequently due to white blood cell transfusions. Laboratory-acquired toxoplasmosis in research personal is not uncommon due to contact with infectious (often cultured) material by skin punctures, eye splashes or open wounds.
- Microfilariae of the blood helminths *Mansonella ozzardi, Loa loa, Diptetolonema perstans,* and *Wuchereria bancrofti* have been observed in blood of asymptomatic donors. No illness or mild disease was recorded in recipients of such blood.

Controversial Issues

- For different reasons, reports of parasitic nosocomial infections are suboptimal in both resource-rich and under-resourced countries which presents a challenge to Infection Control since this underestimation can result in delay of diagnoses and installment of proper preventive measures.
- Expertise in laboratory diagnoses of specific parasitic infections is often limited.
- Even with high standards of treatment, including physical and chemical disinfection methods, contamination with enteric parasites occurs.
- Screening for parasitic infections which potentially can be transmitted by blood transfusion (e.g., malaria and Chagas disease) requires locally adapted strategies to take into account both care for the recipient as well as unnecessary waste of blood donations.

SUGGESTED PRACTICE

- Effective hand washing and routine glove use are the most important preventive measures since many immunocompetent patients may be asymptomatic carriers. Sanitary control is also important in preventing the presence of insects such as mosquitos and flies that propagate parasitic infections.
- Time of shedding of *Cyclospora* and *Isospora* oocysts in stools can be shortened by treatment with cotrimoxazole and *Giardia* by metronidazole or tinidazol.
- There is no established therapy for *Cryptosporidium*. HAART (highly active antiretroviral therapy) is the only proven treatment in patients with advanced HIV and *C. parvum*. Oocysts can be removed from drinking water by either boiling for one minute or by filtering water. Full details are provided by the CDC Preventions Website. *Cryptosporidium* can be inactivated on surfaces or instruments by i.e. 10% formal saline, 5% ammonia for 18 hours or full-strength (12%) commercial bleach for 10–15 min.
- The corner stone to prevent blood-transfusion-associated protozoal infections, i.e. malaria, trypanosomiasis (African and South American), babesiosis and leishmaniasis, is donor selection using questionnaires and use of screening tests. After a visit to a malaria endemic area blood donors are deferred from blood donation for periods varying from 4–6 months, 3 years or even permanently, depending on the origin of the donor (born and lived in endemic area, European visitor), having experienced febrile episodes in the period after the visit and country of blood donation. In the USA and Canada a deferral time of 12 months after return from an endemic area is applied for blood donors. Use of serological tests for malaria in the tropics is, given the high prevalence of malaria in most countries, of little use and deferral on basis of positive antibody tests too drastically can reduce the donor pool. Antigen tests and microscopy can be used instead, but sensitivity is suboptimal. Routine screening for babesiosis in not in common practice.

- To prevent American trypanosomiasis (Chagas disease) in endemic areas, questionnaires, serological tests for *Trypanosoma cruzi* and treatment of blood with gentian violet are used; the latter being an effective strategy to prevent nosocomial blood transfusion. In non-endemic countries use of questionnaires for Chagas disease are often targeted to special donor groups, i.e. visitors or immigrants of South America. Performing serological screening is not done routinely in non-endemic countries but is considered in the USA when a FDA licensed test should be available.
- To prevent transfusion-acquired leishmaniasis in some countries (USA, Ireland) donors are deferred for 12 months when they visited endemic countries, especially Iraq. Also donors with multiple scars and fresh cutaneous leishmaniasis are deferred. In other countries use of specific questionnaires or antibody testing is not routinely performed.
- Serological testing for *T. gondii* of both donor and recipient in advance should, in case of mismatch, alert the clinician of potentially life threatening complications. Prophylaxis with pyrimethamine can be provided to the recipient. Alternatively anti toxoplasmosis treatment can be started when seroconversion and clinical manifestations occur, although clinical symptoms often are non-specific.
- To prevent myiasis patients should be advised to keep wounds and draining orifices clean and covered. Efforts should be made to reduce flies in the health-care environment.
- Prompt recognition of scabies followed by immediate implementation of preventive measures is the mainstay for the containment of nosocomial outbreaks. Simultaneous mass prophylaxis is the most efficient strategy for terminating ward outbreaks and may prevent ward closure. In case of crusted scabies, contact precautions should be strictly implemented including use of disposable gloves, gowns and shoe covers. Local treatment with 5% permethrin cream, applied overnight on two occasions one week apart, is highly effective. Lindane lotion 1% is an effective, cheap alternative but is potentially more toxic. In addition to

local treatment in crusted scabies oral treatment with ivermectin at a dose of 200 µg/kg, at one to three doses, is beneficial.

SUGGESTED PRACTICE IN UNDER-RESOURCED SETTINGS

Recommendations listed above are also feasible for application in resource-poor settings.

SUMMARY

Nosocomial parasitic infections can be caused by enteric, blood, tissue and ectoparasites. Frequency of infection is low in developed countries where infections are mostly driven by ectoparasites. From developing countries only few data are available. Proper detection of outbreaks requires adequate diagnosis which, in both settings, often has restrictions. In developing counties outbreaks are difficult to detect due to high background prevalence. Enteric protozoan parasites, malaria, American trypanosomiasis, toxoplasmosis, scabies (classic or crusted) and myasis are among the most frequent reported nosocomial infections. Patients with AIDS, children and transplant recipients are particularly at risk.

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